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Pepperdine University  
Graduate School of Education and Psychology

LATINE FAMILY MATH ENGAGEMENT:  
A PHENOMENOLOGICAL STUDY OF CO-DESIGN APPROACHES

A dissertation submitted in partial satisfaction  
of the requirements for the degree of  
Doctor of Education in Learning Technologies

by

Susana Beltran-Grimm

January, 2022

Dr. Reyna García Ramos, Ph.D. – Dissertation Chairperson

This dissertation, written by

Susana Beltran-Grimm

under the guidance of a Faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

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## ABSTRACT

Mathematics achievement at school entry is the strongest predictor for eighth-grade performance, regardless of race, gender, or family socioeconomic status. Yet, California Latine children continue to lack in math proficiency, struggling with concepts such as knowledge of numbers, counting, and spatial and pattern skills development. Existing literature has demonstrated that Family Engagement support children's development. However, Latine parents often feel less comfortable doing math themselves and in participating in their children's math learning. This interpretive phenomenology research study was designed to uncover participants' cultural repertoires and learning experiences to explore how Latine families perceived and engaged in co-design workshops to develop a mathematics activity for their 3-5 years old children. This study collected data from (a) semi-structured interviews and (b) co-design workshops (including co-design workshop recordings, transcriptions, photos and screenshots). Thematic analysis identified the key findings that emerged from the semi-structured interviews are (a) traditional education virtues, (b) familismo, (c) role of language, (d) ecological environment, (e) views on knowledge, (f) interest-driven learning, (g) identity formation related to (math) learning. Further, building upon existing frameworks, this study's results and analysis suggest that through co-design approaches, Latina mothers engaged in (h) teamwork and collaboration, (i) sense-making, (j) intrapersonal openness, and (k) conscientiousness in the co-design and co-construction of a mathematics activity for their children. In centering Latina mothers as designers and users of their own mathematics learning experience, it positioned them as experts in their own and their children's learning and allowed for the co-design and co-creation of a meaningful learning math experience. Co-design approaches may be helpful to engage marginalized groups, such as the Latina mothers in this study, to achieve successful family engagement outcomes. Co-design approaches herald a different way of engaging Latine families as an alternative to standard family engagement interventions.

## **Chapter 1: Introduction**

Chapter 1 introduces and describes the goals of this research study. This section includes an introduction to the research focus and problem statement. It provides background on the research and explains the purpose of this study, along with a description of the theoretical framework for this study. Additionally, this chapter provides a brief description of the methodology, outline of the guiding research questions, study design, and key definitions used in the study.

### **Overview and Context**

The Latine population account for a large and growing share of the population in the United States. According to the Pew Research Center (2020), the Latine population grew to 60 million in 2019, making up nearly one in five members of the U.S. population. By 2060, the Latine population are projected to account for 111 million people, constituting 28.6% of the nation's total population (United States Census Bureau, 2020). In California, Latine children are already the majority, with 53% of the 0-17 age population, comprising the largest single share of California's ethnic groups (California Department of Finance, 2018). This data suggests that the academic achievement of the state of California will continue to be directly related to Latine students' academic success.

Latine children are an asset to California. Yet, the state of California is not providing sufficient resources to support their health and education (Children Now, 2020). And although California has shown commitment to supporting early childhood, quality early learning programs remain unavailable to approximately 72.2% of Southern Californian children ages 0-5 who are not enrolled in a state program (California Assembly Blue Ribbon Commission on Early Childhood Education, 2019)—leaving them at a definitive disadvantage in their educational experience (Kern & Friedman, 2009). California children continue to lack in academic skills, especially in math proficiency. Lack of necessary math skills hold children back, struggling with

concepts such as knowledge of numbers, counting, and spatial and pattern skills development (Children Now, 2018).

The Current State of Scientific Knowledge on Pre-Kindergarten Effects report by Phillips et al. (2017), stated that almost all studies found prekindergarten education had a positive effect on children's academic success. Still, according to Kidsdata (2018a), 34.5% of Los Angeles County and 36% of Orange County children were not enrolled in preschool between 2014 to 2018. According to Children Now (2018), California students—particularly Black and Latine—are also not meeting grade-level expectations in math and science. Moreover, lack of preschool participation as well as limited exposure to preliteracy and early math activities at home have resulted in low school readiness for Latine children (Ramirez et al., 2017).

As a result, it is critical to put heavy emphasis on Latine family engagement strategies, especially when Latine families face systemic barriers, such as the lack of access to resources, and less formal educational attainment, that obstruct these same families from building social capital (Conger, 2015; Suarez-Orozco et al., 2015). Latine children will have a profound and increasing impact on the social and economic well-being of the United States, and it is imperative to empower and equip families to encourage their children's learning proficiency, confidence, and excitement around learning at a young age, preparing them for success in kindergarten and beyond regardless of their race, national origin, or socioeconomic status.

### **Problem Statement and Significance of the Study**

The growing evidence on the impact of family engagement research continues to emphasize the essential need for schools and the community to support early childhood learning through family engagement approaches (Cartmill et al., 2013; Crosnoe, 2012; Halgunseth et al., 2009). Across studies, mathematics achievement has been found to be the strongest predictor of later success in mathematics—demonstrating that entering kindergarten with early math skills is the best predictor of eighth-grade performance, regardless of race, gender, or family socioeconomic status (Claessens & Engel, 2013; Duncan et al., 2007; Watts



et al., 2014). Researchers have also found that children who consistently struggle with math are less likely to receive a high school diploma or attend college (Kern & Friedman, 2009).

Interest in early childhood mathematics has increased in the past few decades as a result of lack of math proficiency across grades in the United States (National Center for Education Statistics, 2015a, 2015b). Students in the US have consistently ranked below the basic level of mathematics achievement and proficiency (National Center for Education Statistics, 2015b). According to Miller and Parades (1996) and most recently with Garcia's (2015) report, this gap starts as young as preschool. The early math knowledge gap is most pronounced in young children living in low-income neighborhoods that are faced with low-quality formal school instruction, lack of parents' formal schooling, and minimal community access to resources (Murphey et al., 2014). Similarly, there are limited family-based intervention programs addressing the math achievement gap, despite a vast body of research proving that family engagement approaches are essential for children's learning and development.

Indeed, a number of research studies have shown a connection between parent-child interactions and children's understanding of math concepts (Anders et al., 2012; Claessens et al., 2009; Claessens & Engel, 2013; Sparks, 2017). This research points toward the importance of family engagement in mathematics learning for young children. Although there are significant studies highlighting the importance of acquiring mathematical knowledge and skills in early childhood, most of these studies have focused on understanding how children develop mathematical reasoning (Claessens & Engel, 2013; Manolitsis et al., 2013; Niklas & Schneider, 2014). In fact, a group of scholars and researchers have started to address early math achievement gaps by promoting the field of "family math":

'Family math' [is defined] as culturally relevant math activities and interactions occurring in the informal contexts in which families engage with young children.

These activities and interactions provide opportunities to introduce and enhance

children's math skills and knowledge, as well as to support positive attitudes towards math and learning. (Eason et al., 2020, p. 5)

Eason et al. (2020) argued to consider families in creating high quality math learning experiences for children. Although, family math is an emergent field, there needs to be greater unity and coherence to help integrate families in mathematical learning spaces. Family math must address the cultural and structural barriers that prevent families from intentionally engaging in math learning with their children. This is especially true for Latine children, as they tend to have lower rates of math learning compared to their White peers, which can turn into long-term risk[s] of learning and achievement in schools (Gándara & Contreras, 2009). Thus, there is a need for authentic, well-designed, and culturally relevant family engagement approaches to center Latine family voices to challenge the imbalance of power and to provide families a space to share and construct mathematical knowledge.

Further, Latine families possess funds of knowledge—culturally relevant bodies of experience like professions, hobbies, or household responsibilities (Moll & González, 1996; Moll et al., 1992)—that are often suppressed or denied in favor of traditional and mainstream normative practices (Hanley & Noblit, 2009). However, limited research has been done in exploring Latine families' construction of mathematical knowledge as embedded in cultural knowledge. That is to say that it is not enough for Latine families to possess funds of knowledge in mathematical domains; families should also construct and turn that knowledge into practice in the form of artifacts, activities, and resources (Bang et al., 2016; González et al., 2001).

This construction of knowledge can be mediated through approaches like co-design methodologies. Co-design has often been used to represent human-centered design approaches (Costanza-Chock, 2020). Human-centered design is a method that focuses on understanding the perspective and needs of a person who experiences a problem, determining whether the proposed solution will effectively meet their needs (Hanington, 2010). Co-design then means engaging the community as co-researchers and co-designers, spending time in

“their space, learning about needs, and working together through all stages of design”

(Costanza-Chock, 2020, p. 98).

While family engagement research has focused mostly on families, schools, and community partnerships, there is a growing need to rethink traditional family engagement approaches to broaden family math participation. Further studies in this area are needed to unearth broader Latine family engagement approaches to help address the math achievement gap in the nation’s largest growing population. To do this, Latine families must be part of collaborative and participatory methodologies, such as co-design approaches. Through co-design approaches, learning possibilities are enabled so that families develop a voice and identity as “doers” of math. Co-design experimentation seeks to design a process in which families are part of a social transformation as co-designers and co-creators of learning experiences to facilitate engagement with their children. Much previous research examining co-design approaches has focused on healthcare co-design, and this research would like to bring that approach to early math education (d’Young et al., 2014; Holliday et al., 2015; Larkin et al., 2015; Pallesen et al., 2020). However, this study is unique in that it explored how co-design workshops are perceived by Latine families while engaging in the co-creation of a math activity for their children from the lens of culturally relevant mathematical knowledge and experiences.

To address the gap resulting from limited research on co-design approaches of family math, this study explored the experiences of Latine families during the co-design of a math activity for their children. The overarching aim of this study is to be exploratory and aimed at unearthing assumptions of funds of knowledge in families, placing participants as experts of their own mathematical experiences to co-design and co-create a math activity for their children. This study seeks to both contribute to the emergent scholarly field of family math and also to provide research on how to center families’ voices to rethink family engagement practices. Although there is varied research demonstrating the significant and positive relationship between parents’ participation and their children’s learning, there is a need to understand how

Latine families engage in co-designing solutions as a way to bring their stories, experiences, culture, and expertise to the fore as an active approach to family engagement practices.

### **Theoretical Framework**

It has been established that positive adult-child interactions at home are critical for children's social and emotional well-being, opportunities for school, family, and community collaborations across different settings are needed to support children's early learning development. Here, Bronfenbrenner's (1979a) ecological systems theory frames the analysis of family engagement in the early learning stages of a child's development and how families can play a key role in supporting their children's academic success. This dissertation research study draws on the work of Bronfenbrenner's (1979a) ecological system, which describes children's development within the environments (microsystem) of home, neighborhood, and community, which are interconnected in relationships (mesosystem) with individuals as well as interactions with systems like schools and social services in place (exosystem) and the culture (macrosystem) in which they live, which are foundational to their everyday lives (chronosystem; Bronfenbrenner, 1979b).

As the theoretical model for this study, examining family engagement in relation to children's mathematical success, ecological systems theory served as the guiding protocol for investigating the lived experiences of Latine families in relation to co-design approaches to support their children's mathematical knowledge. This study also drew from González et al., (1995) funds of knowledge research, which describes how immigrant families with accumulated cultural knowledge support skills and strategies in children's functioning and development (Esteban-Guitart & Moll, 2014; González, 1995; Kiyama, 2010; Moll & González, 1996). One of the focuses of this research is on recognizing and understanding how Latine households hold valuable resources or funds of knowledge to help shift pedagogical practices. Moreover, the researcher used the connected learning framework (Ito et al., 2013) as a guide to understanding and supporting learning experiences and to rethink traditional family engagement approaches

within the context of Latine families (a more detailed description of the theoretical framework for this study is shared in Chapter 2).

### **Purpose of the Study**

The purpose of this study was to utilize a qualitative phenomenological approach to explore and analyze how Latine, Spanish-dominant families perceived co-design workshops by investigating their involvement in a co-design and co-creation of a math activity. Additionally, this study sought to uncover how Latine families are centered as experts of their own mathematical experiences in co-designing culturally relevant, authentic, and meaningful math learning experiences to reframe family engagement beyond sign-up-and-watch experiences. Furthermore, this study explored how families construct knowledge in the interactions of a group in the co-design workshops. Therefore, this qualitative research study adopted a phenomenological approach since it provides a useful way of understanding Latine families' lived experiences with math co-design approaches as part of culture and the learning environment. This study aimed to contribute to policy, the literature on family engagement practice, and academia by illuminating co-design approaches with Latine families. The following research questions guide this qualitative phenomenological dissertation study:

### **Research Questions**

1. How do Latine families create math learning experiences for their children?
2. What perceptions do Latine families hold of math co-design approaches?

### **Nature of the Study**

A qualitative research phenomenological was designed for this study. According to Creswell (2003), qualitative research methods provide an in-depth understanding of the lived experiences of participants. The phenomenological methodology also sought to understand the essence of human experiences conceptualized in the participants' awareness about a phenomenon they describe (Creswell & Creswell, 2018; Mohajan, 2018). Furthermore, this study was informed by a constructivist paradigm. Constructivism refers to the active creation of

knowledge in which individuals construct knowledge from others and their environments (Piaget, 1957). For the purpose of this study, constructivism will mean Vygotsky's (1978a) approach, where meaningful learning takes place when individuals construct knowledge from social contexts, history, and exploration for early learning settings and spaces.

Using criterion-based sampling, the researcher recruited six Latina mothers from one research site. The researcher employed attrition strategies to maintain research participation. According to Maxwell (2013), criterion-based sampling is helpful to establish a productive researcher-participant relationship. Participants for this research group were recruited with the assistance of two nonprofit organizations from one Southern California community that from here forward will be known as the Metro City research site. The researcher translated all research materials into Spanish and used Sperber's (2004) innovative method for validating translated documents. Spanish research materials were also sent to a professional translation company to review translations and ensure accurate translation of technical language.

For data collection methods and instruments, the researcher implemented semi-structured interviews and three co-design workshops. The researcher used an interview protocol (Appendix A) as a data collection instrument to assess parents' funds of knowledge, their math learning experience, their parental involvement and family activities and routines at home. Participants were also asked to take a brief survey (Appendix B) at the end of each co-design workshop to assess attitudes and participation awareness after participating in the co-design workshops.

For the purpose of this study, Latine families participated in three co-design workshops to engage them in the discussion of co-design and co-creation a mathematics activity. The co-design structure of the workshops was developed by the researcher based on data from the semi-structured interviews (Appendix A) and it integrated Murdoch-Kitt and Emans' (2020) guidance for remote team collaboration. The purpose of the co-design workshop was to gather observation data by recording the workshops and collecting data from the workshop activities

where participants wrote down their notes, drawings, visual aids, and prototypes of the activities and took the end-of-workshop surveys (Appendix B). The aim of the co-design workshops as data collection was to observe participants engage in making meaning for themselves through the co-creation of a math activity for their children. Interviews and co-design workshops were administered virtually via the Zoom online platform.

### **Definition of Terms**

According to Creswell (2009), definition of terms and language should be included in the research study to clarify ambiguity and provide precise language. The following terms provide contextualization of the study and its design to better understand the complexities of Latine family engagement and their lived experiences during the semi-structured interviews and co-design workshops.

- **Latine Families.** There is different terminology used to identify and describe Latino families. Latino communities also self-identify as either Latino or Hispanic (Grieco & Cassidy, 2001). Most recently, Latinx has emerged as the preferred alternative to be more inclusive. The researcher will use Latine to represent Mexican, Mexican American, Mexican immigrants, and other South American communities. The research decided to use this term based on Melzi et al. (2021) definition “the “E” already exists in Spanish as in: una estudiante or un estudiante”. For the purpose of this study, the term Latine will be used throughout this study.
- **Family Engagement.** This study draws from the Department of Education’s dual capacity-building framework (Mapp & Bergman, 2019) to define family engagement as an interactive process in which families connect with neighborhoods, schools, community organizations, and peers to support learning for both the adult(s) and the child.
- **Early Learning Development.** Early learning refers to children’s educational, social, and emotional development competencies and outcomes. For the purpose of this study,

early learning development is primarily driven by language, social context, and adult guidance (Vygotsky, 1978b). For the purpose of this study, a child's early learning and development spans chronologically from 2-5 years old.

- **Early Mathematics Learning.** Young children create mathematical knowledge through actions and language (Anthony & Walshaw, 2007). Early mathematical learning includes understanding and reasoning in early math content areas, such as numbers and operations, geometry and spatial sense, measurement, and data analysis and probability, in children ages 2-6 (National Council of Teachers of Mathematics [NCTM], 2006).
- **Family Math.** Family math refers to activities outside of the classroom and within the contexts of culture, family relationships, the community, or everyday life that support young children and families to strengthen awareness, enthusiasm, and access to math (Eason et al., 2020).
- **Parents, Caregivers, and Family.** For the purpose of this study, parents, caregivers, and family will be used interchangeably to assume that many children look to adults who are not technically parents but guardians, grandparents, siblings, or other relatives, and thus the terms parents, caregivers, and family should be understood as inclusive of all adults taking care of young children.
- **Culturally Relevant.** Culturally relevant refers to using cultural knowledge, prior experiences, and skills to bridge and scaffold knowledge to make it appropriate and effective for a specific group of people (Ladson-Billings, 1995). Specifically for this study, culturally relevant refers to the ethnic, cultural, and linguistic backgrounds of Latine families to leverage all aspects of learning.
- **Culture.** From a sociocultural perspective, culture refers to the values, behavior, identity, and norms of individuals or groups (Aikenhead & Jegede, 1999). For the purpose of this



study, culture is used to explore how Latine families experience their social environment through their culture and relate with one another at home, at school, or in the community. For the purpose of this study, Latine culture includes a) “consejos,” sayings to reinforce character, b) “apoyo,” moral and emotional support, c) “sacrificios,” motivation to continue their education pathways, and d) “respeto,” Latine families’ cultural adaptation and intervention to support children's learning.

- Deficit Thinking. Deficit thinking refers to the assumption that individuals or a group of people fail in learning or education because of their own “deficiencies” or inequalities—limited intelligence, lack of motivation and resources—while ignoring context, history, and background (Patton Davis & Museus, 2019).
- Funds of Knowledge. Funds of knowledge are the “historically accumulated and culturally developed bodies of knowledge and skills essential for household individual functioning and well-being” (Moll et al., 1992, p. 133).
- Co-design. Co-design approaches refer to placing individuals at the center of the collaborative process (Costanza-Chock, 2020). Further, Sanders and Stappers (2008) defined co-design approaches as specific approaches to co-create, co-construct, and co-design involving participants’ capacities, beliefs, and relationships to develop a resource or a service. For the purpose of this study, co-design approaches will refer to the process in which families engage in participatory learning experiences to bring their stories, experiences, and expertise from within their culture and community.
- Generative Co-design Activities. Activities designed to with an specific goal to inspired and encourage co-design workshop participants to engage with them. For the purpose of this study, generative co-design activities serve to help the researcher have a deeper understanding of what participants feel, dream, want, and need. This is a generative

technique in co-design approaches to allows the researcher to empathize, understand, and bring participants along with the researcher in the design process.

- Decolonizing Methodologies. Decolonizing methodologies means “a process which engages with imperialism and colonialism at multiple levels...[including] having a more critical understanding of the underlying assumptions, motivations and values which inform research practices” (Smith, 2012, p. 21). For the purpose of this study, decolonizing design methodologies refers not only to the idea of producing knowledge “with and from rather than about” (Schultz et al., 2018, p. 89) Latine parents’ experiences.

### **Assumptions, Limitations, and Delimitations of the Study**

#### ***Assumptions***

According to Leedy and Ormrod (2010), “Assumptions are so basic that, without them, the research problem itself could not exist” (p. 62). In conducting this study, the following assumptions were taken into consideration. It was assumed during the design of the methodology that:

- The data collection instruments elicited reliable responses.
- Participants fully understood and answer interview questions honestly and thoroughly since both in English and Spanish.
- Participants had sufficient time to attend the co-design workshops, given COVID-19 challenges.
- Participants had a sincere interest in participating in the study since it relates to their cultural background and children’s education.
- Participants did not withhold from participating or sharing information.
- All instruments, documents, resources, and interview protocols were presented both in English and Spanish.

## **Limitations**

According to L. R. Gay and Airasian (2000), limitations are “an aspect of a study which the researcher knows may negatively affect the results or generalizability of the results, but over which he or she has no control” (p. 625). This study used a qualitative phenomenological approach to provide compelling data. According to Creswell (2014), one of the biggest limitations in phenomenology is the researcher’s personal bias—personal beliefs and values. Further, this study selected a small purposive sample size of six participants with no control group, and the results from this study cannot be applied to larger populations—decreasing the generalizability of findings (Maxwell, 2013).

Therefore, it was imperative that the researcher emphasized critical investigation and present the data findings in a way that reflects and reveals the purpose of this study. Moreover, the data gathered in this study was limited, as only six Latina mothers were the only participants interviewed and the researcher relied on the perceptions of parents and caregivers, who may have a different perception of family engagement and mathematical learning experiences. Another limitation to take into consideration is my insider/outsider dichotomy as a Mexican woman. As the main researcher, I “filter[ed] the data through a personal lens that is situated in a specific socio-political and historical moment, one cannot escape the personal interpretation brought to qualitative data analysis” (Creswell, 2003, p. 182).

The above factors are beyond the scope of both researcher and participant. However, to counter these limitations, the researcher implemented triangulation to bracket the study (Carpenter, 2007). Further, the researcher triangulated this study by using data and theory triangulation—different sources of data and inclusion of multiple perspectives to interpret a single data set to establish validity (Creswell, 2003). Moreover, the researcher implemented Giorgi and Giorgi’s (2003) four characteristics model to make a clear distinction of the methodological analysis, which includes (a) description (openly reading), (b) reduction (sorting

of meaningful units), (c) search for essences (reflecting on each meaningful unit), and (d) intentionality (based on research questions that reveal the essential structures of phenomena).

### ***Delimitations***

A delimitation of this study was the specific population—Latine families. Families who participate in this study might be reluctant to share information or feelings about their histories, cultural backgrounds, mathematical learning, or their children’s education. They might not be able to articulate their construct of knowledge as they participate in interviews or workshops. One more delimitation may be the connection between the researchers and participants when interviewing and leading the co-design workshops. To counter this, I established a relationship of trust between the participants and myself by sharing my history with education as a Mexican woman. Rubin and Rubin (2011) emphasized this point by stating that interviewing requires reciprocity and suggested that researchers reveal something about themselves in order to build trust. Moreover, as the data collection is both in English and Spanish, there may be portions of the data collection that may not be accurately represented. To counter this delimitation, the researcher sent the results to a professional translation company to review translations and ensure accurate translation of technical language.

### **Summary and Organization of the Study**

This chapter provided an overview of the problem and its significance within the realm of Latine family engagement, family math, and co-design approaches. Given the importance of family engagement, math achievement in Latine children, and the emergent field of family math, this phenomenological study seeks to explore Latine families’ construction of mathematics knowledge embedded in cultural knowledge through co-design approaches to support their young children’s math learning. Although there is a vast body of research proving family engagement supports children’s development, these studies have sought to understand how families engage in their children’s academic outcomes. There is a need to focus on research for designing collaborations with families to identify and conceptualize connections between their

historicity and their everyday experiences. Additionally, the systematized literature review in chapter 2 did not identify research specifically focused on co-design approaches for family engagement. There is a gap and need in the knowledge regarding this specific topic.

Chapter 2 presents a summary of key literature to lay out the background of this research project and provide context for this study. The methodology of the dissertation research is addressed in Chapter 3. Chapters 4 present the data in single case narratives for both the semi-structured interviews and the co-design workshops. Chapter 5 offers an analysis of major themes and key findings emerging from the narratives and their significance in terms of Latine family engagement in co-design approaches and lived experiences revealing funds of knowledge. Chapter 6 concludes the study with a brief discussion of conclusions, recommendations, and opportunities for future research areas.

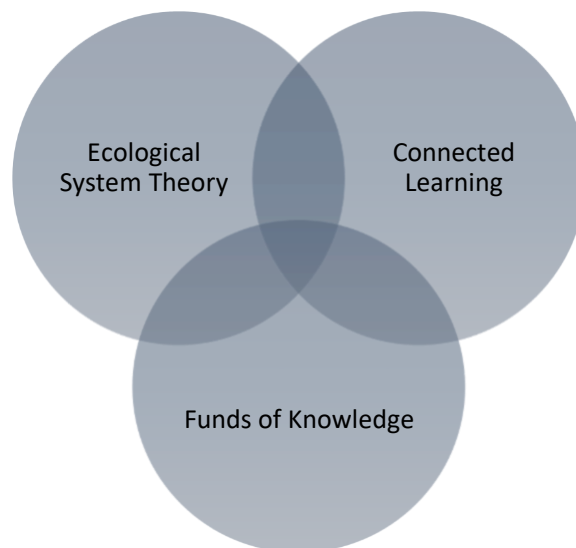
## Chapter 2: Literature Review

Chapter 2 examined the existing research that is foundational to this study. This chapter begins with the theoretical framework and examines the three areas of the literature review. Further, this chapter provides context for relevant research to understand the history and demographics of Latine families in the United States and family engagement practices. Chapter 2 is organized into the following three sections. The first section explores the changing dynamics of Latine families in the United States, including cultural contexts like parents' beliefs.

The next section examines family engagement research and practice, including co-design approaches, outlining its impact on young children's development and achievement as well as barriers and challenges, and provides a description of traditionally used family engagement frameworks. Finally, the third section examines emergent family math literature, providing a synthesis of existing literature and practices that support early math engagement across a wide range of research and practice. A summary is presented at the end of the chapter. Figure 1 provides a description to connect the three sections of the theoretical framework and their relationship to this study.

### Figure 1

*Conceptual Framework to Illustrate the Relationship of the Theoretical Framework*



## Theoretical Framework

The theoretical framework is grounded in three approaches that complement and build on each other to create a comprehensive lens through which to conduct this research.

*Ecological systems theory* (Bronfenbrenner, 1979a) serves as the primary basis of rationale for this study, while the *funds of knowledge* concept (González et al., 1995; Moll & González, 1996) and the *connected learning* framework (Ito et al., 2013) frame this research in the context of Latine families for this study. These theories have a significant impact on the education and learning research field and are discussed with respect to early learning and family engagement.

This section also describes each of the three theories, delineates the similarities and differences between theory and practice, and discusses why the theories complement each other. This part of the theoretical framework draws attention to research foundations that support children's well-being and learning through family support systems. Since this research explored the early learning development of children in the context of family, the researcher recognizes that learning does not take place in a vacuum but that children experience ongoing direct interactions with their families, peers, educators, and communities.

Therefore, the three theories provide a foundation for understanding and exploring Latine family engagement. These theories also underscore its ecology in the home, and in educational and community settings, while also accounting for families' cultural practices and identifying a need for culturally relevant family engagement approaches to center Latine family voices. The three theories overlap in a complementary way to offer a connection between theories of learning and the epistemology of a constructivist practice to provide a counterargument to the deficit lens through which Latine family engagement is often viewed. The combination of these three approaches also provides a theoretical framework lens for the research questions and research design. Unique to this study is the connection of the connected learning framework to advocate for broader access to family learning that is socially and cultural embedded.

## Ecological Systems Theory

A foundation of this theoretical framework is Bronfenbrenner's work on ecological systems theory, which emphasizes the importance of building effective relationships within the context of various layers of the environment to understand the development of young children. Within ecological systems theory, Bronfenbrenner (1979b, 1986, 1989a, 1995) described the environment as a series of nested structures wherein human development is shaped by the interrelationships between people, objects, culture, and symbols. Bronfenbrenner (1979b) described the multilayered environment as separate from and connected to a social system and consisting of five layers: *microsystem*, *mesosystem*, *exosystem*, *macrosystem*, and *chronosystem*. The *microsystem* refers to a child's direct relationships and experiences in an immediate setting, such as the home, family, or neighborhood. This system has the most influence on a child's development because of its direct relationship with people. The *mesosystem* is a "system of microsystems" (Bronfenbrenner, 1977, p. 515) composed of connections among one's immediate environments.

Bronfenbrenner (1979b) described the *mesosystem* as having "interconnections" and "intermediate links in a social network" (p. 25), for example, the relationship between home and school. The *exosystem* has a direct influence on the child's development by interacting with other layers in the child's direct environment. Economic policies that affect families' child-rearing practices are an illustration of the *exosystem*. The *macrosystem* includes any group where members construct values and belief systems, such as culture and lifestyles. Lastly, the *chronosystem* relates to life changes over time, such as a child's development over time within larger societal changes (e.g., shifts in quality of life or beliefs). Ecological systems theory contextualizes child development and positive learning outcomes in connection to larger family engagement systems and factors.

Bronfenbrenner's theory highlights the importance of systems and environments that play an essential role in decision making within family contexts. No system exists without the



others. Thus, the importance of understanding child development also lies in understanding how internal and external factors affect the child and family practices (Levine & Munsch, 2014). While effective adult-child interactions at home are critical for children's social and emotional well-being, the relationships between home, peers, and school are equally vital in supporting young children's social-emotional and learning development (Bronfenbrenner, 1986; Bronfenbrenner & Morris, 1998, 2006).

Extensive references are made to Bronfenbrenner's ecological systems theory in the literature of child development and most recently in the literature of family engagement (Hampden-Thompson & Galindo, 2017; Hirano et al., 2018; Holt et al., 2008; Lin & Bates, 2010; Paat, 2013). Ecological systems theory positions family engagement as an active process within a set of relationships and connections that can influence a child's development. Enhancing the opportunities for children to succeed in life will provide children with long-term benefits. According to Bronfenbrenner (1979a), relationships and connections start at home. To understand the first connections that can be formed at home, funds of knowledge serve as a link between ecological systems theory and the accumulated and cultural bodies of knowledge found in families, especially in Latine families (Moll et al., 1992).

Ecological systems theory has produced a vast body of knowledge framing learning as a complex and multifaceted process. It invites researchers and practitioners to be reflective of ecosystems as patterns of variability from small to large scale in the science of learning. Yet, there is no operational framework due to the complexity of a multitiered approach. Therefore, including funds of knowledge as part of an epistemology of practice frames a lens to conceptualize and contextualize knowledge and learning, one that is part cultural, part organic, and that stems from families' lived experiences. Funds of knowledge are integrated into this study to understand how knowledge and skills are developed and cultivated through Latine families' lived experiences within different ecosystems. Funds of knowledge provides a framework to gather first-hand information about how Latine families learn at home.

## **Funds of Knowledge**

Vélez-Ibáñez and Greenberg (1992) introduced the concept of funds of knowledge to represent the accumulated knowledge and values that exist in the home to support a child's school-home relationship and academic achievement. Funds of knowledge is consistent with a sociocultural approach rather than schooling (Hogg, 2011). According to González et al. (2005), the concept of funds of knowledge is based on a simple premise—people possess and construct knowledge, and their life experiences serve as a foundation to develop learning identities.

González et al.'s (1995) funds of knowledge research described how Latine immigrant households can serve as informal learning hubs full of cultural resources. Their study emphasized the direct engagement between educators and Latine parents to foster trust and reciprocity rather than assumptions based on a deficit lens (González et al., 1995). Latine families have strengths and skills, and the complexity of their life experiences can offer a rich tapestry of teaching and learning possibilities—an accumulated cultural knowledge that contributes to children's educational development (Esteban-Guitart & Moll, 2014; González et al., 1995; Kiyama, 2010; Moll, 2010; Moll et al., 1992; Moll & González, 1996).

Similar to González et al. (1995), Gallo and Link (2015) described how undocumented Latine families' navigation of the political system becomes a learning asset that can be translated into a classroom skill but is rarely done. For example, children can serve as language brokers—linguistic mediators assisting their non-English-speaking families through translations and interpretation in different contexts, such as in immigration, healthcare, and education (Akam & Vanja, 2014; Kim et al., 2018; Roche et al., 2015). This is significant from an epistemological perspective—funds of knowledge demonstrate how knowledge and skills can be constructed through a family's everyday practices to provide a learning space to reformulate knowledge.

González et al. (2005) further emphasized this point by stating that funds of knowledge “presumes coherence within groups, which may not exist” (p. 10). The focus then is on

"practice—what households actually do and how they think about what they do...how households draw from multiple cultural systems and use these systems as strategic resources" (González et al., 2005, p. 10). Therefore, funds of knowledge offers an alternative pedagogical approach to understanding family engagement practices that are oppositional to the prevalent deficit discourse in Latine family engagement, which often attempts to fix or improve families instead of understanding how context—often determined by structure, culture, and agency—can shape a young child's learning. It argues for the integration of sources of knowledge from home, cultural values, and life experiences as a link to educational development for children both at home and in formal educational settings.

Like Moll and González (1996), Kiyama (2010) further explored funds of knowledge with Mexican American families. Her research found that families' household practices, jobs, and child-rearing philosophies aided in supporting high school students' academic achievement. Mexican American families' working roles turned into accumulated cultural knowledge of families' skills and workforce experiences. Funds of knowledge creates a frame to understand families in real-world contexts, where home provides an enduring and multigenerational culture of learning. A family's history and culture are rich examples of abilities and assets that traditional family engagement programs often fail to acknowledge.

The funds of knowledge framework complements the ecological systems theory to broaden family engagement interpretations as a source of influence in a child's development. It creates a connection to incorporate key theoretical ideas into practice. Funds of knowledge argues for a culturally relevant pedagogy for how children and adults learn. It argues that families' voices and participation are central to children's development. Yet, programs often fail to see families' capabilities and unique contributions, especially for Latine families.

The connected learning framework serves as a tool to support and build environments that "connect learning across the spheres of interests, peer culture, and academic life" and argues for the inclusion of diverse voices in designing programs (Ito et al., 2013, p. 5).

Connected learning calls for family engagement practitioners and program designers to center families' histories and everyday experiences as part of family engagement design programs. Connected learning then provides a framework from which program designers can challenge assumptions and biases, promote collaborative decisions in partnership with families, and create authentic and meaningful family engagement learning experiences and resources.

### **Connected Learning**

Family engagement services, resources, and learning experiences must include social, equitable, and participatory practices. Reflecting on the same ideas of funds of knowledge and culturally relevant pedagogy, Ito et al. (2013) developed the connected learning framework as a guide to understand, create, and support equitable learning opportunities in the digital age. Ito et al. noted that the framework is not a new approach but an effort to link existing approaches "that share a set of core values and goals" (p. 34). Connected learning then:

Advocates for broadened access to learning that is socially embedded, interest-driven, and oriented toward educational, economic, or political opportunity.

Connected learning is realized when a young person is able to pursue a personal interest or passion with the support of friends and caring adults, and is in turn able to link this learning and interest to academic achievement, career success or civic engagement. (Ito et al., 2013, p. 4)

The framework also serves as a theory of intervention to connect learners across different social, technological, and cultural contexts to foster learning opportunities and expand their social support. Although connected learning was developed to understand youth engagement in formal and informal settings, this framework is applicable to family engagement practices to center the parent as the adult learner. Thus, learning experiences and opportunities, such as the facilitation and exchange of skills and relationships in family workshops or family services, are especially critical in supporting children's development.

Studies have shown that families indirectly influence a child's education from the beginning by providing objects like toys or engaging in exploration (Barron, 2006; Barron et al., 2009). Parents as the adult learners can, therefore, significantly influence a child's early learning, such as reading and math. The integration of different settings as places of learning underscores how families can support young children and in turn can be supported by connected networks of libraries, schools, parks, etc. (Riojas-Cortez & Flores, 2009).

A significant tenet of connected learning theory is that social interactions intersect with interests, opportunities, and relationships. Yet many learners believe that academics are disconnected from the so-called real world (Baker et al., 2012). However, connected learning can provide authentic and meaningful learning experiences and foster a sense of community. Arnold and Paulus (2010) described connected learning as blending the academic and personal lives of students to provide a connection between formal and informal learning settings. Connected learning offers a framework to promote learning through interactions within different systems and learning interests, thus bridging academics, cultures, and relationships.

Connected learning reframes family engagement as family learning. Family engagement and learning becomes a dynamic relationship where places, ideas, people, histories, and communities connect learning to practices and broaden participation as democratic, culturally relevant, and active (Bang et al., 2012; Bang et al., 2016). Participatory design methods illustrate how connected learning" would be implemented in practice. Co-design approaches have roots in participatory design methodologies. Co-design approaches challenge the imbalance of power often held within select groups of individuals. Family engagement providers often design programs for families and children without considering what they need and what they want.

There is a significant paucity in connected learning research and the connection to family engagement practices, and there is a need to investigate the intersection and relationship between them. For the purpose of this study, the connected learning framework informed future-

oriented family engagement practices from design experimentation. Connected learning complements the ecological systems theory and the funds of knowledge concept by integrating all three to argue for drawing connections between families' historicity and their everyday experiences from an asset-based perspective rather than a deficit lens. Together, these three theories provide a conceptual framework to rethink traditional family engagement approaches to broaden family engagement to be democratic, culturally relevant, and active.

These three theories and frameworks provide a lens through which to examine this research study. Ecological systems theory, funds of knowledge and the connected learning framework guided the literary review and the methodology. Further, the theoretical framework provides a synthesis of tested research and how it relates to my proposed study as the researcher understand these theories, and it additionally served to analyze my study data. By integrating all the three theories and frameworks, this study argues for drawing connections between families' historicity and their everyday experiences from an asset-based perspective rather than a deficit lens.

### **Summary**

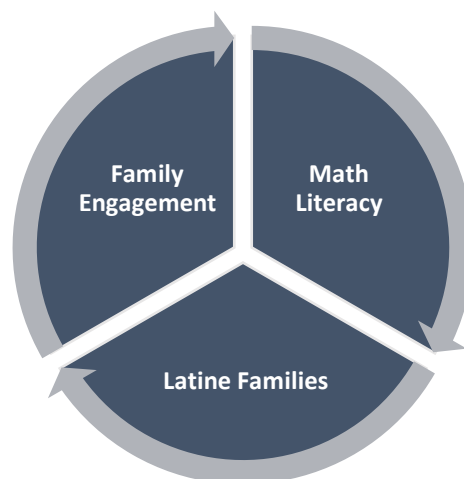
The ecological systems theory provides a basis for family engagement models. However, operationalization of the theory's concepts remains challenging. Further, in order for learning to be meaningful for disenfranchised families and children, the pedagogy of learning needs to be culturally responsive and relevant (Gay, 2010; Ladson-Billings, 2013). Therefore, funds of knowledge and connected learning complement the ecological systems theory to help examine the different roles individuals play in creating meaningful family engagement and learning to support children's educational outcomes. These three theories and frameworks helped shape the theoretical framework for this research on family engagement and early childhood learning in the context of Latine home environments.

As such, this study utilizes the conceptual framework in Figure 1 incorporating ecological systems theory, funds of knowledge, and the connected learning framework to discuss child

development and family engagement as a social process rooted in the child's relationships with other people, environments, and cultures. The funds of knowledge and connected learning frameworks can help operationalize ecological systems theory to (a) support families in sharing their unique knowledge and skills and encourage active participation in formal and informal learning settings, (b) center families' voices and cultural knowledge to transform family engagement as equitable and participatory, and (c) foster a home environment that values learning and supports family engagement programs. Family engagement cannot be disembedded from the cultural and social context families experience (González et al., 2001). Therefore, family engagement must be responsive, meaningful, and culturally fitting to support children's learning development. Figure 2 provides a lens to frame the literature review for the purpose of this study.

## Figure 2

*Framework for the Literature Review*



## Latine Families and Children in the United States

The terms Latine is used by the researcher throughout the study to represent Mexican, Mexican American, Mexican immigrants, and other South American communities. Further, the term Latina is used to represent and describe the six Latina mothers who took part of this study.

Additionally, terms such as Latinx, Hispanic, Mexican, Mexican American, and Mexican immigrants are used throughout Chapter 2 to reflect how different authors identify the diverse Latine community.

### **Latine History and Demographics**

Latine American history and immigration are complex and rooted in different phases of American history. The often-forgotten Mexican landowners called Californios were the first people of Latin American descent to arrive and settle in California and become "Mexican Americans" (Sánchez, 1995; San Miguel, 1987). California also had steady arrivals of Mexican immigrants during the gold rush era, where Latine immigration was spurred by the discovery of gold in California (González, 2019). In the 20th century, the demand for a larger workforce to support the thriving agricultural sector continued to influence immigration. Recognizing the growing reliance on immigrant labor, the United States created the Bracero Program in 1942, a project aimed at recruiting Mexican immigrants to legally work in the United States to address the labor shortage caused by World War II (González, 2019; Hahamovitch, 2011). Seasonal migrant workers formed a significant percentage of California's agriculture labor and influenced the next large Latine immigration wave that came after 1965 (Suarez, 2013).

Although Latine immigration is varied and diverse, Latines and Latine Americans have not been incorporated within American culture and society. American culture and society has been defined by White historical narratives and power structures, limiting Latine immigrants' social standing, power, and education (Flores-Gonzalez, 2017; González, 2019; Raymond, 2014; Suarez, 2013). This is important to note to understand Latine Americans' national origin and socioeconomic status and elucidate their link to family relations and the education of Latine American children. According to Raymond (2014), despite upward mobilization for some Latines, many have not yet succeeded in gaining membership within American culture, which is necessary to foster a sense of inclusion for them and their children.



In 2015, Latines represented the largest and fastest-growing minority group in the United States, with an estimated undocumented and documented mixed population of 55.5 million (Pew Research Center, 2016). Latine school-age children also constitute the largest increase among all racial and ethnic groups between 2003 and 2013 (National Center for Education Statistics, 2014). Latine families comprise the single largest minority group, and young Latine children lead the way. According to Lopez et al. (2018), Latine children comprised 25% of the 54 million K-12 students in 2016, an increase of 16% from 2000, and by 2050 they are projected to make up nearly one-third of children in the United States under age 18. In California, they comprise more than 53% of all children aged 0-17 (California Department of Finance, 2018; California School Boards Association, 2016). The vast majority of Latines living in the United States are of Mexican heritage, comprising 62% of the total U.S. population of Latines, followed by those from Puerto Rico (9.5%), El Salvador (3.7%), Cuba (3.7%), Dominican Republic (3.3%), Guatemala (2.4%), Colombia (2.0%), Honduras (1.5%), Spain (1.4%), Ecuador (1.3%), Peru (1.2%), Nicaragua (.7%), Venezuela (.5%), and Argentina (.5%; Lopez & Patten, 2015).

The changing and pronounced demographic shift among Latine groups is of interest not only in political discourse but also in education. Several studies have shown that young Latine children are less likely to attend preschool or receive early childhood development services, more likely to be placed in remedial classes in high school, and less likely to complete high school education and pursue or finish a postsecondary degree (Guerrero et al., 2013; Kohler & Lazarin, 2007; Ramos, 2014; Suarez-Orozco et al., 2015). These challenges are the unintended consequences of systemic and cultural barriers many Latine families face in their everyday lives. According to the National Center for Education Statistics (2019b), public schools will continue to see larger representations of Latine children. In 2016, Latine school enrollment increased from 14.9% to 25.7% for kindergarten, while for elementary enrollment, the growth went from 14.1% to 25%. High school and college enrollment went from 13.2% to 23.7% and from 8% to 19.1%, respectively (Bauman, 2017).

In the state of California, where this study took place, the Latine student population varies by county and district. In Los Angeles, Latines make up 48.5% of the county's population (Los Angeles Unified School District, 2017). For the 2019-2020 academic year, Los Angeles County had 65.5% Latine students enrolled in K-12 public schools, whereas Orange County had 49.1% Latine students enrolled in its schools (Kidsdata, 2018c). The Santa Ana Unified School District has the largest percentage of Latine students, with 92.5% enrollment (Kidsdata, 2018e). In the Los Angeles Unified School District, 74.1% of its student enrollment is Latine, whereas the Compton Unified School District has 77.2% Latine enrollment (Compton Unified School District, 2018; Los Angeles Unified School District, 2017). The majority of Latine children are in school today, but by 2030 they will represent the majority of the U.S. workforce (National Research Council, 2006). Since young Latine children will play a vital role in the future of the United States labor force, addressing Latine children's education has important implications for the nation's future.

As Latine children are the fastest-growing demographic in the United States, it is critical to understand their educational attainment challenges and successes in the context of engagement. Along with the demographic changes mentioned above, young Latine children face familial integration challenges as children of immigrant parents. The most recent data from 2013 describes more than half of Latine children having one parent born outside the United States, while nearly all Latine children were born in the US (Landale et al., 2011; Murphey et al., 2014). Latine families are driven by dreams of better educational opportunities for their children and, in turn, a better life for themselves and their family as a unit (Suarez-Orozco et al., 2008). However, for Latine children, growing up in a Latine and immigrant family tends to define their social and educational inequities, including low-income housing, lack of educational resources, language barriers, lack of school system knowledge, immigration status, and parents' lack of employment opportunities (Conger, 2015; Fry & Gonzáles, 2008; Lee & Bowen, 2006; Suarez-Orozco et al., 2008, 2015).

Research has also shown that differences in parents' educational attainment and employment conditions are linked to their children's educational pathways (Cataldi et al., 2018; Crosnoe & Turley, 2011). Crosnoe and Turley (2011) stated that many Latine young children are living with parents who do not have high school degrees, a sharp contrast to their White peers whose parents on average have completed at least two years of an associate's degree. According to the National Center for Education Statistics (2007), in 2005, Latines between the ages of 0-25 had only completed five years of elementary school, and 58.5% had completed high school. For Latines aged 25-29, 11.2% had received a bachelor's degree (Gándara, 2008; National Center for Education Statistics, 2007). Further, parents with higher levels of education tend to have better employment opportunities and are more likely to offer more educational opportunities to their young children (Duncan & Murnane, 2011; Suarez-Orozco & Suarez-Orozco, 2013). For children of immigrants, this is rarely a possibility or an opportunity.

Further, children living in poverty are more likely to have fewer years of school experience and to encounter more educational risks (Gándara & Contreras, 2009; Ku & Bruen, 2013). Latine families with young children have lower rates of access to public benefits like Medicaid, cash assistance, or the food stamp program, which in turn limits their young children's access to public benefit programs (Gándara & Contreras, 2009; Ku & Bruen, 2013). For Latine children, the poverty rate is a critical factor that is linked to their lower participation in preschool programs (Murphey et al., 2014; Suarez-Orozco et al., 2015).

Research further shows that school readiness skills help young children for later learning and school success. However, because of this socioeconomic disadvantage, Latine children tend to start school with lower reading and math skills (Murphey et al., 2014). Equally important, Latine English language learners are a fast-growing demographic in United States schools and are more likely to drop out of school and less likely to find and sustain employment because of lack of English proficiency and poor academic achievement (Perez & Morrison, 2016; Sheng et al., 2011).

## English Language Learners

United States immigration policies have led to unprecedented growth of immigrant populations from diverse ethnicities. In recent years, the number of English language learners (ELLs) in the U.S. public school system consisted of 4.7 million students (Musu-Gillette et al., 2017). According to the U.S. Department of Education (2016), English learners will account for 40% of the school-age population by 2030. In California, the percentage of English learners is 21%. Spanish is the most common native language spoken outside of English, and its speakers account for 82% of the total ELL population in the state (Sugarman & Geary, 2018). In the Los Angeles Unified School District, 92.5% of English learners are Spanish speakers (Los Angeles Unified School District, 2017). This is important since this district is the second-largest in the nation, and English learners tend to perform poorly on state assessments (Uriarte et al., 2011). The rapid growth of English learners in this country demands considerable attention and response from our educational system (Short & Boyson, 2012).

It is important to note the different achievement levels of ELLs compared to their peers. In 2017, approximately 12% of school-age Latine children spoke another language at home and had difficulty speaking English, compared with about 1% of White, non-Hispanic children and 2% of Black children (Federal Interagency Forum on Child and Family Statistics, 2019). According to Musu-Gillette et al. (2017), there were 4.6 million ELLs in U.S. schools in 2012-2013, representing 9.4% of all students. By 2015, two-thirds of ELL students represented 16% of the nation's K-5 students, compared to 4% of 12th graders (National Center for Education Statistics, 2019a). ELLs are also a growing segment of the K-12 student population, and by 2030, ELLs will represent 40% of all public school students. A recent report by Wilson (2014) noted that although most ELL working adults are part of the U.S. labor force, they tend to be concentrated in low-paying jobs. In California, immigrants with limited English proficiency face incredible challenges in finding and sustaining employment (Wilson, 2014).

According to Shin et al. (2010), higher levels of English fluency are also highly correlated

with higher levels of education. Further, lack of English fluency in Latine immigrant families creates barriers to educational services for their young children (Marrero, 2016). Marrero (2016) also noted that many parents who do not speak English tend to have feelings of inferiority and helplessness, which alienate them from the educational system. The issue of language often comes up in discussing the acculturation of Latine families and their children. Further, families also depend on young children to be language brokers—bilingual children helping families communicate for linguistic and cultural resources in education, health, and employment (Kim et al., 2018; Orellana et al., 2012). Substantial language barriers that limit access to school spaces and the ability to understand how the school system works can affect how much families feel equipped to participate in their children's education. Further, Gándara and Contreras (2009) noted that for many Latine families, language continues to be a concern. Many Latine families' lack of language fluency hinders their ability to know about their rights to educational services to support their children at home (Marrero, 2016; Zuckerman et al., 2014).

### **English Learners and Poverty**

In 2014, approximately 20% of English language learners were from families living in poverty (National Council on Disability, 2018). In California, school-aged English language learner children living in poverty range from 74% to 85% compared to the overall poverty rate for the state (Hill, 2012). High poverty rates, along with a lack of English fluency in Latine families, appear to be a strong indication of Latine children's low school readiness (Murphey et al., 2014). In part, English learning acquisition is a complex process influenced by a family's situational and immigration background.

Barriers for Latine families include policies like "English only" laws, which influence negative attitudes and policies toward bilingualism (García, 2014). More notably, Latines are less likely than White parents to read daily to young children; a little more than a third of Latine children have parents who do so, compared with two-thirds of White children (Gesell et al., 2012; Murphey et al., 2014). It is not surprising that for Latine families whose home language is

primarily Spanish, reading to their young kids in the language they are most dominant in might not be a priority for fear of negative bilingualism attitudes.

Further, this puts Latine children behind their White peers on a variety of critical education outcomes, like entering kindergarten with low levels of reading and math skills (Carnoy & Garcia, 2017; Hoff, 2013). Young Latine children remain a disadvantaged group facing several educational disparities. DeCapua and Marshall (2011) further emphasized that ELLs' "lack of understanding of and familiarity with academic ways of learning...disadvantages them when they enter mainstream U.S. classrooms" (p. 36). English language learner students do not feel prepared for or supported in literacy and math skills and thus not ready for academic development (Kanno & Varghese, 2010; Menken & Kleyn, 2010).

### **Latine Cultural Values**

In spite of these limitations, research has shown that Latine families incorporate cultural values into their parenting as a form of intervention and adaption (Mariñez-Lora & Atkins, 2012; Ramos, 2014; Domenech Rodríguez et al., 2011). According to Han and Love (2015), one-size-fits-all models do not address the importance of including sociocultural factors for immigrant families. McKenna and Millen (2013) emphasized this point by noting the importance of context and culture when defining family engagement. Similarly, Harris (2011) argued that low academic achievement in minority students is complex and bound to socioeconomic status, parental education and engagement, and poorly designed curricula for both student and family programs. Furthermore, Harris described how academic institutions fail to acknowledge the lack of support for minority students, often arguing for assimilation. According to Harris, opposing minority students' culture is simplistic and generalizes an entirely different population.

Studies like Altschul (2011) and Walker et al. (2011) found that Mexican American families are highly involved in traditional home-based involvement activities. Walker et al.'s research found that Latine families engaged their children in values, beliefs, and behaviors to support learning and educational success. Families in this study stated they "try to do their part"

in partnership with schools. Although Walker et al. did not specify what "doing their part" means, based on previous literature, it aligns to cultural concepts such as *consejos* (sayings to reinforce character), *apoyo* (moral and emotional support), and *sacrificios* (motivation to continue their education pathways) to help in their children's academic success (Murphey et al., 2014; Ramos, 2014). This is important to note because it is consistent with nascent literature documenting how Latine families implement cultural values as intervention practice to help promote children's academic success at home.

Guadalupe Valdés (1996) was one of the first researchers to explore how Mexican American families created meaningful learning experiences with their kids through their Latine family identities of language, literacies, and cultural ways of being. Valdés wanted to understand "the ways in which children were prepared by their [Mexican] parents to function within the family, in the outside community and in the school setting" (p. 7). One of the seminal findings in her study was how Mexican American families use *respeto* as a cultural adaptation and intervention to support their children's learning. *Respeto* is respect translated in English, but for Latine families it serves as a cultural value for child-rearing (Calzada et al., 2010; Valdés, 1996). *Respeto*, as a cultural value, goes further back to Peck and Díaz-Guerrero's (1967) research. In their study of Mexican college students, they described *respeto*:

Although the Spanish word *respeto* and the English word *respect* are identical in origin, very similar in form, and similar in the dictionary definition, the actual behavior patterns and the conceptual association surrounding these terms might, we thought, differ significantly in the two cultures. (Peck & Díaz-Guerrero, 1967, p. 275)

While *respeto* is considered a cultural duty and obligation in Latine families, the notion of *respeto* in educational terms serves as a motivational construct interpreted and applied to educational contexts (Valdés, 1996). Therefore, *respeto* provides a rich picture of how cultural

forces shape Latine children's lives and attitudes and, therefore, influence their development both in home and academic spheres.

Valdés (1996) further described how Mexican mothers use *consejos* (spontaneous homilies designed to influence behaviors and attitudes) to position themselves as the teacher in their children's learning experiences. While not visible in traditional school settings, Latine families draw upon these cultural values in hopes to help their children stay in school and succeed academically (Calzada et al., 2010; Valdés, 1996). The use of cultural beliefs is most notable in immigrant mothers who are low-income or have recently arrived in the US. In using cultural beliefs like *consejos* and *apoyo*, Latina mothers are rethinking traditional narratives of education and the spaces in which children learn (Elenes et al., 2001).

Latine families also emphasize efforts parents make on behalf of their children (*sacrificios*) as motivation to continue their education pathways (Murphey et al., 2014). For many Latine families, their immigration and marginalization experiences serve as a dual frame of reference to encourage their children to go to school and do well on their education path, unlike their parents' experience (Suarez-Orozco et al., 2008, 2015; Suarez-Orozco & Suarez-Orozco, 2013). Similarly, McKenna and Millen (2013) noted that family engagement is "fluid, robust, and specific to context and culture" (p. 9), reaffirming Latine family values as positive contributions to their children's academic success.

Gándara and Contreras (2009) pointed out how language is a culturally embedded value among Latine families. Latine families see their Spanish language rooted in their identity. Despite efforts from the education system to limit and restrict native language instruction (Arreguín-Anderson & Kennedy, 2013), Latine families continue to raise bilingual children. It is important to note that although preserving Spanish is a cultural value, Latine families continue to face language barriers, as schools are not equipped to draw upon the knowledge and skills found within the households of Latine families (Domenech Rodriguez et al., 2011; Marrero, 2016). Cultural values are important in understanding Latine family engagement practices for



the success of Latine children's education. It is also critical for practitioners and researchers to support this population better. Bernal et al.'s (2009) study provided strong evidence that family engagement programs that are culturally relevant with evidence-based methods do in fact work.

Furthermore, Latine families hold different views regarding teacher-parent relations, which ties to their cultural background and does not align with the mainstream and dominant American culture norms (Bower & Griffin, 2011). For many Latine families, responsibility for their children's education falls under the school and teachers (Chrispeels & Rivero, 2001; Quezada et al., 2003). That is to say, for Latine families intervening in school or questioning teachers or school administrators might be seen as a sign of disrespect in their culture and within their community. Hiatt-Michael (2005) also noted that in research on Mexican parenting culture, Mexican parents viewed school involvement as assuring that their children were clothed and fed to attend school. Yet, Mexican and Mexican American parents encourage their children's education at home through family stories and conversations (Hiatt-Michael, 2005).

Additionally, Saenz and Ponjuan (2009) claimed that one of the most deep-rooted cultural values in Latine families is "familismo," "which involves the strong identification and attachment to immediate and extended family" (p. 62). "Familismo" emphasizes a collective family approach where loyalty, responsibility, and obligation are also central cultural values to maintain the family unit. Although the preservation of Latine family culture in America might be seen as an opposition to the dominant culture, it is important to note that such culture and values can be adaptive and transformative when integrated into family engagement programs. Latine family culture helps contextualize success and barriers for a deeper understanding of the experiences and knowledge obtained through cultural values. Just as relationships, people, objects, and symbols play a role in the microsystem, values, belief systems, and culture play a role in the macrosystem environment of a child, and this is especially true for Latine families.

Latine families' identities can be a lens through which educational institutions and educators can address challenges for successful student and family engagement. It is crucial to

understand Latine family engagement in the context of immigration, language, and culture to support Latine children's learning development. Thus, family engagement affects a child's development, depending on the environment in which a child grows. The following section discusses various family engagement research as evidence-based interventions.

### **Family Engagement Research**

Over the past decades, a growing body of family engagement research has explored the benefits of successful parent-teacher relationships (Hindin & Mueller, 2016; Jeynes, 2010; Lasater, 2016; Minke et al., 2014), family-school partnerships (Epstein et al., 2002; Henderson & Mapp, 2002; Walker et al., 2010), and parent involvement and engagement (Barnard, 2004; Crosnoe, 2012; De Gaetano, 2007; Epstein, 1995; Mapp & Kuttner, 2013; Moore et al., 2016; Wong, 2015). Several family engagement scholars have concluded that the home, school, and the community are major ecological settings to support young children's academic outcomes. This is especially true in cases where families do not have the resources or knowledge on how to engage in their children's early learning development (Conger, 2015).

### ***A Working Definition of Family Engagement***

Scholars like Mapp and Kuttner (2013) and Pushor (2012) have noted the importance of defining the differences between parent involvement and family engagement. Other scholars have stated that "parent involvement" and "family engagement" should be used interchangeably (Wong, 2015; Yamamoto et al., 2016). Some definitions of family engagement have included activities like volunteering in the classroom (Baker et al., 2012; Epstein et al., 2002), while other definitions include collaborations between schools, teachers, and the community (Epstein et al., 2002; Henderson & Mapp, 2002; Mapp & Kuttner, 2013). For the purpose of this study, family engagement is defined as an interactive process in which families are centered to support learning for both the adult(s) and the child. This study's definition of family engagement draws from the Department of Education's dual capacity-building framework (Mapp & Bergman, 2019). Further, although there are several accepted models of family engagement in the literature, this

research explores four of the most cited works in this area. The following section introduces four main family engagement frameworks, including making a case for why Mapp and Bergman's work (2019) best fits the goals of this study.

**Epstein's Six Types of Involvement.** Epstein's model described six categories as a framework to support family engagement and increase students' academic achievement in partnership with schools (Epstein et al., 2002). Epstein's model illustrates core family engagement typologies as a guide for schools to produce the desired family engagement outcomes. However, Epstein's model provides no framework for equitable learning opportunities for diverse communities—it falls under the "one-size-fits-all" approach and fails to acknowledge and address the need for engaging diverse and disenfranchised families.

**National Association for the Education of Young Children's Principles of Family Engagement.** The National Association for the Education of Young Children (NAEYC) outlined six principles for effective family engagement in early childhood education. NAEYC's principles sees families as central to children's development, noting that children's learning is connected to their families' participation in the program (NAEYC, 2005, p. 11). A significant challenge of NAEYC's principles is the lack of adoption for early childhood programs. Many are not NAEYC accredited and lack proper training on how to engage with diverse families in diverse settings (Barrueco et al., 2015). NAEYC's family engagement principles appear to be created for specific learning contexts within early childhood sites or programs. Moreover, family engagement implementation for those adopting the NAEYC program might not be effective, particularly among ethnic-racial minority parents.

**Head Start Parent, Family, and Community Engagement Framework.** The Head Start Parent, Family, and Community Engagement Framework (PFCE) described seven family outcomes from Head Start learning programs in partnership with families. The framework outlines guidelines for how the Head Start system can foster knowledgeable and engaged families (Keystone Human Services, 2015). Similar to NAEYC's family engagement principles,

the Head Start parent and family outcomes appear to have been created for early learning sites and program providers, expecting families to engage during learning hours. Despite the great emphasis on family engagement, there is limited information as to how centers design and centered family programs, thus, further research is needed to validate the outcomes.

**Dual Capacity-Building Framework.** Mapp and Bergman's (2019) dual capacity-building framework calls for an integrated, responsive, and sustainable approach for school, teacher, and family partnerships. The framework provides a compass for the development of effective family engagement programs, consisting of four strategies: (a) a description of the capacity challenges that must be addressed to support effective home-school partnerships (the challenge); (b) an articulation of the conditions integral to the success of family-school partnership initiatives and interventions (opportunity conditions); (c) an identification of the desired capacity goals for family engagement policies and programs at the federal, state, and local levels (policy and program goals); and (d) a description of the capacity-building outcomes for families and for school staff (family and staff capacity outcomes).

The first iteration of the dual capacity-building framework created a model to build and enhance the capacity of school staff and family programs by integrating the "4 C" areas: capabilities (skills and knowledge), connections (networks), cognition (beliefs, values), and confidence (self-efficacy; Mapp & Kuttner, 2013, p. 10). The latest iteration of the dual capacity-building framework includes a more comprehensive strategy using research from five key family engagement components: (a) effective home-school partnership strategies, (b) relational trust, (c) parent organizing, (d) adult learning and motivation, and (e) leadership development (Mapp & Bergman, 2019). The updated framework calls for researchers, practitioners, and policy makers to integrate families as part of their children's education decision-making process to challenge the deficit-based perspective of family engagement. This study adopted the dual capacity-building framework as a blueprint to center Latine family voices in equitable, social and

participatory underpinning when designing culturally relevant family engagement activities or programs.

### ***Family Engagement at Home***

Family engagement has played a significant role in a child's learning process throughout history. Bronfenbrenner (1977, 1979a, 1986, 1989b) and Vygotsky (1978a) noted that parents and caregivers are role models for guiding and structuring a child's development. This scaffolding of knowledge is what Vygotsky called the zone of proximal development (ZPD). The ZPD is defined as "the distance between the actual developmental level as determined by independent problem solving and the level of the potential development as determined through problem solving under adult guidance" (Vygotsky, 1978b, p. 86). Therefore, home is a major ecological setting for family interactions to help foster children's growth and learning.

When adults and children collaborate in building knowledge and learning, adult-child relationships are optimized as a support system—social interaction enhances the learning process (Vygotsky, 1978b). Therefore, family engagement at home sets the tone upon which a child engages in learning throughout their life. This is especially true for children from low-income families who face a higher likelihood of early learning developmental risks and barriers to their academic development (Cartmill et al., 2013; Crosnoe, 2012; Halgunseth et al., 2009). Similarly, Manz et al.'s (2014) study found that parent-child interactions with home-based activities, such as playing educational games, fostered strong family engagement practices with children ages two and three years old. The study suggested that parents understand how important it is to nurture children's early learning from a young age.

The earlier families can make connections between home as a learning environment and learning development, the more likely children will improve early learning skills, such as literacy and math development. In fact, many in the field of family engagement view parents and caregivers as their children's first teachers at home (Berger, 1991). Early research, like that by Miedel and Reynolds (1999), revealed the greater the frequency of family engagement in

kindergarten in school activities like classroom volunteering, the higher the reading achievement scores in kindergarten readiness. Miedel and Reynolds argued that home learning environments and parent engagement play a critical role in fostering children's development. When learning is reinforced at home, children will have greater positive learning outcomes.

Moreover, Crosby et al. (2015) examined parents' reading, rhyming, and wordplay interactions at home with their kindergarten children. Children whose parents implemented the strategies and resources given by the program had positive gains in literacy achievement compared to the children who did not participate in the study. Ozturk et al. (2016) further examined children's attitudes towards literacy from a social constructivism approach in family literacy contexts. The study revealed that frequency of parental engagement in reading books to their children was positively correlated with children's literacy readiness.

The positive effect of parent-child interactions in language and early writing skills is further emphasized in Bohart et al.'s (2014) research, noting the role families play in engaging their children in conversations contributes to early literacy skills and increases children's school readiness. Adamson et al. (2014) also investigated the relationship of joint engagement in parent-child interactions during early childhood to promote early literacy skills. The study highlighted the crucial role that parents play during a child's first conversations to develop language skills. Results like this have prompted scholars to consider the importance of contextualizing at-home learning to support children's academic outcomes.

Hirsh-Pasek et al.'s (2015) research further emphasized what several other studies have suggested regarding the importance of child-adult relationships for early learning. Their research examined the effects of mother-child interactions, including activities like shared book reading, language variation like gestures and patterns of communication, and verbal and nonverbal acts. The results confirmed that the quantity of input and quality of the adult-child relationship predicted later language ability. According to Hirsh-Pasek et al., the powerful contribution of adult-child relationships at home is layered within ecological environments

(Bronfenbrenner & Morris, 2006). From infancy, positive adult-child relationships shape a child's way of learning and life journey within social and cultural family contexts.

### ***Family Engagement and Partnership with Schools***

Studies such as that of Walker et al. (2010) have contended that schools, families, and community relationships are critical for supporting family engagement. This is necessary to maintain, develop, and sustain children's academic outcomes. The practice of family engagement creates a common ground for positive, long-term effects on children, especially for those living in low-income communities. Therefore, family engagement is also central to family-school partnerships, especially when children look up to parents and caregivers as the main source of education and school information (Epstein et al., 2002).

Hindman and Morrison's (2011) study examined the nature and extent of family engagement in partnership with teachers' outreach in the home. The study revealed preschool children's reading and vocabulary skills increased when parents and caregivers were involved at home teaching letter sounds and reading words in partnership with teachers. Further, children demonstrated positive attitudes toward learning based on the encouragement families received from the educators visiting their homes. Equally important, Sheridan et al. (2010) examined the school social-emotional readiness and outcomes of children aged 0-5 from disadvantaged backgrounds. The study revealed that family intervention programs in school settings and partnerships between teachers and administrators could significantly enhance positive gains in interpersonal competence in young children, promoting long-term school success.

Further, Crosnoe's (2012) research also pointed to family engagement as a key to reducing performance disparities. The study results indicated that children with high parent engagement were associated with significant reading gains. In contrast, children with one-sided engagement, from school, tended to be more at risk and disadvantaged, unlike their more affluent peers. Further, Moore et al. (2016) investigated the positive effects of family engagement when schools created proactive programs to establish trust with families. The

findings of this study argued for more school and family partnerships to build an influential, collaborative culture to support students' well-being and academic success. The study revealed that higher levels of family engagement are associated with students' positive educational outcomes—as parental involvement in education increased, so did children's academic outcomes. It is important to note that for programs like this to be effective, schools should integrate culturally relevant pedagogy and provide families with program structures (Benner et al., 2008).

Furthermore, Mendez's (2010) study noted that families who engage in teacher collaboration in school settings, like reading in a child's classroom or attending class, were highly associated with children's increased vocabulary and overall school readiness. Patterns of family engagement have several implications for parent-school partnerships, especially for Latine families whose parent participation might not be as visible. McWayne et al. (2013) examined culture-specific dimensions of family engagement in preschool children's education to provide a reliable and valid measure for Latine family engagement in Head Start programs. The survey results yielded four culturally salient dimensions of family engagement, which shows evidence that family engagement plays an especially vital role in the lives of Latine children.

Further impact on family engagement and partnership with schools is described in Peercy et al.'s (2013) study on English language learners. The study found that when parents, students, teachers, and other school personnel collaborated as part of a community of practice for an afterschool program, Latine student English proficiency increased and the home-school collaboration was more effective. According to the authors, the community of practice developed for the elementary afterschool program brought together families, teachers, and other adults who otherwise would not have come together to understand and support English language learners' development (Peercy et al., 2013). These adults formed "relationships and commitments" that "carried over into school activities, strengthening the support and interactions that ELLs and their families participated in during school" (Peercy et al., 2013, p. 295).



Encouraging positive relationships between schools and families will empower parents to advocate for their children, especially Latine families. Latine families are more likely to have less sense of belonging in school settings and are less likely to feel prepared to support their children's academic lives. When schools encourage and establish family engagement strategies and programs that recognize parents and caregivers as equal partners in the children's learning process, children will receive greater support to succeed academically, both at home and in school settings. School, family, and community partnerships are needed to provide support to families and children with resources and services to help mitigate education disruptions in a young child's life and education.

### ***Family Engagement in the Community***

A growing body of evidence shows that meaningful family and community engagement improves school readiness, academic achievement, and graduation rates (Barnard, 2004; Crosnoe, 2012; De Gaetano, 2007; Mapp & Kuttner, 2013; Moore et al., 2016). However, neighborhood structure tends to influence disenfranchised communities with overwhelmingly underfunded schools and low educational attainment (Wen et al., 2003). Families living in these neighborhoods face limited learning experiences for their children, and differences in a child's early learning experiences play a crucial role in shaping the young child's school readiness. Neighborhood and community matters. Community partnerships and access to resources and services can help improve education disruptions in lifelong learning.

Riojas-Cortez and Flores (2009) asserted that partnership collaborations between varied community organizations can reinforce multidimensional relationships to support families and children's learning at home and in the community. Riojas-Cortez and Flores' study examined the relationship between a low-performance preschool, a university, and teacher collaborations to support early literacy skills in Mexican American children. The study addressed the importance of integrating culturally responsive pedagogies by working with Mexican American and Mexican parents using their cultural practices. Parents engaged with their children in reading *cuentos*

(stories) to reflect storytelling and writing. The study also validated the ecological systems theory framework by finding positive community partnership results between teachers, families, the preschool, and the university.

Riojas-Cortez and Flores' (2009) research illustrated that family engagement intervention programs can significantly enhance positive gains in interpersonal and academic competence in children when taking into account the fluid and multidimensional aspects of culture. Similarly, De La Garza and Kuri (2014) examined the partnerships among a university, Latine community organizations, and public schools to improve Latine student literacy achievement. The study followed a community service model for collaboration. When the university, community organizations, and public schools came together to support families, parents were found to have a better grasp of home literacy experiences. One of the study's implications was the need to adapt culturally relevant books and lesson plans for Latine students—arguing for the need to view learning as a cultural process (Nasir et al., 2006). The study demonstrated that community partnerships are a critical component of family engagement programs.

The proven impact of evidence-based community engagement initiatives and the amplifying power of family involvement in children's learning calls for community partnerships to promote academic and emotional health for both the student and the parent (Dotson-Blake et al., 2009). In considering the desired changes for families and children using the ecological systems framework, Singh et al. (2015) highlighted the importance of community organization collaborations for long-term children's educational implications. The study examined how library programs, literacy coalitions, and the Central New York community assisted refugee families to increase children's school-based education. The study provided an example of service delivery models for family engagement support in nontraditional, ethnically diverse settings. Community partnerships are the extra support a family needs to continue to strengthen their engagement practices and view involvement as an asset.

To approach family engagement with a transformative method, community organizations and members should be part of a deliberate and collaborative process (Henderson & Mapp, 2002). Through community interventions and in partnership with local organizations that advocate for and benefit children in need, Public Broadcasting Service stations have approached family engagement from an ecological systems approach, supporting disenfranchised families and children facing severe educational barriers (Balfanz et al., 2013). Local public stations bring together community organizations like libraries, cultural and community centers, and housing authorities to support children's academic outcomes in schools (Balfanz et al., 2013; Education Development Center, 2019).

In a Corporation for Public Broadcasting report by the Education Development Center (2019), community organizations and families reported family engagement programs increased overall through the partnerships, with 83% of partner staff reporting being able to provide more services for the same families over time. The development of lasting community partnerships with organizations like Head Start and school districts helped engage families to be their children's first teacher and greater advocate in their community (Balfanz et al., 2013; Education Development Center, 2019). Community partnerships play a vital role in effective family engagement, and children living in neighborhoods with limited or no resources can benefit from community partnerships (Henderson & Mapp, 2002).

### ***Co-Design Approaches for and with Families***

Co-design approaches have roots in participatory design methodologies and often represent human-centered design methods (Casper & McWilliams 2019; Costanza-Chock, 2020). At the core, co-design approaches acknowledge participants when designing artifacts, activities, or tools (Sanders & Stappers, 2008). Co-design also seeks to change participants' epistemic agency by centering and amplifying participants' experiences, cultures, and beliefs by co-designing or co-creating an artifact or activity for and with other people (Khan & Beltran Grimm, 2020).

Traditional approaches involve researchers, program providers, curriculum writers, and designers creating resources to test and ask for feedback, but co-design approaches equalize the relationship between the participants and the researcher (Casper & McWilliams 2019; Holliday et al., 2015). According to Bang et al. (2012), we must design with a "desettling frame" that pushes us to think beyond the "normative knowledge-power paradigm[s]" (p. 314). Bang et al. (2016) called for educators to recognize that learners of all ages bring various learning repertoires to the table—assets, values, culture, and everyday practices.

This is evident in Morris et al., (2019) research study of co-design methodologies for a parenting program in Australia. Their research focused on examining how co-design approaches engaged and empowered families by engaging them in the co-creation of sessions and content for the parenting program. The study found that co-design approaches helped reframe the parenting program from service delivery to a service system that contextualizes services to meet parents' needs. Similarly, Westerlund et al., (2003) research positioned families as design partners for the "development of IT artefacts to be used for communicating within families" (p. 1). The study provided a lens to understand families' cultural "situation, desires, and needs" (Westerlund et al., 2003, p. 5) by intentionally and meaningfully identifying families' experiences and desires and adapting this into a collaborative design approach to develop a tool for families.

Furthermore, Booker & Goldman's (2016) study explored co-design processes for systemic transformation to "repair" family engagement barriers. The researchers observed participants through a four-year timeline where families engaged in co-design approaches with "teachers, scholars, students, community organizers, curriculum designers, and a mathematician" (p. 224) to explore math learning experiences. Their study found that when families were provided with opportunities to exercise their knowledge, barriers to participation in formal school math decreased as families developed a greater agency as a sustainable and realistic solution to systemic barriers of family participation in traditional school settings.

Co-design then can be understood as a process to “collective creativity as it is applied across the whole span of a design process” (Sanders & Stappers, 2008, p. 6) to engage the community as co-researchers and co-designers, spending time in “their space, learning about needs, and working together through all stages of design” (Costanza-Chock, 2020, p. 98). Therefore, narratives of family engagement must include families drawing connections between their historicity and their everyday experiences, to provide a lens to explore co-design approaches for family engagement beyond traditional family engagement practices. As family engagement continues to be a topic of discussion for research, practice, and policy, more research is needed to understand co-design methodologies as integral in family engagement innovations, especially for the emergent field of family math. The following sections discuss math literacy research and the emergent field of family math.

## **Math Literacy**

### ***Early Childhood and Mathematics***

Early childhood development theories have laid the foundation for the field of early childhood education, from classical learning theories by behaviorists, cognitivists, and humanists like Skinner (1953), Piaget (1957), Dewey (1963), and Vygotsky (1978a) to the father of preschool and kindergarten, Friedrich Froebel. Froebel's influence on early childhood pedagogy goes beyond establishing the first early learning centers. His philosophy included the understanding of early mathematics as an essential element of early childhood pedagogy (Clements & Sarama, 2014). These early pioneers held the common belief that child development is prescribed in three domains—physical, cognitive, and social and emotional—and growth in one domain influences the other domains (Penn & Kjørholt, 2018). Over the past decades, researchers have found that children can develop strong mathematical foundations and competence at an early age (Clements & Sarama, 2014).

Children's initial mathematical competence was evident in Wynn's (1998) study of knowledge of numbers. Wynn argued that children can individuate and enumerate counting

principles. Children "are not only sensitive to number[s]; they can also engage in numerical computation" (Wynn, 1998, p. 296). According to Piaget (1957), children actively construct an understanding of the world through experiences. Piaget emphasized cognitive development as active selection, interpretation, and construction of knowledge—learning is more likely to happen when subjects are compared and related to existing knowledge (Powell & Kalina, 2009). Piaget's social constructivism idea is similar to Wynn's "puppet" experiment, where young children watched puppets hop in patterns of two and three jumps. Children identified the jumps and the numerical attributes in the puppets' actions.

Research has also shown that early numeracy skills are a strong entry point for children's later success in mathematics (Claessens et al., 2009; Claessens & Engel, 2013; Duncan et al., 2007). Gersten and Chard (1999) defined early numeracy skills in children as the "child's fluidity and flexibility with numbers" (p. 19). Claessens et al. (2009) further noted that knowledge of numbers and ordinality in the early years is highly predictive of fifth-grade math skills. Similarly, Kern and Friedman (2009) asserted that mathematical knowledge and achievement at a young age predicts later academic performance more than reading abilities or socioemotional development and also predicts later success in children's professional, financial, and personal wellbeing. Consequently, children with a strong start in math by age five become critical thinkers and problem solvers—and are more likely to have a bright future ahead of them.

For the purpose of this study, math literacy is defined per the Organization for Economic Co-Operation and Development as "an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgments and to engage in mathematics..." (Lemke et al., 2004, pp. 22–23) and is concerned with "students' capacities to analyze, reason, and communicate ideas effectively by posing, formulating and solving mathematical problems in a variety of domains and situations" (Lemke et al., 2004, pp. 22–23). Therefore, the preschool years are optimal for children's development in three areas: social and emotional, physical, and cognitive. Children also go through developmental

milestones: a series of practical proficiency or age-specific tasks that most children can perform within a specific age range (NAEYC). In early learning pedagogy, the developmental milestones for children ages 3-6 are as follows based on the California Learning Foundations Volume 1 (California Department of Education, 2008):

- Social and emotional development: Children learn to identify feelings of self and others. Independence and self-worth motivate children to accomplish more.
- Language and literacy development: Children begin to listen, speak, and communicate with others. Children gradually learn grammar and pronunciation rules and exceptions.
- English language development: Children can master different languages because of early development. Children develop standard oral and literacy skills by using names correctly, using language during snack time, and using cultural greeting songs.
- Mathematics development: Children develop mathematical reasoning, using thinking skills for problem solving, judgment, and reasoning in play and everyday activities.

Further, the NAEYC and the National Council of Teachers of Mathematics (NCTM) have created recommendations for early math content areas: number and operations, geometry and spatial sense, measurement, and data analysis and probability (Copely, 2010; NCTM, 2006). The following section describes the five major early mathematical skills for children before they enter kindergarten.

**Numbers and Operations.** Number sense is a group of skills, including the ability to recognize relationships, make comparisons, and understand quantities, symbols, and order of numbers (Groffman, 2009; Vukovic, 2012). Gersten and Chard (1999) also noted that number sense has been compared to phonological awareness in reading development. Similar to how early literacy skills and exposure to books at a young age impact the development of reading skills, early exposure to math concepts can be an important contributor to future success in children's mastery of mathematics (National Mathematics Advisory Panel, 2008; Platas, 2012).

**Geometry and Spatial Sense.** Shape attributes and relations are a foundation for a child's awareness of space, movement, and pattern recognition (Copely, 2010; NCTM, 2006). Further, according to Clements and Sarama (2011), "Geometry and spatial thinking are often ignored or minimized in...early education" (p. 133) and sometimes math learning is equated to just counting (Clements & Sarama, 2011). International achievement data from the International Mathematics Report by Martin et al. (2004) showed that eighth-grade students' performance must improve to be on a par with the students in the highest-performing countries of the world. Knowledge of geometry is essential to expand children's learning through the years for academic success.

**Measurement.** Measurement is all about quantity—how much? Or how long? Measurement skills help children describe their world using words to estimate and compare (Copely, 2010). Further, learning about measurement helps children relate to real-world situations and bridge geometry learning to real numbers (Clements & Sarama, 2011; Platas, 2014). Early mathematical learning is critical through high-quality teacher-child interactions and family interactions. It is critical for adults to model measurement conversation and actions.

**Data Analysis and Probability.** Data analysis and probability supports children's understanding of collecting and organizing information and teaches them to represent that information graphically (Copely, 2010; NCTM, 2006). In this domain, adults should focus on teaching children how to solve problems and answer questions with data. Data analysis and probability skills are critical for children, as they also relate to real-life situations. Children should be able to understand the question, form a hypothesis, collect data, test and analyze the data, and present answers (Platas, 2014).

It is vital to understand early childhood theories and pedagogy approaches to support children's potential for learning and engaging in mathematics. Interest in early mathematics has increased in the United States in the past decades due to a lack of math proficiency in children. The early math knowledge gap is most pronounced in children living in low-income



neighborhoods, which face low-quality school instruction and lack of community access to educational resources (Children Now, 2018, 2020; Gándara & Contreras, 2009; Lee & Bowen, 2006; Suarez-Orozco et al., 2015; Suarez-Orozco & Suarez-Orozco, 2013). According to Children Now (2018), California students—particularly Black and Latine—are not meeting grade-level expectations in math and science.

In California, only 39.7% of students in grades 3<sup>rd</sup> to 11<sup>th</sup>, met the math standards on the California Assessment of Student Performance (California Assessment of Student Performance and Progress, 2019). Moreover, fewer than 10% of low-income children can count to 20 in preschool, a skill that correlates to the strongest math achievement in first grade (Sparks, 2017). This lack of early educational opportunity manifests in achievement score gaps as early as age five (Sparks, 2017). Fortunately, effective early math interventions like home learning environments can positively influence children’s mathematical knowledge and skills (Anders et al., 2012).

According to the National Research Council (2009), mathematics hasn’t been considered a high-value outcome for preschool compared to elementary school. Yet, there is consensus that early mathematics is necessary in the preschool curriculum and pedagogy as evidenced by the creation of the five essential domains in the Head Start Child Development and Early Learning Framework (United States Office of Head Start, 2016), the NAEYC, and the NCTM recommendations for early math content areas (Copely, 2010; NCTM, 2006). Further, mastering math at an early age sets children up for later life success regardless of race, gender, or family socioeconomic status (Kern & Friedman, 2009).

However, for many families, especially from disenfranchised communities, teaching or participating in their children’s math learning can be uncomfortable and creates a conduit of math anxiety for both the parent and the child (Civil & Bernier, 2006; Lopez & Donovan, 2009). Similarly, researchers with the Center for Childhood Creativity summarized, "Currently, parents and caregivers are far more comfortable supporting their children’s literacy development—

reading with and to their young children—than incorporating STEM learning at home" (Hadani & Rood, 2018, p. 3). Further, early childhood education views childhood learning as independent of adult learning. Yet learning together in adult-child relationships is fundamental for a child's lifelong learning.

Similar to Vygotsky (1978a), Bandura's (1977) social learning theory views adults as active information processors--children learn by observation and imitation. Bandura suggested that the observational process is a model for reciprocal interaction between the person, the behavior, and the environment (Bates, 2019). Children learn by observing others' behavior, attitudes, and outcomes of those behaviors. According to Bandura (1976), "Most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed...this coded information serves as a guide for action" (p. 22). Therefore, by viewing family engagement through the lens of early childhood development theories, the scope of childhood development can be understood as a process of reciprocal interactions between human beings—in this case, between the parent and child.

### ***Family Math***

Family math can be a turning point to support children's learning and development. According to Clements and Sarama (2014), educators can build mathematical learning environments when integrating learning trajectories. Scholars assert that learning trajectories consist of three parts:

- a mathematical goal;
- a developmental path along which children develop to reach that goal; and
- a set of instructional activities or tasks, matched to each of the levels of thinking in that path that help children develop higher levels of thinking (Clements & Sarama, 2014).

Spitler (2011) further elaborated on teacher's math learning trajectories by suggesting that educators need to develop a literacy identity within the context of teaching mathematics. While

developing a math literacy identity is important as a pedagogy for teachers, it also fosters math identities in children (Clements & Sarama, 2011; Spitler, 2011).

Berkowitz et al. (2015) noted that parents who engaged in number talk with their preschool children predicted their four and five year old's' grasps of foundational number concepts. Additionally, the frequency with which parents talk about shapes and spatial math concepts also predicts children's spatial thinking, an important component of mathematical success as they enter kindergarten (Berkowitz et al., 2015). Similarly, Zippert and Rittle-Johnson (2020) emphasized the home learning environment for the development of numeracy in children. Their study found that families engaged in numeracy skills multiple times a week through activities such as math talk and playing games involving patterns.

Effective early math interventions like home learning environments can positively influence children's mathematical knowledge and skills (Anders et al., 2012). Booker and Goldman's (2016) study analyzed epistemic authority, exercising the right or the power to know, as a form of agency for families to advocate for their children's math learning. This is especially true for Latine children. Latine young children remain a disadvantaged group facing several educational disparities. At the preschool and elementary levels, Latine young children are disproportionately more likely to have low reading and math levels compared to their White peers (Hoff, 2013; Murphey et al., 2014).

Lopez et al.'s (2007) study evaluated different parent engagement models to understand the effect of complex, interacting systems on desired parent engagement outcomes for preschool math learning. The study demonstrated that parent engagement has an overall impact on a student's achievement in long-term practice. The research further suggested that Latine children's mathematics performance is influenced by parents' previous exposure to math, whether positive or negative. What is not clear is whether parent engagement directly impacts students' test scores or grades in the short-term.

Furthermore, Lopez et al.'s (2007) longitudinal study observed 73 young Latine children and their families to research the mathematics achievement of Latine students. The study's data collection consisted of project interviews with parents to find out about their children's math achievement. The study revealed that students whose mathematics performance started in early years remained stable in elementary and middle school. Meanwhile, students exhibiting low levels of math performance continued in the low-rank order in middle school that they had in first grade. Results such as these suggest that family engagement is deeply interconnected with larger social systems that can profoundly affect the lives of children without an explicit, direct relationship with the child.

González et al.'s (2001) study further revealed how mathematics can be "uncovered" in home contexts, even if families may not have math experience and knowledge. Their research also used the funds of knowledge approach to help families recognize how their prior learning experiences scaffold for new math learning with their children, in this case mothers using their sewing skills to teach fractions and patterns. Additionally, Cheadle's (2008) study found that family engagement was related to children's early math achievement, especially for children who came from non-English-language homes. However, Cheadle noted that family engagement in supporting math academic developmental processes may decline as math becomes more complex in middle and high school.

Yet, Napoli and Purpura's (2018) research emphasizes family learning environments as critical hubs to support children's math literacy development. Their study investigated parent-child numeracy practices and children's academic outcomes. When families engaged with children by reading math books, children's understanding of math numeracy and literacy increased (Napoli & Purpura, 2018). Enhancing the opportunities for children to gain skills in math in their early years will provide children with the long-term benefits of improved literacy and math skills and the likelihood of graduation from high school (Halgunseth et al., 2009).

A learning climate has the power to improve children's intellectual health when combined with parent engagement. Thus, when parents and children interact about math story problems—even as little as once a week—children show increased math achievement by the end of the school year. The benefits of math-related interactions are especially apparent for children whose parents are anxious about math. By providing an engaging way for math-anxious parents to share math with their children, a math app may help cut the link between parents' high math anxiety and children's low math achievement (Berkowitz et al., 2015).

However, out-of-school activities can help parents and caregivers develop math awareness and have less anxiety in making mathematical connections for their children (Lopez & Donovan, 2009). Recent recommendations include implementation of family math nights, which are a combination of events hosted in schools, community organizations, or libraries (Furner, 2018; Hodge & Lawson, 2018; Jacobbe et al., 2012; Lopez & Donovan, 2009). The goal of family math nights is to have families engage in math activities together to develop math skills and positive attitudes towards math (Lachance, 2007). Lopez and Donovan (2009) further noted that family math nights also help schools create positive family-school partnerships. When schools prioritize family engagement through family nights, families feel better about their abilities, create awareness around their children's learning, and feel more empowered to support learning in the home (Furner, 2018; Hodge & Lawson, 2018; Jacobbe et al., 2012; Lachance, 2007; Lopez & Donovan, 2009). While effective adult-child interactions at home are critical for children's language development, school-parent collaborations across settings are also needed in partnership with family engagement practices to support positive child development. Lawson and Alameda-Lawson's (2012) study results demonstrated that when families recognize how important it is to help their children and partner with the school, they can make more meaningful contributions to the education of their children.

Instead of adults being distant observers of children's learning and social and emotional experiences, mutual engagement, exploration, and meaning making can influence and

accelerate a child's social and cognitive achievements. Family math nights can provide parents with strategies and activities that can continue to be reinforced at home. Chan et al. (2020) investigated parental engagement across play activities with their children. The study revealed that both parents and children engaged in mathematical conversations during the play sessions, bolstering the above research—families can support children's early mathematical thinking and development by creating a connection between formal and informal education. Although early childhood education is not the same as adult learning education, both the child and adult engage in social constructivism to support an active learning approach; in the same way, both Piaget and Vygotsky thought of play as cognitive development (Lourenço, 2012). Considering the implications of the above research, it is important to understand family engagement practices, especially the strong connection between at-home learning and formal education.

### **Summary**

Chapter 2 has reviewed research that establishes the importance of understanding how Latine families define their role, language, social networks, and prior educational experiences to their children based on their history in the United States. This chapter also reviewed family engagement literature to provide a spectrum of how family engagement opportunities impact children with the long-term benefits of improved literacy and math skills, particularly to support Latine young children. In particular, in math literacy, the literature reveals that early exposure to math concepts can be an important contributor to future success in school and life for young children (National Mathematics Advisory Panel, 2008; Platas, 2012).

Further, while there is a vast ecology of family engagement research recognizing a direct correlation between parent-child interactions (Adamson et al., 2014; Guerrero et al., 2013), there has been few studies done on family engagement with co-design approaches for early math learning to move family engagement beyond traditional frameworks such as Epstein et al.'s (2002) Six Types of Involvement. Additionally, there is few research on parents' mathematical identities and self-efficacies and how they relate to the mathematical identities of

their children through co-design approaches. Therefore, there is a clear need for further investigation on how Latine families engage in co-design approaches to acquire mathematical concepts based on their funds of knowledge and lived experiences through the participation in co-design workshops.

### Chapter 3: Methodology

This chapter presents a detailed outline of the study design, including the research paradigm and philosophical frame used to guide this study, the researcher's positionality, sources of data, data collection methods, instruments, ethical considerations, data analysis, and finally limitations and delimitations of this research. The focus of inquiry guiding this study was to explore how co-design workshops are perceived by Latine families while engaging in the co-creation of math activity for their children, from the lens of culturally relevant mathematical knowledge and experiences. The overarching aim of this study was to be exploratory and aimed at unearthing assumptions of funds of knowledge in families, placing participants as experts of their own mathematical experiences to co-design and co-create a math activity for their children.

A comprehensive review of the literature indicated there has been little to no research that explores the experiences of Latine families with co-design approaches that go beyond the traditional, school-based family engagement practices. Much of the previous research examining co-design approaches has focused on healthcare co-design with and for patients (d'Young et al., 2014; Holliday et al., 2015; Larkin et al., 2015; Pallesen et al., 2020). Thus, this study aims to contribute to an understanding of the development of co-design approaches for Latine family engagement in one city in Southern California.

This study explored the need for broadening Latine families' engagement, specifically to create cultural, authentic, and meaningful mathematics learning experiences to expand the definition of what math is and who can do math. The study also used the theoretical framework defined in Chapter 2 to support the study's analysis on Latine families' perspectives. The theoretical framework guiding this study is based on the ecological systems approach and further enhances that approach by utilizing funds of knowledge and connected learning design principles to complete the framework that explores the unique lived experiences of immigrant, Latine, Spanish-dominant families in co-design workshops. To that end, this study was guided by the following research questions:



1. How do Latine families create math learning experiences for their children?
2. What perceptions do Latine families hold of math co-design approaches?

### **Research Design**

In order to comprehensively address the above questions, a qualitative phenomenology research approach was implemented with co-designed methodologies to explore Latine families' funds of knowledge with mathematical concepts through interviews and explore their lived experiences in co-design workshops. This study did not intend to quantify the conceptualization of mathematics learning from families, but rather, the researcher offered a description of the affordances and constraints of Latine families within their cultural context as they participate in co-design workshops. Therefore, a qualitative methodology approach was appropriate for the interpretive nature of this study.

According to Creswell (2013) a qualitative approach "begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem" (p. 44). This approach adds to the inductive and empathetic components of qualitative research, which seeks to understand an issue within social and human contexts (Creswell, 2007). Qualitative research then gives a voice and meaning to participants' life experiences, including the researcher (Maxwell, 2013) as a means to explore "how people interpret their experiences, how they construct their world, and what meaning they attribute to their experiences" (Merriam, 2009, p. 23). This is not to say that qualitative research is purely subjective. However, it provides a space for a more in-depth interpretation of cultural and historical phenomena not specifically quantitative in nature (Creswell & Creswell, 2018; Maxwell, 2013; Vogt, 2007).

Additionally, this study utilized Maxwell's (2013) interactive model of research design to conceptually map the design of this study. Maxwell provides a research model as a framework to explore participants' and the researcher's experiences. It includes: (a) a clear research structure to use as a guideline, (b) a system to "explicitly" identify the methods to generate a

clear research decision, and (c) an "emphasis" on connected networks as interpretive and interactive narratives to the design approach.

More specifically, this qualitative research study adopted a phenomenological approach to provide a rich description of participants' lived experiences. Phenomenology seeks to make meaning of human life experiences embedded in common daily life practices (Smith et al., 2009). Moreover, phenomenology seeks to understand the essence of human experiences as conceptualized in the participants' awareness about a phenomenon they describe (Creswell & Creswell, 2018; Mohajan, 2018). Through this method, the complex experiences of participants can be translated into patterns and relationships of meaning (Merriam, 2009; Smith et al., 2009). Furthermore, Ponterotto (2005) explained that within a constructivist paradigm, the researchers and participants share a combined reality of the research process.

Therefore, a phenomenological approach was the most appropriate method to gain insight on how Latine families co-design and co-create mathematical learning artifacts and environments for their children. Through a phenomenological approach, the researcher explored everyday funds of knowledge that participants use to make sense of how they learn and how they bring their "essence" to a co-design workshop on mathematics. That is to say, every participant has a unique way of viewing the world, particularly in how they construct their knowledge (Lopez & Willis, 2004). Thus, a constructivist philosophical foundation also emerged as a natural fit for this phenomenological study.

### **Research Paradigm and Philosophical Considerations**

Phenomenology was originated by Edmund Husserl (1889-1938), whose phenomenological ideas were based on the philosophical tenets of understanding and ascribing meaning to the activities and behavior of humans (Lester, 1999; Qutoshi, 2018). While Husserl's approach was more descriptive, aimed at exploring the everyday life of humans (Pietkiewicz & Smith, 2012), Martin Heidegger (1889-1976) diverged from descriptive phenomenology and approached phenomenology from an ontological view—in which individuals construct and

interpret their interactions in their world and reality. From this point forward, phenomenology also adopted a social constructivism approach with Peter L. Berger and Thomas Luckmann. According to Berger and Luckmann (1966), individuals construct their experiences as shaped by social interactions and lived experiences with other individuals.

This study was informed by a phenomenology methodology within a constructivist paradigm—the researcher and participants were interactively linked, and findings were created during the research process. Integrating a constructivist philosophy with a phenomenology methodology rests on the assumption that both approaches argue for sense-making within multiple contexts and realities, with constructivism describing how learners construct knowledge, while phenomenology seeks to understand how lived experiences and social relationships affect the understanding of a phenomenon (Broido & Manning, 2002; Smith et al., 2009). Schwandt (1994) further emphasized this point by stating that “human beings do not find or discover knowledge so much as construct or make it” (p. 237).

The study’s constructivist epistemology is also aligned with the connected learning framework in that it is inclusive of participants’ voices as social negotiations of meaning to support learning across different contexts (Ito et al., 2013). A constructivist epistemology for this study took into consideration the conditions of learning for Latine families and will “enable the researcher to develop a level of detail about the individual” (Creswell, 2003, p. 181) to explore how Latine families view their constructions of math knowledge in their everyday routines and through co-design workshops (Ishimaru et al., 2018; Ponterotto, 2005).

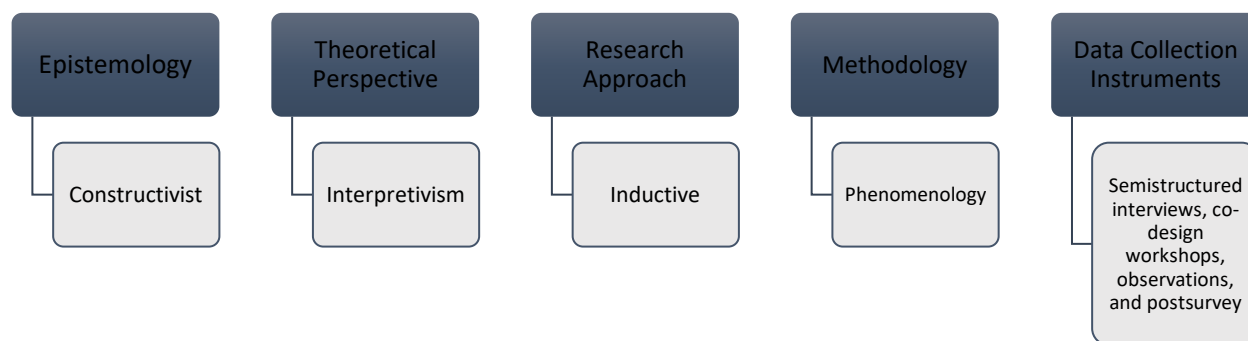
### **Phenomenology: Research Approach**

Phenomenology is the qualitative methodological approach for this study. Phenomenology research has two different branches: hermeneutic and transcendental (Creswell, 2007). For the purpose of this study, a hermeneutical phenomenology approach was chosen as the researcher sought to provide not only a description but an interpretation of the lived experiences of Latine families during the research process (Creswell, 2007). Interpretive

phenomenological analysis (IPA) was used as an extension of phenomenology (Smith et al., 2009). IPA, according to Pietkiewicz and Smith (2012), is used in studies examining how participants make meaning of their experiences. Smith et al. (2009) further emphasized this point by arguing that “IPA researchers are...interested in what happens when the everyday flow of lived experience takes on a particular significance for people” (p. 1). Therefore, interpretive phenomenology served to facilitate the revelation of information that might not be immediately visible during the co-design workshops (Smith et al., 2009).

Further, this research incorporated interpretivism as a methodological perspective. According to Gray (2014), positivism and interpretivism are the most commonly used theoretical perspectives when conducting qualitative research. Per Crotty (1998, as cited in Gray, 2014), interpretivism argues for a “culturally derived and historically situated interpretation of the social life-world” (p. 23). An interpretivist theoretical perspective is well suited for this study since it also argues for the construction of knowledge where no single reality exists for the participants’ experiences (Gray, 2014). Additionally, the interpretivism approach also aligns well with the theoretical framework for the study described in Chapter 2. Ecological systems theory, funds of knowledge, and connected learning frameworks all seek to understand how relationships and knowledge are intertwined, embedded, and constructed within history, culture, and everyday experiences. These external forces are part or larger social systems that can profoundly affect the life of a child even without direct relationships.

To pursue this approach, an inductive research approach was utilized during data collection and analysis (Merriam, 2009). The researcher organized the data to made sense of patterns and analyzed Latine families' lived experience in the co-design workshops to make new meaning of Latine families were centered as adults learner-centered to make sense of how they constructed mathematics knowledge and engaged in co-design approaches. Figure 3 provides a description of the research process, which includes epistemology, theoretical perspective, research approach, methodology, and data-collection instruments.

**Figure 3***Description of the Research Process***Positionality**

The researcher of this phenomenology study states her positionality as a "stance or positioning...in relation to the social and political context of the study—the community, the organization or the participant group" (Coghlan & Brydon-Miller, 2014, p. 628). This positionality also informed my theoretical assumptions and lived identity as a Mexican woman. The researcher's inquiry has evolved out of years of work with Latine families and a personal connection to this content and the families of this study. I was born in Mexico and immigrated to the United States when I was 14 years old. My first language is Spanish, and I am also a first-generation college student. I was raised by my immigrant and working-class sister in a neighborhood with limited educational and community resources. I have experienced firsthand the challenges of navigating the educational system, but I am also aware that my higher education background has afforded me some privileges that could make me an outsider to the families in this research study.

Furthermore, the researcher's perceptions, experiences, expectations, cultural understanding, and beliefs specific to Latine and Spanish-speaking families have been shaped over the past 15 years through the researcher's own educational and professional journey. I have worked in the nonprofit and education sector for the past 12 years serving high-need and Latine families. I have also experienced firsthand the challenges many Latine families face

every day in trying to support their children's education. All of these experiences and my identity as a Mexican woman can be an asset in centering Latine families' voices, but I am also aware that my positionality can be a limitation. As the researcher, I tried to be conscious of the insider-outsider dichotomy, and I kept in mind Chavez's (2008) framework (Table 1) of advantages and complications when conducting this research study.

**Table 1**

*Methodological Advantages and Complications of Insider Positionality*

<b>Advantages to Insider Status</b>	<b>Complications to Insider Status</b>
	Positionality
<ul style="list-style-type: none"> <li>● A nuanced perspective for observation, interpretation, and representation</li> <li>● An equalized relationship between researcher and participants</li> <li>● Expediency of rapport building</li> <li>● Immediate legitimacy in the field</li> <li>● Economy to acclimating to the field</li> </ul>	<ul style="list-style-type: none"> <li>● Unchecked insider status that can complicate or overwhelm researcher role</li> <li>● Overidentification or overreliance on status that obscures researcher role or goal of research</li> <li>● Social roles in group or community that constrain researcher role and objectives</li> <li>● Expectation to participate in community events or affairs</li> <li>● Overwhelming exchange or reciprocity requests from participants</li> <li>● Requests to take sides in community political or moral issues</li> <li>● The rise of value conflicts as a result of research and community member role</li> <li>● Compromised professional ethics and/or research results</li> <li>● Participants' perceptions and expectations coopting or constraining researcher role</li> </ul>
	Access
<ul style="list-style-type: none"> <li>● Expediency of access</li> <li>● Access to more in-group activities</li> </ul>	<ul style="list-style-type: none"> <li>● Bias in entering field and establishing rapport</li> <li>● Limited access based on political climate</li> </ul>
	Data Collection/Interpretation/Representation
<ul style="list-style-type: none"> <li>● Insight into the linguistic, cognitive, emotional, sensory, and psychological principles of participants</li> <li>● Knowledge of the historical and practical happenings of the field</li> <li>● Stimulation of natural interaction and behavior</li> </ul>	<ul style="list-style-type: none"> <li>● Culturally inappropriate observer and/or participant role</li> <li>● Large amounts of impression management to maintain rapport and/or identity</li> <li>● Selective reporting</li> <li>● Difficulty with recognizing patterns due to familiarity with community</li> </ul>

<b>Advantages to Insider Status</b>	<b>Complications to Insider Status</b>
<ul style="list-style-type: none"> <li>● Detection of participants' hidden behaviors and perceptions</li> <li>● Detection of nonverbal gestures of Embarrassment and discomfort</li> <li>● Detection of informants' actual behavior versus their performed selves</li> <li>● Identification of unusual and unfamiliar occurrences</li> </ul>	<ul style="list-style-type: none"> <li>● Bias in selecting participants</li> <li>● Breaking or maintaining relationships with participants when leaving the field</li> <li>● Community interaction style compromising interview process or observation</li> <li>● Insiderness obscuring representation or implementation due to turbulent or changing political and historical climate of the field</li> </ul>

Further, Rosaldo (1989) stated the researcher "occupies a position or structural location and observes with a particular angle of vision" (p. 19). In order to mitigate power dynamics, the researcher integrated reflexivity to shape emergent themes and the direction of the study (Creswell, 2013). The researcher implemented Maxwell's (2013) memo-keeping technique to record interactions and relationships with data to reflect and make meaning. This also aligns well with the researchers' constructivist epistemology—the researcher engaged in the construction of knowledge within the learning context of the researcher and participant relationship.

## **Sources of Data**

### ***Research Site***

The context of this study took place in one city in Metro City where Latine families comprise the single largest minority group (Pew Research Center, 2020). For the purpose of this study, the following site in Southern California will remain anonymous and will be described as the following:

- a) *Metro City*. The largest population in Metro City is of Mexican descent. 76.8% of the residents are Latine or Hispanic, and 69.1% speak Spanish. The medium income in 2013-2017 was \$45,064, with 43.3% of children living in low-income households. 45.2% of children ages 3-5 are not enrolled in preschool or kindergarten. According to the California Department of Education, 80.8% of K-12 children enrolled in Metro

City's school district were receiving free or reduced lunch for the 2019-2020 year, and 25% of the K-12 students met or exceeded grade-level standards in mathematics (California Department of Education, 2008; Kidsdata, 2018d; United States Census Bureau, 2019).

The researcher selected the above research site for the following reasons: (a) The growing population of Latine families with young children in these this city is significant and continues to grow, and (b) school data demonstrate that Latine children are not meeting grade-level expectations in math and science (Kidsdata, 2018d).

### ***Participants***

**Sampling.** The researcher identified participants using the purposive method of criterion-based sampling in which researchers “intentionally select individuals and sites to learn or understand the central phenomenon” (Creswell, 2007, p. 214). According to Maxwell (2013), this sampling design is helpful “to select groups or participants with whom you can establish the most productive relationships, ones that can best enable you to answer research questions” (p. 99). Therefore, it was important for this study to select the criteria carefully to define cases that provided detailed and rich data relevant to the particular research problem (Creswell, 2014).

Small size samples are preferred for phenomenology studies because they seek to provide concrete experiential experiences (Van Manen, 2014). Small size samples also align with IPA as it seeks to analyze concrete rather than large-scope phenomena (Pietkiewicz & Smith, 2012). Creswell (2007) and Smith et al. (2009) recommended a sample of 10 participants but no more than 25 for phenomenology studies. Therefore, this study recruited 10 Latina mothers parents to be part of the study. The researcher ensured that there were no fewer than six parents and employed attrition strategies to maintain research participation.

**Target Population.** The population targeted for this study are families with children ages 2-5 who identify as Latine (Mexican, Mexican American, Mexican immigrants, and other South American communities), are Spanish/bilingual speakers, and would like to support their



children's early mathematics learning. Additionally, the participants' children were either enrolled in a Head Start, preschool, or any other early learning agency or organization program serving children who have a low socioeconomic status. Further, the researcher chose participants with no previous knowledge of or learning experiences with co-design approaches. The criteria for participation included that Latine families must be from Metro City with children between ages 2-5 years old.

**Ethical Considerations.** According to the National Research Council (2014), individuals must be "treated as autonomous members of the community with the need to ensure that ill-informed or incompetent decisions will not place their welfare in jeopardy" (p. 101). The researcher took the appropriate steps in accordance with Pepperdine University's Review Board (IRB), which mandated that each participant who agrees to participate be asked to read and sign a parent informed consent form (Appendix C) before participating that promises complete confidentiality. The consent form was written in English and certified in Spanish (Appendix D). Additionally, the researcher considered the ethical standards of the American Educational Research Association (Creswell & Creswell, 2018) for the special needs of vulnerable populations. The researcher did not ask about the immigration status of participants, but the researcher anticipated that some of the participants may be undocumented based on statistical data from the two research sites.

**Participant Recruitment.** Participant recruitment involved obtaining a list of Head Starts, preschools, early learning agencies, libraries, and nonprofit organizations serving Latine families across two research sites. The researcher contacted the above organizations with a letter explaining the research project and ask for commitment to help recruit parents to participate in the study (Appendix E). With permission of the organizations listed above, the researcher provided a flyer both in English (Appendix F) and Spanish (Appendix G) to the organizations' staff for them to distribute to families who could be potential participants. Further, all recruitment materials, consent forms, and letters were translated in Spanish for the

participant families and organizations to understand the context and content of this study. The study's materials were also translated in Spanish by the researcher and sent to a professional translation company to ensure accurate translation of technical language.

The researcher screened participants through a phone call to ensure that they met the criteria for this study; a follow-up call and letter in English (Appendix H) and Spanish (Appendix I) with the parent informed consent form in English (Appendix C) and Spanish (Appendix D) was provided to potential participants two weeks prior to conducting the research to ensure participation in the study. Further, the researcher is bilingual in Spanish and English and was able to explain and answer any questions potential participants had. Participants were provided with a \$100 gift card for their participation in this study and got to keep all the workshop materials as a way to continue math engagement at home after the study.

## **Data Collection Methods and Instruments**

### ***Interview Protocol***

Semi-structured interviews were the preferred method for phenomenology study (Vagle, 2014) because of their conversational nature to elicit as much information as possible to make meaning of participants' lived experiences (Smith et al., 2009). The researcher employed semi-structured interviews to assess participants' funds of knowledge for at-home learning and for the researcher to structure the co-design workshops based on the data from interviews. For example, based on the information from the interviews, the researcher identified the materials (flip charts, post-its, LEGO bricks, etc.) and tools (games, energizing exercises, roleplay activities, and prototyping techniques) expected to be used during the workshop. The researcher also used Jacob and Furgerson's (2012) guide to develop an appropriate research and interview protocol. The Interview Protocol (Appendix A) included warm-up questions and questions to assess funds of knowledge, parent involvement, and family activities at home. The Interview Protocol was developed by the researcher after reviewing funds of knowledge

literature (Moll & González, 1996) to ensure the questionnaire was responsive to the literature, balanced, and clear and translated to Spanish (Appendix J).

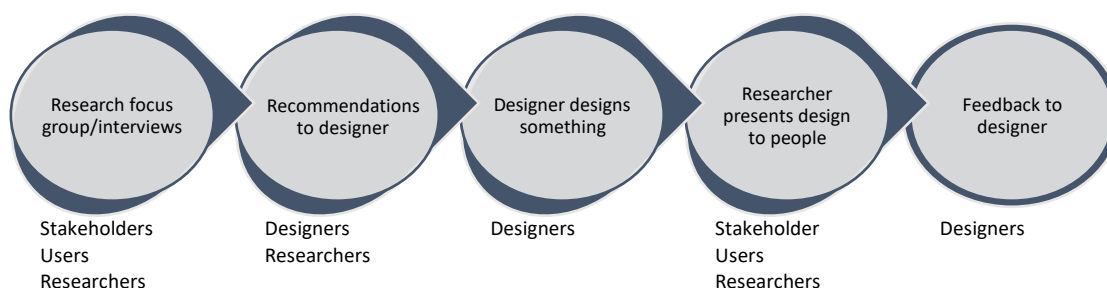
Further, the researcher used Castillo-Montoya's (2016) guide to ensure refinement of the interview protocol. Moreover, with permission from participants, the researcher recorded and transcribed the interviews to clear up confusion, for self-reflection practices, and member check-in. The practice of recording interviews allowed the researcher to take notes as way to remember significant observations, impressions, and emotions during the interviews (Maxwell, 2013). Interviews were conducted individually and lasted between 45 to 60 minutes each. Due to COVID-19 restrictions, the data collection of the study took place over video from the researcher's home office. The semi-structured interviews were conducted Zoom online platform.

### Co-Design Workshops

In Figure 4, Holliday et al. (2015) provide a description of the traditional design process that is too linear and lacking equity, participation, and collaboration from the user.

**Figure 4**

#### *Traditional Design Process*



Co-design approaches are similar to participatory workshops (Hennink et al., 2010) seeking to include a small or large number of preselected participants. The researcher served as the facilitator and designer for the co-design workshops. The researcher used the data gathered from the Interview Protocol (Appendix A) to inform the structure of the co-design workshops. Additionally, the researcher has been previously trained in co-design approaches by a nonprofit

media group and an early learning social innovation organization to build the researcher's understanding of human-centered design and capacity (Iacono & Marti, 2014).

The co-design structure of the workshops was developed by the researcher based on the data from the semi-structured interviews (Appendix A) and using Murdoch-Kitt and Emans' (2020) guidance for remote team collaboration. Since the co-design workshops were implemented via the Zoom online platform, Murdoch-Kitt and Emans' suggestions for communication and collaboration through digital tools were ideal for this study. The following outline provides a brief description of how the co-design workshops were implemented.

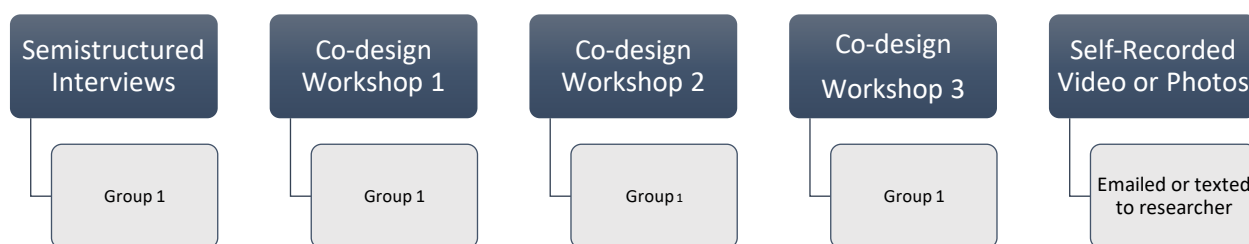
- The researcher contacted the interviewed participants to participate in the co-design workshops. The researcher created and mailed the participants a box full of resources to be used during the co-design workshops (e.g., scratch paper, markers, tape) with instructions both in English and Spanish.
- The researcher conducted three co-design workshops, and at the beginning of each workshop, the researcher included a brief orientation to help guide the participants during the workshops. Each participant was given a math topic to discuss based on the data collected from the semi-structured interviews (Appendix A). All participants discussed the co-design and co-creation of their mathematics activity. By the third co-design workshop, the parents prototyped their activity and took it home to use with their children and families.
- The researcher included visual and creative ideas to engage the participants and help them understand the co-design process (Sibbet, 2010). These included the four steps imagining, engaging, thinking, and enacting (Sibbet, 2010), in the form of the generative co-design activities. These are further explained in Chapter 4. However, in co-design approaches, engaging participants can be and is allowed to be messy and unpredictable (Costanza-Chock, 2020; Holliday et al., 2015; Murdoch-Kitt & Emans, 2020; Sibbet, 2010). But it can also provide a detailed and thoughtful approach in observing

participants' true lived experiences and engagement with the process (Costanza-Chock, 2020; Holliday et al., 2015; Sibbet, 2010), which is what this study did.

The purpose of the co-design workshop was to gather observation data by recording the workshops and collecting data from the activities where participants wrote down their notes, drawings, visual aids, and prototypes of the activities and end-of-workshop surveys (English and Spanish; Appendices B & K). It is important to note that, traditionally, co-design workshops are conducted in person to ensure maximum participation and engagement. But because of COVID-19 restrictions, the co-design workshops took place using Zoom online platform. Therefore, the researcher explored uncharted research approaches. Figure 5 provides a description for the data collection process.

## Figure 5

### *Data Collection Process*



## Data Analysis

For the purpose of this study, data analysis served as an iterative process where “data in their raw form [was] considered, examined, and reformulated to become a research product” (Thorne, 2000, p. 70). The data analysis for this study also consisted of a mixture of Maxwell’s (2013) three analytics options: (a) memos, (b) categorizing strategies, and (c) connecting strategies and Creswell and Creswell’s (2018)’s approach to data analysis. Creswell and Creswell’s (2018) data analysis process argues for “sequential steps be followed, from the specific to the general, and involv[es] multiple levels of analysis” (p. 193).

The following is a description of Creswell and Creswell's (2018) steps: (a) organize and prepare data; (b) read, reflect, and record all general thoughts; (c) classify data by coding; using Boeije's (2010) method for coding, the researcher identified units of analysis (categories) and highlight key points in each dataset. Using coding allowed the researcher to describe data and reveal patterns across the data; (d) generated descriptions and themes in categories; and (e) developed interpretations of data for analysis. Additionally, the researcher used the IPA method developed by Smith et al. (2009). Smith et al. (2009) argued for IPA as a rigorous, valid, and adaptable approach to data analysis because its focus is the lived experiences of participants. Smith et al. suggested the following "steps to analysis" (p. 81):

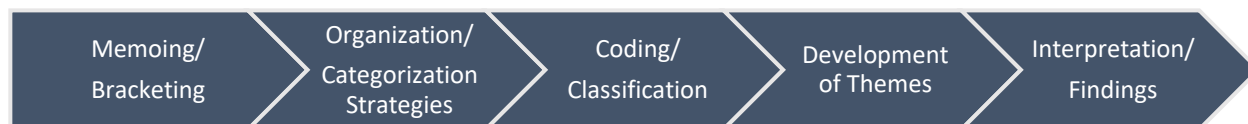
1. Reading and rereading. The researcher must be immersed to understand patterns and make meaning of the participant's lived experience. With participants' permission, the researcher recorded the interviews and transcribe them to provide a richer and more detailed description.
2. Initial noting. This part of the interpretative phenomenology analysis ensures growing familiarity with the data collection to identify and understand the participants' answers. The researcher took into consideration three exploratory areas: a) descriptive, b) linguistic, and c) conceptual, especially with bilingual and/or Spanish-speaking participants. This was a helpful strategy as the researcher needed to deconstruct and construct knowledge of participants' words and meanings.
3. Developing emergent themes. This step notes the shift from the initial analysis of writing notes during the interview process to the transcript and post analysis. The researcher used categorizing to identify recurrent themes and mark up patterns.
4. Searching for connections across emergent themes. This step revolves around the researcher analyzing the data and forming themes. It is important to note that not all themes need to be incorporated in the analysis. The researcher organized themes into groups to form patterns and connections.

5. Moving to the next case. In this step, the researcher moved to the next participant's interview transcript or recorded interview. In this step, bracketing was integrated as much as possible to ensure the researcher's beliefs are not connected to the data (Creswell, 2013).
6. Looking for patterns across cases. In this step, the researcher made connections to illuminate a theme or themes. Moreover, this step helped the researcher move from micro to macro themes, which can also be described on a more theoretical level.

Finally, three processes were used throughout the study: collection, coding, and analysis of data. The researcher did a throughout systematic observation and took field notes to immerse herself in the program and to gained rapport and trust with the sensitive community. Figure 6 describes the structured, iterative, and creative data analysis process for this research study. This aligns well with IPA as it seeks to gain richly described responses from participants and detailed descriptions of Latine families as they experience the co-design workshops (Smith et al., 2009). Further, data analysis included making a comparison and asking questions to further analyze observations and parents' answers in interviews and questionnaires.

### Figure 6

#### *Data Analysis Process*



### Delimitations and Limitations

According to L. R. Gay and Airasian (2000), limitations are “an aspect of a study which the researcher knows may negatively affect the results or generalizability of the results, but over which he or she has no control” (p. 625). According to Creswell (2014), one of the biggest limitations in phenomenology is the researcher's personal bias—personal beliefs and values. To counter this limitation, bracketing was integrated as much as possible to ensure the

researcher's belief is not connected to the data (Creswell, 2013). Moreover, Giorgi and Giorgi (2003) identified four characteristics to make a clear distinction of the methodological nature: description (openly reading), reduction (sorting of meaningful units), search for essences (reflecting on each meaningful unit), and intentionality (based on research questions that reveal the essential structures of phenomena). The researcher implemented the suggested four-step procedure to ensure meaning making and counter the limitations of this phenomenological study.

A delimitation of this study is the specific population—Latine families. Families who participate in this study may have been reluctant to share information about their histories, cultural backgrounds, mathematical learning, or their children's education. In order to contend with this delimitation surrounding cultural beliefs, attitudes, and behaviors, a series of prompts were asked during semi-structured interviews and co-design workshops to elicit relevant data. One more delimitation may have been the connection between the researchers and participants when interviewing and leading the co-design workshops. However, the research acknowledges how inner subjectivities are part of participatory design research, such as this study. This is further explained in Chapter 5.

Moreover, as the data collection was all in Spanish, there may be portions of the data collection that may not have been accurately represented. In order to counter this delimitation, a professional company reviewed and transcribed all Spanish data. To validate the translation of scales, the researcher used Sperber's (2004) innovative method for validating translated documents. Time and costs were also a limitation to phenomenology research. However, the researcher ensured that the data analysis and findings were cohesive and can be replicated by other programs, teachers, or practitioners.

Additionally, and according to Boeije (2010), qualitative research design studies rely on multiple sources of data to "check on one another, seeing if methods with different strengths and limitations all support a single conclusion" (Maxwell, 2013, p. 102). Therefore, analysis of



data from multiple sources can increase the validity and reliability of findings. Thus, the researcher used multiple sources and methods of data collection—interviews, co-design workshops, and questionnaires—to triangulate as multiple analyses to offer the prospect of enhanced credibility of this study (Creswell, 2003). These are also considered as data triangulation and methodological triangulation. By combining multiple sources of data, the researcher countered the study's weakness of intrinsic bias (Creswell, 2003).

### **Summary**

Chapter 3 outlined the methodology of this phenomenology study which was 1) to explore Latine families' culture, beliefs, and perceptions of funds of knowledge for learning, and 2) to investigate the lived experiences of Latine families in co-design family workshop in the co-design and co-creating of a math activity for their young children. A phenomenology research approach was chosen in order to explore Latine families' perceptions of funds of knowledge and their lived experiences in co-design workshops and to investigate how they identify and conceptualize math knowledge to co-create learning environments that will enable young children to build culturally based math learning identities. The results and discussion of these phases are presented in Chapters 4, 5, and 6.

## **Chapter 4: Results and Findings**

This qualitative phenomenological dissertation research study was designed to explore the lived experiences of Spanish-speaking Latine families in co-design workshops. In this study, the researcher sought to uncover participants' cultural repertoires and learning experiences to understand how Latine families perceived and engaged in co-design workshops to develop a mathematics activity for their young children. This chapter presents the findings obtained through the (a) investigation of semi-structured interviews and (b) observations of co-design workshops (including, memo keeping from the researcher, and media such as photos). Chapter 4 presents the findings from the qualitative data gathered to (a) describe the participants and provide a case study description of participants' beliefs, contexts, and experiences throughout the co-design workshops and (b) report findings associated with the research questions through IPA. This chapter starts with an overview of the data finding process, presents the data obtained through single-participant semi-structured interviews and group co-design workshops, describes the validity and reliability of the study and addresses the research questions related to the results and theoretical framework with participant case studies. A summary of the findings concludes this chapter.

### **Overview of Data Findings**

Demographic information about those participating in the study is displayed in Table 2. Demographic data was collected through semi-structured interviews included in the interview protocol (Appendix A). In this study, the researcher conducted IPA to explore and answer the research questions. The researcher used IPA to provide a descriptive and interpretative account of each participant's lived experiences as described in the semi-structured interviews and co-design workshops. It has been suggested, but not shown in design practice, that IPA can be an appropriate method to analyze an experience with a product or service and what that experience means to the user (Arvola & Linder, 2018). For the purpose of this study, the researcher used IPA to analyze participants' semi-structured interviews and their interactions

with the design and creation of a math activity (product) for their young children during the co-design workshops (service).

Additionally, IPA was the chosen and approved method for this study. IPA approach enables both the participant and the researcher to develop and co-construct an understanding of the experience, describe multiple realities, and capture naturally occurring behavior (Smith et al., 2009). This chapter provides detailed data findings through a narrative description of participants' semi-structured interviews through a single case study to verbalize and make sense of participants' understanding of the experiences (Smith et al., 2009). Participants' semi-structured interviews and co-design narratives are presented as multiple case studies following Yin's (2009) parameters of critical case studies.

There were two primary sources of data: (a) a 60-minute semi-structured interview, and (b) observations during the co-design workshops. Additionally, the researcher kept memo notes and collected photos of participants' notes, drawings, and prototypes of their activities and end-of-workshop surveys (Appendix B). The researcher collected, coded, analyzed, and triangulated these data (Boeije, 2010; Creswell & Creswell, 2018; Merriam, 2009). The researcher shared the interview protocol instrument (Appendix A) with her advisor, Dr. Reyna García Ramos, and with Dr. Robert Q. Berry III, whose research focuses on understanding children's mathematics learning experiences. Both reviewed and provided feedback on the protocol's reliability for data collection (Guba & Lincoln, 1989). Dr. García Ramos examined the protocol for clarity and survey length and to ensure that all questions were essential in the final interview protocol. Dr. Berry provided feedback on the contextualization of the questions related to funds of knowledge—specifically how parents' connected learning is interest-driven from their personal experiences with mathematics, to activities they do at home with their children.

To ensure that the structure of the co-design workshops and the creation of the co-design generative activities, was clear and intentional in using participants' semi-structured interview answers, the researcher sought feedback from Mansi Kakkar, an expert on human-

centered design practice. Ms. Kakkar provided input with a culturally relevant pedagogy lens to ensure generative tools and activities, such as cultural probes, were developed with a critical perspective aligned with the participants' history and background. Generative tools are described in detail in the Data Collection Sources section. As a result of the Coronavirus 2019 (COVID-19) pandemic and Pepperdine University's institutional review board (IRB) requirements, the researcher conducted semi-structured interviews and the co-design workshops via the Zoom video-conference platform. The researcher used Murdoch-Kitt and Emans' (2020) guidance for remote team communication and collaboration using digital tools to ensure clear communication between the participants and the researcher.

Additionally, coding schemes were reviewed by Dr. García Ramos, Dr. Caspe (the researcher's committee member), Mansi Kakkar, and Wendy Roldan, a Ph.D. candidate in the Department of Human-Centered Design at the University of Washington. Ms. Roldan's research centers on the design of equitable science, technology, engineering, and mathematics (STEM) learning environments. All experts reviewed the coding schemes to ensure the researcher maintained an objective analysis of codes, categories, and themes. The researcher also used the memos written during the data collection phase to keep a reflective and critical eye on the coding process (Maxwell, 2013). The researcher practiced reflexivity approaches during the coding process using Chavez's (2008) framework for Advantages and Complications of Insider Positionality mentioned in Chapter 3. However, the researcher also acknowledges that as a Mexican woman, her inner subjectivities (a researcher's upbringing and cultural context) were present during this study to honor the collaboration and trust between the researcher and parents. More about the researcher's positionality is discussed in Chapter 5's Analysis of Positionality in Theory and Praxis.

Each participant's semi-structured interview answers and the co-design observations, along with photos of participants' notes, drawings, and prototype of the activities (artifacts) and end-of-workshop surveys were transcribed, coded, and analyzed using IPA's six-part analytic

process by Smith et al. (2009), as designed in Chapter 3. The researcher coded the data by implementing open coding, axial coding, and selective coding to label, define, and develop codes and categories and to identify emergent themes to construct the meaning of this study's phenomenon. The researcher used MAXQDA 2020 software data analysis to organize large raw data from the semi-structured interviews and the co-design workshops. Each level of the coding process went through careful analysis, and all coding schemes went through peer review by Dr. Ramos, Mansi Kakkar and Wendy Roldan, to add reliability.

The researcher addressed each research question by writing about each participant as an individual case study. After all the case narratives were individually written, the researcher distilled the data to develop themes and create a group narrative. The group narrative and themes is discussed in Chapter 5. Three coding schemes resulted from the data. The coding schemes were derived from data obtained during semi-structured interviews related to Latine families' semi-structured interview answer, mathematical learning experiences, co-design processes related to actions (physical and verbal behaviors), and artifacts (objects and concepts participants acted upon).

The researcher identified 155 initial codes in the open-coding phase. Using Smith et al.'s (2009) IPA, the researcher focused on three exploratory areas (descriptive, linguistic, and conceptual) during open, axial, and selective coding to become familiar with the text and make meaning of the codes. Additionally, the researcher used MAXQDA 2020's two-case model analysis to condense large amounts of data and refine codes by frequency among participants. A total of 11 unique themes were identified with three themes that repeated for both semi-structured interviews and the co-design workshops. Additionally, three final subthemes and 32 final codes were identified among the participants. Data are presented in single-case studies of each participant to highlight parents' unique lived experiences (Yin, 2009). Outliers were also identified, and the researcher raised questions regarding parents' experiences in the larger

context of parents' lived experiences in co-design workshops to design and create a mathematics activity for their young children.

Additionally, to maintain secure storage and management of data, the researcher secured the data in password-protected computer folder files and used MAXQDA 2020 to store recordings and media such as photos and transcripts. The researcher will keep all data secured in password-protected computer folder for up to three years and will destroy the files after the three years. The interviewees were informed of this process before the semi-structured interview and co-design workshops began and participants agreed to proceed with the research study. Figure 7 provides a timeline of the data collection procedures.

**Figure 7**

*Data Collection Timeline*



### **Participant Setting, Population, and Sample**

The research setting for this study was Metro City, a Southern California city where most of the participants lived. Because of the COVID-19 crisis, this research project took place via the Zoom video-conference platform to ensure safety protocols for the participants and the researcher. The semi-structured interviews and co-design workshops involved parents logging

in to Zoom via a phone, tablet, or computer. All participants were asked about their experience with Zoom prior to starting the study, and all the participants stated they had experience because of their children's online remote classes during COVID-19.

Although the researcher anticipated doing media literacy training, it wasn't necessary for the parents participating in this study. Participants knew how to access the Zoom link invitation via their calendars and knew how to log in, turn their cameras on and off, use the Zoom chat, and mute or unmute when needed. Many of the participants chose not to work with the cameras on during some of the activities and sessions. This was a delimitation of the study because it was difficult to observe some of the parents' interactions with others and with the researcher.

Participants were recruited in partnership with two Metro City nonprofit organizations that focus on parent enrichment programs to support early childhood education. The researcher explained the research study via a recruitment letter (Appendix E), and both organizations provided signed approval to proceed with recruiting participants (Appendices L and M). Both nonprofit organizations shared English and Spanish flyers (Appendices F and G) with parents via email. The researcher also virtually presented at several Spanish-speaking parent meetings to recruit participants. A total of 18 parents who identified as Latine (Mexican, Mexican American, Mexican immigrants, and other South American communities) expressed interest in participating in the study via texts and emails. The researcher contacted all 18 parents to explain the study's benefits, potential risks, and compensation.

The researcher made 18 preliminary calls at the request of parents who wanted to speak with the researcher after reading the flyer. Ten phone calls were conducted in Spanish and eight phone calls in English. Out of the 18 parents who expressed interest, 10 of them were eligible to become study participants and agreed to sign the informed consent form to proceed with the semi-structured interviews. Six out of the 10 eligible parents continued through the completion of the study as participants in the co-design workshops. The other four participants stated that

because of the time commitment between the semi-structured interviews and participation in the co-design workshops, they were unable to participate.

To preserve confidentiality, participants have been given a pseudonym. Additionally, (Table 2) highlights commonalities and differences and provides an overview of important characteristics in the data of participants' semi-structured interview and co-design case study narratives. The sampling for this study was purposefully chosen to look closely at the lived experiences of Latine families in co-design workshops as a phenomenon. For this phenomenological study, a small and purposive sample was the most productive to investigate individuals within a group of interest, which included Spanish-speaking Latine families with children ages 2-5 and would like to support their children's early mathematics learning.

**Table 2**

*Participants' Demographic Information*

<b>Participant</b>	<b>Gender</b>	<b>Ethnicity</b>	<b>Birthplace</b>	<b>Language</b>	<b>Age</b>	<b>Education</b>
Rosa	Female	Latina	Nicaragua	Spanish	45	College graduate
Daniela	Female	Latina	Mexico	Spanish	36	College graduate
Carla	Female	Latina	Mexico	Spanish	36	HS graduate
Sandra	Female	Latina	US	English/Spanish	34	Some college
Sol	Female	Latina	US	English/Spanish	36	HS graduate
Erika	Female	Latina	Mexico	Spanish	33	9 <sup>th</sup> grade

*Note.* HS = high school.

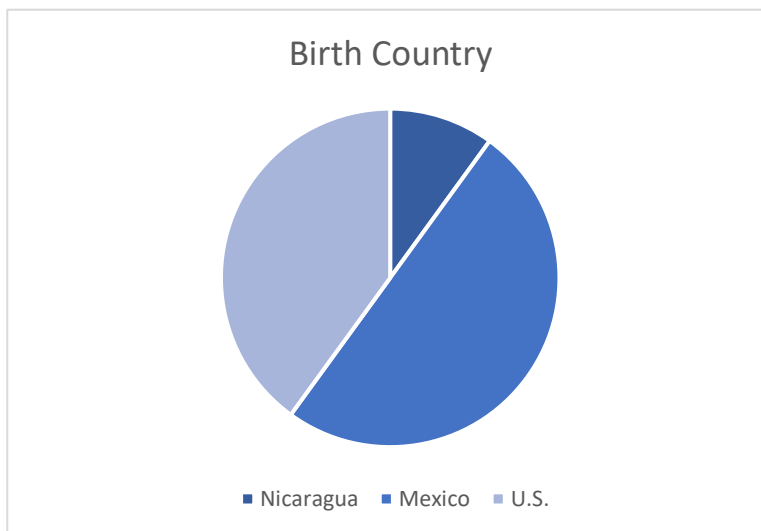
This study drew from 18 mothers who identified as Latinas and who had one or more children between the ages of 2 years and 5 years. Important to note that four out six participants had children in high school and college. All women stated that they wanted to participate in the study because they wanted to "help" their children with mathematics learning. Additionally, all participants stated that they wanted to participate if the workshops were going to be conducted in Spanish. All participants did not have previous experience with co-design approaches. Three



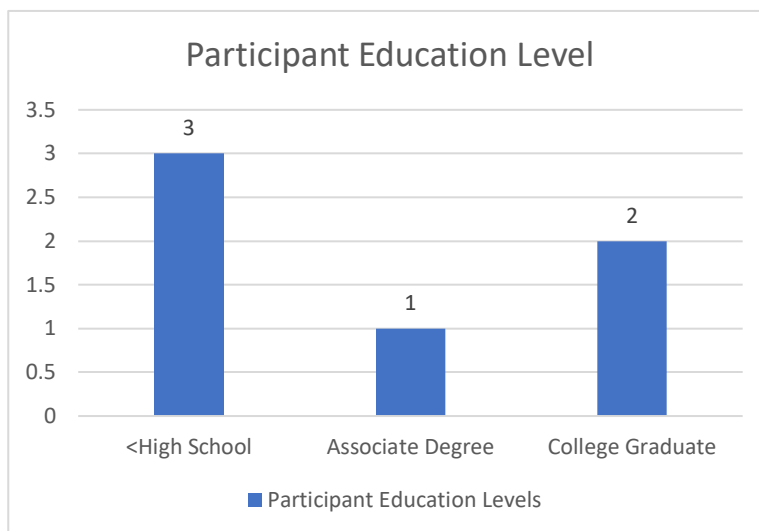
participants identified themselves as immigrants from Mexico, one participant was from Central America (Nicaragua), and two participants were born in the United States (Figure 8) but stated that they both identified as Latina mothers because of their Mexican family background.

**Figure 8**

*Breakdown of Participants' Birth Countries*



All participants reported that their spoken home language was Spanish and that their children spoke English in school. The two participants born in the United States reported being native English speakers, but their home language preference was Spanish. Both Sandra and Sol, who were born in the United States, stated they also wanted to participate in the workshops to continue to learn how to speak Spanish and role model speaking Spanish to their children. All participants emphasized the importance of speaking and teaching their children in Spanish. Participants had different levels of education. Most parents did not have an education beyond high school. The two participants with a higher education degree stated they had earned their college degree in their country of origin. One parent completed 2 years of college toward an associate's degree in a community college in the United States (Figure 9).

**Figure 9***Participants' Education Levels***Presentation of Data**

The following section presents the findings from the semi-structured interviews and the co-design workshops. This section presents only the data results, and the analysis is presented in Chapter 5. This section starts with the restatement of the study's purpose and the research questions addressed in the data collection process. A description of each data instrument is provided, specific to co-design workshop instruments that were created after the semi-structured interview data and iterated during the data collection phases.

***Restatement of Study's Purpose and Research Questions***

The intent of this study was to provide an in-depth analysis of how Latine families engage in co-design practices to co-create mathematics learning experiences and a math activity for their young children. An interpretative phenomenological methodology allowed the researcher to observe participants and gain insights into their perspectives (Creswell & Creswell, 2018; Smith et al., 2009). With the use of IPA methods, the researcher developed an understanding of the participants' experiences, described multiple realities, and captured naturally occurring behavior (Smith et al., 2009). The researcher also sought to understand,

during semi-structured interviews, how Latine families view their learning experiences and cultural knowledge. The researcher used the following research questions to guide the study:

1. How do Latine families create math learning experiences for their children?
2. What perceptions do Latine families hold of math co-design approaches?

This participatory research approach allowed for a deep exploration of Latine parents' stories and revealed their skill and knowledge in engaging in collaboration, communication, and sense-making during the design and creation of a mathematics activity (artifacts).

### ***Data Collection Sources***

Before recruiting participants and collecting data, the researcher received approval from Pepperdine University's IRB (Appendix N). The researcher ensured that ethical considerations were made according to the IRB's guidelines, such as ensuring confidentiality of the research location and participants' names, and secure data storage and management. In this study, the researcher sought to provide a space for Latine families to share their experiences and perceptions through semi-structured interviews with open-ended questions (Creswell, 2009; Smith et al., 2009). The interview protocol was used to allow participants space to share their stories, to give participants the freedom to elaborate naturally (Fraenkel & Wallen, 2009), and to facilitate the researcher in providing a narrative description of participants' lived events through their semi-structured interview answers.

The co-design workshops were developed based on the participants' semi-structured interview answers, as described in Chapter 3. For example, when the researcher conducted the semi-structured interview questions to learn more about parents' funds of knowledge, parents' mathematics experiences and their family activities at home. The researcher asked questions to get participants to recall experiences and reflect on those experiences. The researcher also asked followed up questions and listened to what each participants' answers and took notes of the reasons they gave for these. This approach guided the way in which the researcher weaved together each participant's input to construct the co-design generative concepts and activities.

More about the semi-structured interviews informed the co-design workshop is detailed in the Co-design Workshop Activities Development and Description section.

Therefore, it was crucial to capture participants' thoughts, values, and histories to integrate their perspectives into the development of the co-design workshops. The researcher used the theoretical framework mentioned in Chapter 3 to develop the interview protocol and to ensure the co-design workshop design had culturally relevant activities, tools, and resources. There is a call for co-design approaches that work to understand the participant through an empathy lens in order to develop a shared language to a level that participants can contribute on equal footing with researchers (Mattelmäki & Sleeswijk Visser, 2011).

However, this has created tension in the established core principles and scope of design practices (Chen et al., 2015). This is why it was crucial for the researcher in this study to design the interview protocol within the funds of knowledge framework to shift the co-design workshops' structure such that it worked for and with participants' cultural knowledge. Within this new paradigm, the researcher viewed the participants' relationships both in an ecosystem and with social complexity, aligning with the theoretical framework described in Chapter 2: ecological systems theory, funds of knowledge, and the connected learning framework (Light & Akama, 2012). The following section describes the semi-structured interview development, which was the first step in the development of the co-design workshops.

**Semi-structured Interviews.** The interview protocol (Appendix A) was written with an open-ended and exploratory design but with the explicit purpose of making participants' experiences the focal point which would inform the generative co-design activities. The interview protocol included warm-up questions such as:

- Please tell me about your family background. How did you and your family come to live in Metro City? How long have you lived here?
- How is your family life in Sea City/Metro City regarding culture, values, and traditions; especially when raising your child(ren)? Please tell me more.

The open-ended questions prompted participants to share their immigrant journey and/or their culture and traditions they hold in the United States. Additionally, the interview protocol included home learning environment questions, asking participants:

- How are you involved or engaged in your child's learning at home?
- What does a day in your life at home look like? Please tell me more

This allowed the researcher to contextualize participants' everyday lived experiences for engaging with their children. Furthermore, the researcher asked questions about the home math environment and mathematics learning experiences to understand participants' attitudes and experiences about mathematics. Because this study aimed to understand how parents would co-design and co-create a math activity, it was important to understand their histories, experiences, and perceptions of math. For example:

- Tell me about your experiences with math.
- How was it learning math at home?
- How do your views on raising your child(ren) influence how you teach math at home to your child(ren)?

Last, home learning activity questions were included in the protocol to understand more about what activities participants engage in, specifically activities they enjoyed individually or in the family. For example:

- What kinds of things do you and your child(ren) do together that get your child(ren) talking a lot, asking questions, or being excited?
- Are there things you like to do individually at home that you would like to involve your child(ren) in more?

Before conducting the semi-structured interviews, the researcher asked participants to email their signed informed consent forms to the researcher. Interviews were scheduled throughout April 2021 on different dates and times based on the participants' availability.

Although participants had already emailed their signed informed consent form, at the beginning of each interview, the researcher read highlights of the informed consent form and clarified questions participants had regarding the study. The researcher also reminded participants that this was a volunteer study, and if they did not feel comfortable at any point in the research project, they were free to cease participation. All participants agreed to continue with the semi-structured interview and agreed to be recorded via the online Zoom platform. All participants were made aware that the files would be deleted once the final study results were completed. The semi-structured interviews lasted 45–60 minutes, depending on the length of the answers. The researcher conducted all interviews in the participants' preferred language—Spanish.

After each semi-structured interview, the researcher downloaded the Zoom file and sent it to a professional transcribing company to ensure the quality of the Spanish transcription. The researcher also recorded field notes from the semi-structured interviews in memos to include insights, descriptions, and emergent themes from each participant (Maxwell, 2013). The memo entries were helpful in the coding process and the data analysis in Chapter 5. Interview videos and transcripts were entered into MAXQDA 2020 for the coding process and analysis. This process is described in detail under the Development of Codes section. The researcher used a professional transcript company along with member checking to verify transcripts and to triangulate the data (Harper & Cole, 2012). All participants responded that they were okay with the transcriptions..

**Co-design Workshops and Activities Development.** Following the participants' semi-structured interviews, the researcher took the following steps in developing the co-design generative activities. The researcher used Sanders and Stappers' (2013) book as a guide to developing the generative activities participants used in the co-design workshops. Sanders and Stappers (2013) recommend that before implementing a co-design session, the researcher or practitioner should conduct a series of self-awareness exercises that allow participants to share more about their experiences and everyday routines. For the purpose of this study, the self-

awareness exercise was the semi-structured interview. The first step in the process to inform the co-design workshops included interviewing the participants to understand more about their learning experiences, their math histories, and what they do at home with their children. The second step included the analysis of what participants stated in their semi-structured interviews—for example, reading and re-reading their semi-structured interview transcripts, interview notes, and the researcher memos.

In the third step, the researcher focused on participants' contexts to frame each co-design workshop activity. For example, when participants stated that they preferred and valued Spanish, the researcher created all the materials from a Spanish first design approach—activities were not translated but designed and interpreted within cultural and linguistic frameworks such as Chicana/Latina feminist methodology approach. The four and final step included the creating of the co-design generative activities. These include generative activities designed to encourage and prompt participants to reflect on their own wants, needs, relationships with their culture, traditions, and learning experiences. The design of the activities prompted participants to engage with the generative activities on a deeper level. Table 3 provides a brief description of the co-design workshop generative activity. The generative activities were designed to meet the three co-design phases mentioned in Chapter 3: observe and empathize, define and ideate, prototype and test. A thorough description of each generative activity participants used and engaged with during the workshops is described in detail in the Co-design Workshop Generative Activities section.

**Table 3***Description of Co-design Workshop Activities*

<b>Co-Design Activities</b>	<b>Timeline</b>	<b>Activity Description</b>	<b>Co-Design Phases</b>
<i>Mi Auto Retrato/My Self-Portrait Activity</i>	Co-design workshop 1 (Part 1)	This generative activity engaged participants in the use of different materials to interpret a full-bodied self-portrait or a self-portrait related to personal and cultural identity	Observe & Empathize
<i>Estética de Arte/Collage Activity</i>	Co-design workshop 1 (Part 2)	This generative activity engages participants in the creation of a collage of their own, to display and discuss the choices they made in selecting which a topic of interest based on their interviews data.	
<i>El Periódico/New s Story from the Future Activity.</i>	Take-home activity after co-design workshop 1	This generative take-home activity was design to help participants ideate an idea for their mathematics activity. The purpose of this activity was for participants to think about what their mathematics activity would look like in the future, without having to plan, design, or prototype first.	
<i>Mis Números en Casa/My Personal Number Activity</i>	Co-design workshop 2 (Part 1)	This generative activity was meant to pre-brainstorm ideas and to create a linkage between formal preschool mathematic concepts and informal mathematic contextualization.	Define & Ideate
<i>Viñetas de Platicas/Story board Activity</i>	Co-design workshop 2 (Part 2)	This generative activity engaged participants in a linear visualization to describe their mathematics activity. This activity was meant as a tool to help participants engage in platicas with each other and to illustrate a mathematics concept or idea.	
<i>Modelos de Presentación/ Prototype Activity</i>	Co-design workshop 3 (Final activity)	This generative activity engages participants in the design and creation of a model to represent their mathematics idea into a physical artifact.	Prototype
Testing of activity	Implementation of activity	Participants engage in the creation of their mathematics activity with their children at home.	Test

The three co-design workshops were implemented on May 20, May 27, and June 2 of 2021. As mentioned, six of the 10 participants were able to continue with the second phase of the research project. All co-design workshops (which include the generative activities and



resources) were implemented via the Zoom video-conference platform. At the beginning of each co-design workshop, the researcher reiterated the purpose of the research study. The researcher also restated confidentiality procedures and reminded participants they were volunteering in the study's second phase. They were told that if they didn't want to proceed, they were free to stop being part of the study at any time. Additionally, the researcher asked for permission to record the co-design workshop sessions. All co-design workshops were downloaded from Zoom after each session and sent to the same professional transcription company used for the semi-structured interview transcription to ensure the quality of the Spanish transcription.

All participants attended a total of three co-design workshops, once a week for two hours each. During each co-design workshop, the researcher (also facilitator for this study) led participants through different generative activities, including the prototyping of their mathematics activity (artifact). One of the participants (Daniela) was unable to fully participate during the live sessions. Daniela informed the researcher that she wanted to participate and listen to the workshops to gather all the information required to do the activities after the live sessions and during the weekend. Daniela committed to listening and did the activities after the live co-design workshops when she had time to complete them at home. All participants decided to keep their cameras off when the researcher spoke and only turned their cameras on when they had a question, needed clarification, or showcased their creation of artifacts. All the participants were media literate in using Zoom. Parents were all adept at logging in and out, turning cameras on and off, and muting or unmuting when needed.

Toward the end of each workshop, before logging off Zoom, the researcher asked participants to complete a mini follow-up survey via their phones. After each workshop, the researcher shared the co-design workshop presentation with participants via email and put the survey on a Google form to make it more accessible for participants to take on their phones. After the first workshop, four participants answered the survey. Two participants answered the

survey after the second workshop, and three participants answered the survey after the last workshop. The mini follow-up survey had open-ended questions and aimed to gather contextual information regarding participants' views, feelings, and experiences during the co-design workshops. All survey data were collected through Google forms onto Google sheets and downloaded to Excel spreadsheets to be saved, coded, and analyzed in MAXQDA 2020 software. Dr. Reyna García Ramos reviewed the mini follow-up survey to ensure the efficiency of questions to elicit rich, detailed first-person accounts of experiences or events related to the phenomenon being experienced (Smith et al., 2009).

As mentioned, the structure of the three co-design workshops and the generative activity instruments were developed after the participants' semi-structured interviews were coded and analyzed. The co-design workshops also drew from the theoretical framework described in Chapter 2, specifically from the connected learning framework. One of the major tenets of connected learning is to purposefully design and implement learning environments that are "socially embedded, interest-driven, and oriented toward educational, economic, or political opportunity" (Ito et al., 2013, p. 4). For the purpose of this study, it was important to structure the co-design workshops with a culturally and contextually appropriate lens to engage Latine families, especially Spanish-speaking participants.

This was a crucial approach to take because the data needed to reflect participants' funds of knowledge, needs, home math environments, and home learning environments to make participants partners in the research process (Smith, 2012). For example, all participants expressed how they valued speaking Spanish as part of their culture and how they wanted their children to continue to speak Spanish. With this in mind, it was important to move away from the Eurocentric historical design canon (de la Rosa et al., 2021), like commonly used jargon, to rename and modify design tools and resources to align with participants' personal experiences, thoughts, and emotions.

Examples include renaming generative activities like cultural probes based on the participants' semi-structured interview information, including renaming the workshops *talleres creativos*, intentionally not naming them math workshops (Smith, 2012). Creating and modifying the tools served as a research strategy to better understand participants and thus create a space for them to feel integrity, respect, humility, and reciprocity between the researcher and themselves as participants. However, it is important to note that moving from the Eurocentric design canon is not just about inclusiveness or about taking out the "bad" parts of White-centric design methodologies; it is a way to "design meaningful material—symbolic change that is neither pacified nor disabled by the colonial designs of academy" (Schultz et al., 2018, p. 83).

Design theory and practice, much like traditional research, is linked to "Anglocentric and Eurocentric ways of seeing, knowing, and acting in the world" (Abdulla et al., 2019, p. 130), ignoring the many ways marginalized people use culture, traditions, customs, beliefs, and values to navigate and negotiate experiences (Schultz et al., 2018). For the purpose of this study, decolonizing design methodologies refers not only to the idea of producing knowledge "with and from rather than about" (Schultz et al., 2018, p. 89) Latine parents' experiences but to also deconstruct traditional Eurocentric design tools to center Latine parents' salient identities as creators of home math environments and users of mathematics artifacts. Decolonizing methods happen when people make meaningful changes to the marginalized participant's experience in ways that can positively alter perceptions, attitudes, behaviors, and power dynamics (Abdulla et al., 2019; Gutiérrez & Jurow, 2016).

Therefore, it is up to the researcher to understand how to use design tools to emphasize and extend the narratives of Latine parents whose families and lives are directly impacted by immigration histories that are evident in the participants' semi-structured interview answers. Therefore, as Zavala (2013) argued, decolonizing research strategies are "less about the struggle for method and more about the spaces that make decolonizing research possible" (p. 55). Creating intentional design tools for Latine parents is more about having space where they

can consume and engage rather than being merely research subjects. The following section describes the co-design workshop generative activities used to encourage participation and facilitation of participants' learning in the co-design sessions.

### ***Co-design Workshop Generative Activities***

**Papelerías/Cultural Probes Boxes.** Cultural probes boxes are commonly used as a generative design technique that involves giving participants a package, such as a camera, journal, and markers (Brown et al., 2014; Thoring et al., 2013). Participants use these boxes throughout the co-design period, and the resulting data can be evaluated by the researcher afterward. In this case, the resulting data from the cultural probes are the Mi Auto Retrato/Self-Portrait, Estética de Arte/Collage, Viñetas de Platicas/Storyboard, and Modelos de Diseño/Prototypes, which were collected and analyzed to improve reliability. The papelerías/cultural probes boxes also represent how the researcher honored participants' funds of knowledge to ensure that participants identified with the name of the tool and that were experiential to enhance participants' learning (Bang & Medin, 2010; de la Rosa et al., 2021).

Because all participants stated they valued speaking Spanish and mentioned experiences with papelerías in their home countries, the cultural probes boxes were renamed papelería plus the participant's name. Participants who were born outside the United States explained that papelerías are neighborhood shops where they go to buy everything needed for school materials in their home countries, similar to stationery stores in the United States. Even for the participants born in the United States, they recognized papelerías because whenever they visited their parents' home country, they encountered papelerías in almost every corner of their parents' town. This co-design tool strategy not only aligned to the funds of knowledge framework but also to the connected learning framework (part of this study's theoretical framework), which states that the "connected learning [research] agenda involves building more diverse entry point and path to opportunity as an avenue to this broader reform and equity agenda" (Ito et al., 2013, p. 34).

Figure 10 shows how the papelería looked from the outside to the participants. Figure 11 shows the inside of the papelería with all the materials participants used during the three co-design workshops. Materials were also based on the participants' semi-structured interview data. They included low-tech resources such as journals, notebooks, disposable cameras, pens, markers, color pencils, clay, tape, stamps, blocks, paper magazines, glue, foam paper, and yarn. Papelería boxes were delivered via mail to participants a week prior to the first co-design workshops. None of the participants reported issues receiving the boxes, and some of the parents texted the researcher to let her know their box had been received.

### Figure 10

*Cultural Probes Box, Renamed Papelería*



**Figure 11**

*Papelería/Cultural Probes Box Co-Design Workshop Materials*



Each participant's papelería/cultural probes box included English and Spanish descriptions of the co-design workshops, including a welcome letter describing what to expect during the co-design sessions. It asked participants to familiarize themselves with the materials and contact the researcher if they had any questions. The welcome letter included a pre-workshop activity that the researcher wanted the participants to do before the first session. However, none of the parents had the time to do this pre-activity. The pre-activity was a means to get parents to familiarize themselves with the resources, but it was not a critical point for data collection if the participants did not do it.

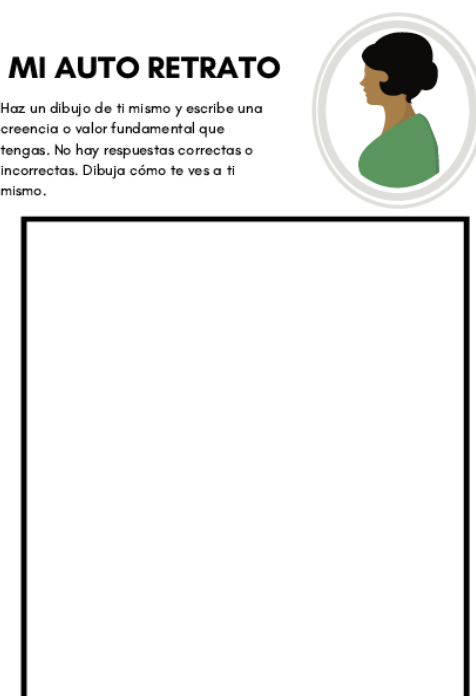
The welcome letter also included information about the participants' compensation for volunteering in the study and a reminder to participants to keep all the resources after the last session to continue to engage with their young children at home. The following section describes the generative tools used for each co-design workshop. These tools were also renamed to align them with participants' funds of knowledge and were designed based on the participants' semi-structured interview data. All generative activities were renamed in Spanish to

simplify academic and technical co-design jargon and to move away from the Eurocentric co-design canon (de la Rosa et al., 2021) to center participants' cultural histories and Spanish language.

**Mi Auto Retrato/My Self-Portrait Activity.** Mi Auto Retrato/Self-Portrait was the first generative activity participants did in the first co-design workshop. According to Grushka (2008), a self-portrait can help participants reflect on different facets of themselves and others. Participants generated drawings of what they saw within their histories and contexts and what was hidden within their artworks (Grushka, 2008). Grushka argued that the self-portrait "situates [participants] as critical observers and social commentators...[to]...explore the spaces between individual and collective social subjectivities" (2008, p. 298). For the purpose of this study, the Mi Auto Retrato/Self-Portrait generative activity served three purposes:

- It was an icebreaker to introduce participants, to have them get to know one another, and to build a sense of trust and community between participants and the researcher.
- It provoked a deeper reflection on each participant's identity, values, and beliefs (Gorichanaz, 2019) to reconstruct design service within Latine parents' epistemologies.
- It documented the creation of participants' artifacts (Gorichanaz, 2019) to help the researcher understand origins and relevant stages of the co-design sessions in the context of parents' artifact creation.

Each participant was asked to take 15 minutes to reflect on a core belief or value they followed and draw either a full-bodied self-portrait or a self-portrait representing the said core belief or value. The researcher provided her own core belief as an example for participants to feel more comfortable, to understand the goal of the first generative activity, and to continue to build trust and a sense of community between the participants and the researcher. Figure 12 shows the Auto Retrato/Self-Portrait generative tool in Spanish.

**Figure 12***Mi Auto Retrato/Self-Portrait Generative Activity in Spanish*

**Estética de Arte/Collage Activity.** Similar to the Mi Auto Retrato/Self-Portrait tool, the Estética de Arte/Collage activity was used to continue to tap into participants' funds of knowledge to understand more about their background and what they were interested in to use later in the Modelos de Presentación/Prototype activity. It has been documented that visual and art-based methods can honor the participant's process in making meaning of their feelings, experiences, and viewpoints (Culshaw, 2019). This tool allowed participants and the researcher to conceptualize and reflect on previous educational experience (Ito et al., 2013). Additionally, this activity served to continue to document all data collected for analysis.

The researcher used a word cloud to remind participants about the most significant words throughout their semi-structured interviews. These words represented the contextualization of participants' everyday lived experiences (Figure 13) in response to the semi-structured interview question: Are there things you like to do individually at home that you



would like to involve your child(ren) in more? For the *Estética de Arte/Collage* activity, participants were asked to keep in mind the following prompt: If you identify with [selected word], create an *Estética de Arte/Collage* that represents this word within your values, culture, and traditions as a family. According to Ito et al. (2013), people gain knowledge and skills that are connected to practices and valued relationships “in which learning is not the primary reason for engagement” (p. 46). Therefore, participants were asked to keep in mind the following questions when creating their *Estética de Arte/Collage*:

- What do you remember about your home learning experiences and [selected word]?
- Do you recall a moment when your child began to like [selected word]? If yes, tell me about that moment in your life. If not, please explain why you think you do not remember that moment.
- Describe experiences that your child has with [selected word] at home.
- How do you incorporate your home language with [selected word]?

All participants chose to use materials from their *papelería/cultural probes* boxes; specifically, all used magazines to create their *Estética de Arte/Collage*. One of the flexibilities of collage-making is that participants could use any materials to express themselves through art-making activities. The *Estética de Arte/Collage* tool allowed participants to conceptualize an idea or concept (chosen word) in relation to their families and living contexts.

Parents, especially Latine parents, often feel isolated from formal learning spaces because of their background, language, and education (Good et al., 2010; Olivos, 2004). *Estética de Arte/Collage* provided an alternative avenue for participants to share personal interests that have been cultivated within their particular social and cultural contexts and helped participants bridge contexts of interest, home, and culture to understand one another as participants, as well as the researcher. All participants stated that they had never done this kind of work, although they had seen it in their children’s classes, afterschool programs, or

community events. The researcher also collected screenshots from the participants who finished *Estética de Arte/Collage*.

### Figure 13

*Participants' Word Cloud from the Semi-Structured Interviews*



**El Periódico/News Story from the Future Activity.** This activity was meant for participants to complete at home, not a stated homework activity but a fun exercise to give them a starting point to anchor their vision for their mathematics activity. It is important to know that at this point of the first co-design workshop, the purpose of the study was reintroduced to remind participants to think about a mathematics activity they would like to do with their young children. The take-home activity asked participants to speculate on the desirable future of the mathematics activity they would design and create (Harrington & Dillahunt, 2021).

Speculative design seeks to engage participants in “futuring” thoughts—to think about their potential for imagining an idea or artifact—and it “confronts commercial and traditional design practice with new ideas” (Johannessen, 2017, p. 2). Only two participants completed this take-home activity. Other participants stated a lack of time as their major reason for not doing the take-home activity. Figure 14 shows the *El Periódico/News Story from the Future* activity. Although only two parents completed this activity, the findings were very close to the other

artifacts' findings, and the researcher added the Periódico/News Story from the Future activity to the data analysis.

### Figure 14

*Take-Home Activity: El Periódico/News Story from the Future Activity, in Spanish*

**El Diario Nuevo**

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TITULAR O ENCABEZADO VOLUME Y EMISIÓN

---

HISTORIA DE  
\*NOMBRE:

IMAGEN	TESTIMONIO
--------	------------

HISTORIA CENTRAL

INSTRUCCIONES

1. ESCRIBIR ALGUNOS TITULARES DEL FUTURO PARA NOTICIAS (PERIÓDICOS, ARTÍCULOS EN LÍNEA, ETC.) DE 2050. IMAGINE QUE TODO LO QUE DESHA RESALTAR EN LA CREACIÓN DE SU ACTIVIDAD MATEMÁTICA.

2. REDACTE TODOS LOS TITULARES QUE PUEDA IMAGINAR EN CINCO MINUTOS. NO TIENEN QUE ESTAR DIRECTAMENTE SOBRE LA ACTIVIDAD MATEMÁTICA—FUEREN SER SOBRE UN EVENTO O ESTADO DE COSAS QUE ESTÁ TANGENCIALMENTE RELACIONADO CON EL APRENDIZAJE MATEMÁTICO DE SU COMUNIDAD, ESTADO, REGION O PAÍS.

3. ELIGE TU TITULAR FAVORITO!  
A INCLUIVA UNA CITA DE EJEMPLO DE ALGUIEN QUE PUEDA ENTRAR EN ESTE ARTÍCULO IMAGINARIO

**Mis Números en Casa/My Personal Number Activity.** This activity took place in the second co-design workshop. Before this activity, the researcher introduced the California Preschool Learning Foundations, Volume 1 for Mathematics (California Department of Education, 2021), which was described in Chapter 2 under the Math Literacy section of the literature review. All participants mentioned that they had not heard of the California Preschool Learning Foundations for Mathematics but that they were aware and familiar with some of the mathematical foundations required by California, specifically the most widely known terms—number sense and geometry. The Mis Números en Casa/My Personal Number activity was modified from the "My Personal Numbers!" activity found in Yeh et al.'s (2017) book *Reimagining the Mathematics Classroom*. In their book, Yeh et al. argued for mathematics teachers to meaningfully support students' learning by linking instruction to "students' lived

experiences" and "students' identities," which in turn "leads to increased engagement and motivation to learn mathematics" (Yeh et al., 2017, p. 96).

For the purpose of this study, the researcher introduced this activity to parents as a way to help them explore mathematics in their home learning environments. The goal for this activity was to have parents think about some of the things they had or do as a family that connected mathematics to their everyday life (home math environment). This contextualization of learning with “real-life” experiences allowed parents to authentically relate to formal mathematics in the California Preschool Learning Foundations (California Department of Education, 2021) based on their social–cultural experiences (Ladson-Billings, 1995, 2013). The participants were asked to think about all the mathematics they saw at home/*números en sus casas* that connected to their daily lives, for example, the number of people in their family, their home address, phone number, etc. Some participants created lists of everything they saw as math learning in their homes.

**Viñetas de Platicas/Storyboard Activity.** Storyboarding serves as a visual method for researchers to get participants to share a “common visual language” (van der Lelie, 2006, p. 159). For the purpose of this study and similar to the Auto Retrato/Self-Portrait, Estética de Arte/Collage, and El Periódico/News Story from the Future activities, storyboarding was renamed Viñetas de Platicas to move away from Eurocentric co-design naming (de la Rosa et al., 2021). Because storyboarding is about telling a story where participants draw and generate a fully visualized design, the renaming to Platicas made sense—platicas are commonly used in Latino households to communicate through conversations and storytelling (Fierros & Delgado Bernal, 2016). The integration of the platicas framework for storyboarding was critical to continue to decolonize design methodologies because it allowed participants to “share their lived experiences in a manner that reflects their cultural traditions and practices or their way of knowing and *formas de vivir*” (ways of living; Oliva & Alemán, 2019, p. 74).

For this activity, the researcher asked participants to visualize the word they previously chose from Figure 15 and think about the word as a concept from start to finish by plotting out elements in scene-by-scene boxes in the Viñetas de Platicas/Storyboard (Figure 15). The researcher asked the participants to think about how in our Latine homes *platicamos de todo como forma de contar historias/we talk about everything as a way to tell our histories*. For example, we communicate family stories, *consejos*, *regaños*, and jokes through conversations or *platicas* (Fierros & Delgado Bernal, 2016). At this point of the co-design workshop, the researcher encouraged participants to reflect on their *Estética de Arte/Collage* and think about what word or concept they chose, liked, or identified the most with reference to the preschool mathematics concept they chose from the California Preschool Learning Foundations for Mathematics (California Department of Education, 2021).

Participants were placed into two groups of three to communicate and share ideas, but their *Viñetas de Platicas/Storyboards* were to be made individually. All participants created a visual story of a mathematics activity of their choice. Participants were also encouraged to continue to refine their *Viñetas de Platicas/Storyboards* at home, individually or with their families. Participants were asked to keep their *Viñetas de Platicas/Storyboard* somewhere safe to bring back to the last co-design workshop because it would be useful for the *Modelos de Presentación/Prototype* component.

Figure 15

*Viñetas de Platicas/Storyboard Activity in Spanish*

**Viñetas de Platicas**

Nombre: \_\_\_\_\_

Título de actividad: \_\_\_\_\_

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**Modelos de Presentación/Prototype Activity.** In design-thinking, prototyping is considered an iterative process for developing a product or service (Gerber & Carroll, 2012). It is a process where participants communicate and shape an idea early on by making it real and testing it early (Cross, 2011). For the purpose of this study, participants were asked to use their Viñetas de Platicas/Prototype activity to start fleshing out the math activity experience they would like for themselves and their children. The researcher suggested questions such as:

- What interactions would you need to have?
- Where does your mathematics activity end and begin when using it with your children?
- What are the questions you have or the assumptions you are making when creating your math activity prototype?

Additionally, the researcher suggested that participants create a prototype with paper first, if needed; a paper prototype could be great to shape an idea but could also be a great way to test

early questions about how to design their math activity (Cross, 2011; Gerber & Carroll, 2012). Participants were encouraged to use any of the materials in their papelerías, or they could use materials from their homes.

Participants were told to keep in mind all the previous generative activities they did in the co-design workshops along with the California Preschool Learning Foundations for Mathematics (California Department of Education, 2021) for mathematics to prototype their mathematics activity and create their artifact. For this activity, participants were once again placed into two groups to continue to get inspired by one another and to communicate and brainstorm ideas. All participants presented their Modelos de Presentación/Prototypes at the end of the third co-design workshop. After the co-design workshops were completed, participants kept their Modelos de Presentación/ Prototypes, and the researcher asked participants to share photos of how they implemented their mathematics activity with their children at home.

**Additional Data Collection Sources.** The researcher collected photos from participants' activities and artifacts. Additionally, the researcher took screenshots of some of the participants while engaging in conversations or while participants were describing their activities. There were some challenges collecting data post-implementation of the co-design workshops. Four of the six participants were able to implement their math activity with their children at home and shared photos via email. The other two participants cited work and other responsibilities for being unable to implement their mathematics activity with their children. All data collected from co-design workshops were transcribed by a professional transcription company and uploaded in MAXQDA 2020 for coding and analysis. The following section describes the development of codes after all data were collected and uploaded to MAXQDA 2020 software for data analysis. The researcher chose this data analysis tool because of previous experience with the software.

### **Development of Codes**

IPA was employed as a guide for coding to capture, represent, and interpret the essence of both the participants' semi-structured interviews and co-design workshop data (Saldaña, 2016; Smith et al., 2009). Specifically for this study, the researcher used the following books and IPA guiding questions: Smith et al.'s (2019) *Interpretative Phenomenological Analysis: Theory, Method and Research*, Saldaña's (2016) *The Coding Manual for Qualitative Researchers*, and Arvola and Linder's (2018) guiding questions to understand user experience in phenomenology. Additionally, the researcher used memo keeping as a bracketing and epoché strategy to acknowledge any bias that emerged during the data collection phases and to triangulate the data (Creswell & Creswell, 2018).

However, the researcher acknowledges that inner subjectivities are part of the process. This doesn't necessarily mean biases, but noting these subjectivities is a way to be radically honest and center the researcher's positionality as an ethical stance rather than a method (Williams, 2016). In the code development phase, the researcher navigated formative stages of co-construction of knowledge alongside positionality enactments to not only honor participants' lived experiences but to unveil the inner subjectivities of decolonizing methodologies and humanizing community-based research. More about the researcher's positionality is discussed in the Analysis of Positionality in Theory and Praxis section of Chapter 5. With this in mind, the researcher engaged in an immersive, disciplined, and systematic IPA process analysis as outlined in Smith et al. (2009) and described in detail in Chapter 3. The researcher took the following steps in developing codes and categories to understand patterns and develop themes. Figure 16 describes the coding workflow for this qualitative phenomenology study.

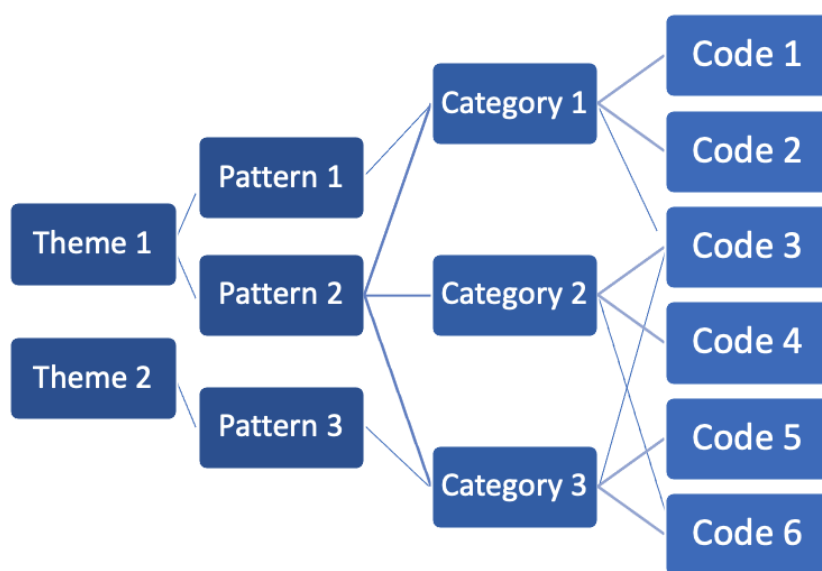
Before engaging in the data analysis, the researcher had all data transcribed by a professional Spanish-speaking transcription company and uploaded it to MAXQDA 2020 software for data analysis, including Zoom recordings, photos and screenshots. MAXQDA 2020 allowed for easy organization and categorization of data. The researcher organized all data into two sets: (a) semi-structured interviews, which included data from the interviews' recordings and



transcriptions; and (b) co-design workshops, which included data from the co-design workshop recordings, transcriptions, and media (photos and screenshots). Under each set of data, several documents were attached to the corresponding participant. For example, Participant 1 had an interview transcription plus a co-design workshop transcription from sessions one, two, and three, including photos or screenshots from the generative activities and artifacts. The same was true for Participants 2, 3, and so on.

### Figure 16

*Coding Workflow of an Interpretative Phenomenological Analysis Methodology*



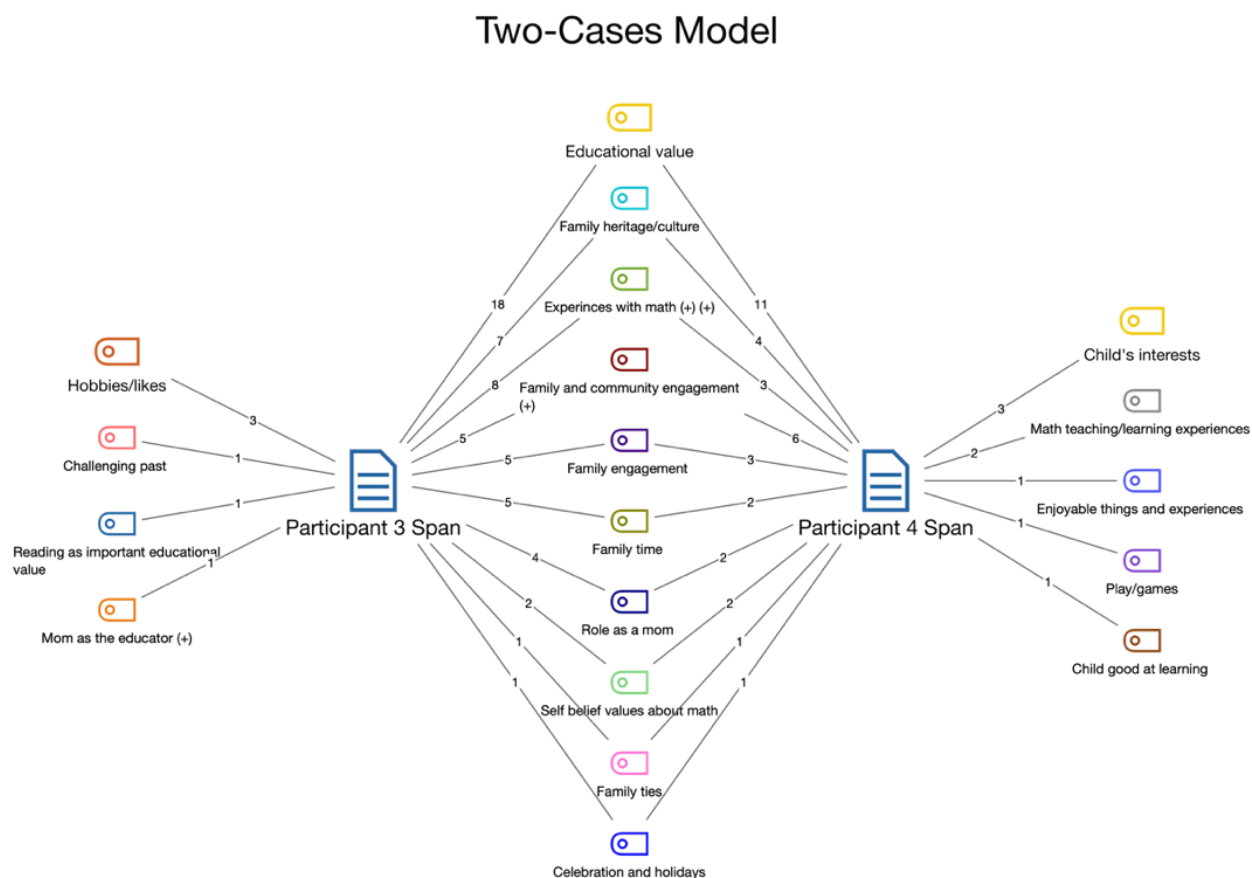
Starting with the semi-structured interviews' data, the first step in developing codes to analyze large amounts of textual and media data was to employ open coding. In this first step, the researcher used open coding to notice and label concepts, words, visual imagery from photos or screenshots, sentences, and statements from participants. Thus, the researcher used open coding mode in MAXQDA 2020 to capture "first impressions" (Saldaña, 2016). For example, the researcher used inductive thematic data analysis to extract codes and referred to

the theoretical framework in Chapter 2 for more insights about patterns and themes, especially in reference to the funds of knowledge and connected learning frameworks.

From the initial open coding stages, the researcher then moved to organizing the codes based on similarities and frequencies from the data collected. For example, “belief in being capable of learning something,” “deficit thinking,” and “learning experience” codes were merged to form a single code: “self-perception of inherent ability.” During the open coding phase, the researcher used MAXQDA 2020’s two-cases model analysis to visualize the frequency of codes produced by participants (Figure 17). This process allowed the researcher to see commonalities and differences between codes. In using the two-case model, the researcher further refined codes and identified preliminary categories and themes.

**Figure 17**

*Visualization of Code Frequency in MAXQDA 2020 Two-Cases Model Analysis*



Open coding yielded 155 initial codes. Because of the large number of codes with similarities, the researcher began consolidating similar codes into preliminary categories. Additionally, during open coding, the researcher used the memos she kept throughout the research study to support the development of codes and categorizations. Although MAXQDA 2020 allows memos and notes to be attached to transcripts, the researcher chose to write ideas and findings in a journal as they emerged during the coding phase in MAXQDA 2020 to bracket the open coding process.

Next, the researcher employed axial coding to further refine, align, and categorize the codes. In this section, the researcher reviewed all 155 initial codes and used axial coding to refine and create new categories. For example, the researcher employed the Six C's Model, part of axial coding, to categorize data based on "causes, contexts, contingencies, consequences, covariance, and conditions" (Larossa, 2005, p. 98). The researcher merged similar codes such as "belief in being capable of learning something," "deficit thinking," and "learning experience" into the "self-perception of inherent ability" code, this eventually became a "self-belief perceptions" category and a pattern the researcher noticed throughout the data, and eventually the "learning experience" code became a theme that encompassed several codes that were similar and had the same analytical frequency. At this point, the researcher went from 155 codes to 64 codes. The researcher finalized codes in the selective coding phases to 32 codes. Table 4 describes all the final codes from the semi-structured interviews and co-design workshops.

**Table 4**

*Final Codes Generated in Selective Coding of Interviews and Co-design Workshops*

<b>Number</b>	<b>Code</b>
1	<i>Educación</i>
2	Educational aspirations
3	Holding onto home
4	Cultural practices enacted
5	Family Centric

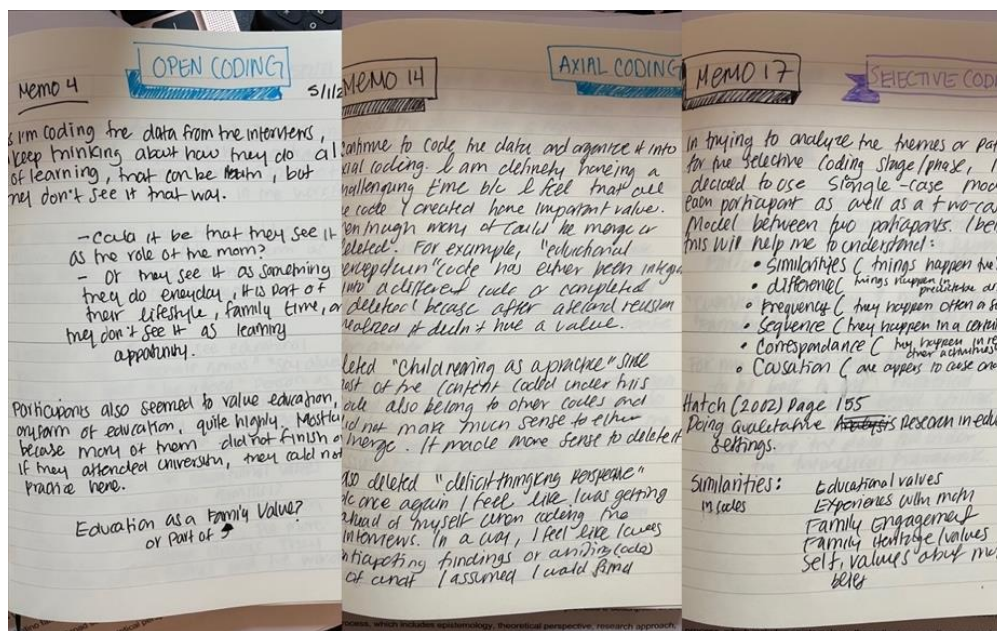
<b>Number</b>	<b>Code</b>
<b>6</b>	Spanish
<b>7</b>	Parent's family relations/socialization
<b>8</b>	Motherhood
<b>9</b>	Parent engagement
<b>10</b>	Community engagement
<b>11</b>	Literacy achievement
<b>12</b>	Child's way of learning
<b>13</b>	Personal & cultural awareness and curiosity
<b>14</b>	Self-efficacy beliefs about math
<b>15</b>	Math interest
<b>16</b>	Math teaching contexts
<b>17</b>	Self-perception of inherent ability
<b>18</b>	Questions & request for help
<b>19</b>	Cooperation
<b>20</b>	Oral & written communication
<b>21</b>	Embodied behaviors (physical behaviors)
<b>22</b>	Problem-solving
<b>23</b>	Construction of knowledge
<b>24</b>	Views on expertise
<b>25</b>	Self-beliefs about competence
<b>26</b>	Perceptions of creativity
<b>27</b>	Emotional expressiveness
<b>28</b>	Pride/agency
<b>29</b>	Generating ideas
<b>30</b>	contextualization of activities/artifacts
<b>31</b>	Personal & cultural awareness and curiosity
<b>32</b>	Self-reflection

The last step in the code development phase was to use selective coding. In this last stage, the researcher “search[ed] for the most frequent or significant codes to develop the most salient categories in the data” (Saldaña, 2016, p. 240) to formulate analytic sense, identify patterns, and eventually create themes. The researcher specifically used Smith et al.’s (2009) “step 6: looking for patterns across cases” (p. 101) in the last step of coding to construct a deeper theoretical meaning. For example, the researcher reread all codes to review and refine them. The researcher also used this study’s theoretical framework as guidance to explore and

name thematic nuances of the data collected. Further, the researcher used her memos (Figure 18) as analytical tools to aid in identifying emerging theoretical constructs.

**Figure 18**

*Example of an Analytic Memo Based on the Raw Data Collected*



In addition to open, axial, and selective coding, the researcher employed Arvola and Linder's (2018) guiding questions to identify and assign codes to actions, relationships, and language observed during the co-design workshops. Because the purpose of the co-design workshops was to have participants design and create a mathematics activity, the workshops were created to engage participants as creators, users, and consumers of the product: the mathematics activity. According to Arvola and Linder (2018), it has been suggested but not shown in design practice, that IPA can be an appropriate method to analyze experience with a product (mathematics activity) or service (co-design workshops) and what that experience means to the user (Latina mothers).

Thus, the researcher used the following questions framed by Arvola and Linder (2018) to describe the essence and write a descriptive account of each participants' lived experience in the co-design workshops. According to Arvola and Linder (2018), "In user experience research,

the analysis would answer the following experiential questions (1–2) and interpretative questions (3–4)” (p. 6).

1. What are the objects of concern (e.g., relations, processes, places, events, materials, documents, rules, values, principles)?
2. How are the objects of concern experienced in the co-design workshops?
3. What do the objects of concern mean for the participants given the preunderstanding they bring to the situation of use (i.e., why they are important and the consequences of the participants' experience)?
4. What theoretical concepts can be used to understand what the participants' accounts mean?

Additionally, the researcher employed memoing in MAXQDA 2020 (Figure 19) and used the following steps as a guide for each participant's (semi-structured interview/co-design workshop) narrative case study.

- Descriptive comments: experiences, things, and emotional reactions.
- Linguistic comments: wording, repetitions, and hesitations.
- Conceptual comments: interpretations of each participant's understanding and perceptions of their experience (Arvola & Linder, 2018, p. 5).

Figure 19

Example of an Analytic Memo Written in MAXQDA 2020 Software for Data Analysis

The screenshot displays the MAXQDA 2020 interface. At the top, the document is titled "er: Workshop 3 transcript - Spanish (448 Paragraphs)". The main text area shows a transcript of a conversation in Spanish. A yellow sticky note is attached to the text, containing an analytic memo. The memo discusses the challenges of choosing a topic for a project, noting that the researcher has many options and needs to make sure or look for validation about what she chooses. The transcript text includes:

para que se nos hiciera fácil el prototipo.  
 259 [redacted]: Eso es como los arquitectos cuando están haciendo sus creaciones, se las cambian. Hoy sí  
 entendí, siempre relacionado con el tema que escogimos, ¿verdad?  
 260 Susie: Sí. ¿Otra pregunta? [redacted]  
 261 [redacted] Es que yo todavía estoy haciendo colores, geometría y números, ¿me tengo que escoger yo  
 enfocarme en los números que escogí?  
 262 Susie: Sí, pero que te guste, que te gustaría enseñar. Por ejemplo, tú habías mencionado que pintura  
 es algo que te guste y que tus niños también disfrutan. A lo mejor usamos pinturas para enseñar  
 números o pinturas para enseñar patrones, pero si buscan algo que al final de cuentas te sientas  
 más-- Que se pueda hacer esta actividad.  
 263 No dejen de ir de las otras actividades porque a lo mejor eventualmente podemos hacer cinco  
 actividades, seis actividades o más actividades, pero mientras, uno. ¿Otra pregunta ¿con el thumb  
 up, todos estamos bien?  
 264 No los veo poner a todos el thumb up, perfecto.  
 265 Otra vez de tiempo, sorry, no les voy a dar el break, [ríe] porque no tenemos tiempo, porque sí quiero  
 terminar a las 6:00 PM, no las quiero mantener más tarde de eso. Si no les molesta, [redacted] ¿nos  
 podemos poner en los cuartos por 30 minutos? Esta vez va a ser 30 minutos o de 5:15 PM a las 5:40

The analytic memo (yellow sticky note) reads: "Most of the issues/ challenging is about choosing a topic for [redacted] She has a lot and needs to make sure or looking for validation about what she chooses".

The researcher used memoing to keep track of the data collection and analysis activities. Memos helped capture the researcher's thinking process by allowing her to immerse herself and review the memos and field notes several times throughout data collection, coding, and analysis. The researcher searched for thematic ideas until no new insights could be developed or incorporated into the findings (data saturation). Memoing also aligned with the constructivist epistemology of this research study. Through memoing, participants were given a voice through the data, and the researcher generated knowledge through the process of inquiry.

Analytical memos helped to further refine code reliability when data saturation was reached. Analytical memos allowed the researcher to gain insights into how participants approached the activities they engaged with during the co-design workshops (Boeije, 2010; Creswell, 2013; Maxwell, 2013). The next sections take all of the data described in this section and present the data findings in detail, starting with an explanation of participant case studies and followed by participants' semi-structured interview narratives, participants' co-design workshop narratives, a presentation of the coding scheme, and a summary of Chapter 4.

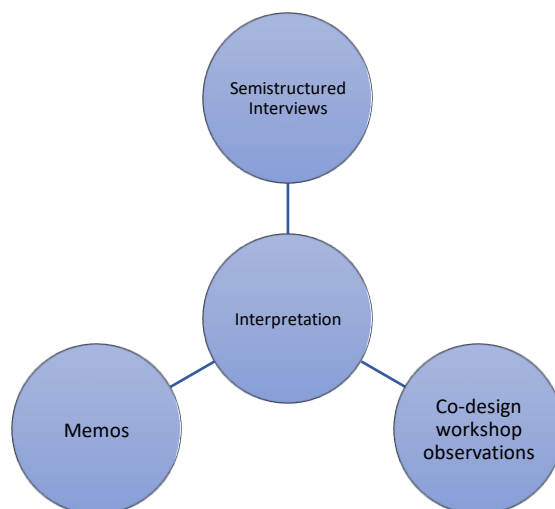
### Validity and Reliability

## **Triangulation**

Boeije (2010) suggested that to establish validity and reliability, the researcher must choose triangulation as a method to increase the credibility and trustworthiness of the data gathered. Main sources of data were (a) semi-structured interviews, (b) co-design workshops (mini-surveys, photos and screenshots were part of the co-design workshop data collection; Merriam, 2009). Furthermore, the researcher employed theory triangulation integrating “more than one theory [and] applied [it] to interpret the data” (Boeije, 2010, p. 176). This study used the theoretical framework discussed in Chapter 2 as theory triangulation. All data used to triangulate this study are represented in Figure 20. Additionally, the following strategies were implemented to increase the internal validity of this study: (a) rigor, (b) memos, (c) data saturation, and (d) transferability.

**Figure 20**

*Data Triangulation Sources*



## **Rigor**

The researcher employed rigor as a strategy to increase reliability of the study. Smith et al. (2009) described rigor as ensuring “thoroughness...of the sample, quality of the interviews and the completeness of the analysis undertaken” (p. 181). Rigor is part of Smith et al.’s six



steps for the IPA process, which the researcher incorporated into the study findings and analysis phases. For this study, the researcher ensured that all instruments were reviewed by the researcher's adviser, peer reviewers, and experts. For example, the interview protocol used Castillo-Montoya's (2016) framework for refinement of interview protocol processes. Additionally, all Spanish research instruments and data findings, such as coding schemes, were validated using Sperber's (2004) innovative method for validating translated documents. All Spanish data collection instruments and transcriptions were sent to a professional Spanish translation company for review to ensure quality and accuracy of technical, academic, and colloquial jargon. Experts like Dr. Reyna García Ramos, Dr. Robert Q. Berry III, Mansi Kakkar, and Wendy Roldan, a Ph.D. student, peer-reviewed data collection instruments and coding schemes.

### **Memos**

The researcher used the process of memoing to write down field notes and analytical memos, and to bracket thoughts and analysis throughout the data collection phase. The researcher also used memoing as an analytical journal to record the researcher's learning experience during the semi-structured interviews and the implementation of the co-design workshops (Boeije, 2010). Memoing also served as a tool for the researcher's iterative processes to ensure that co-design workshops were adjusted based on participants' feedback (Merriam, 2009). For example, at the end of every co-design workshop, the researcher asked participants whether anyone would like to volunteer to share what they liked, what they learned, and what they wished. Sandra stated the following:

*¿Qué querría? Yo pienso que si fuera en persona, hablar con otras personas para sentirme que estoy con otras personas. Por que cuando estaba haciendo esto, no sabía qué hacer, estaba sola, sé que estabas ahí, pero yo me sentía más sola que nada.*

What I wish? I think if we were in person, I could talk to other people so that when I was doing the activities, I didn't know what to do. I was alone. I know you were there, but I felt more alone than anything.

In response to Sandra's feedback, the researcher modified the structure of the second and third co-design workshops to include breakout rooms for the participants. This modification and adjustment continued to add rigor to this study's quality and commitment to the process of data collection and analysis. Additionally, memos served as a reflexivity process. Findings are shaped by the choices made by researchers over the course of the research process (Creswell & Creswell, 2018; Maxwell, 2003; Merriam, 2009). And the researcher used the memos to reflect and to attempt to understand the essence of the phenomena being studied. For example, here is one of the researcher's memo entries from the first co-design workshop:

For the first co-design session, I wasn't sure how much I could share about me. I did mention to the participants my positionality as an immigrant Mexican woman, why I am doing this study and work, and why it matters for me to do this work with Latine families. I shared my immigration background and the reason why I continue to speak Spanish. I think in order to get them to feel comfortable, I realized that as a researcher I need to identify with them [participants], especially when the conversations and relationship building are happening over Zoom. Still, I wonder if this was a bit too much. Do I need to center my research through Eurocentric methodologies? I am not sure, but when I think about doing this kind of study, I think that we, as researchers, need to be okay with identifying and taking the role of participants during this research process.

### ***Data Saturation***

According to O'Reilly and Parker (2012), data saturation is reached in qualitative research when there is no new information the researcher can gather from the data collected. In the case of phenomenological research, epoché assists the researcher in pursuit of data

saturation (O'Reilly & Parker, 2012). For the purpose of this study, data saturation was accomplished through the implementation of epoché to ensure an objective interpretation of data findings. However, the researcher continues to acknowledge that in using a participatory research design, her positionality also needed to be centered to demonstrate critical epistemology toward my own research. As mentioned in Chapter 3, this study's epistemology is constructivist, and thus the creation of knowledge happened between both the researcher and the participants.

Additionally, data saturation was reached when implementing different data collection instruments. This research strategy allowed the researcher to get as much information as possible from the same participants using different instruments (Guest et al., 2020). The researcher also ensured the data were differentiated between "rich and thick" (O'Reilly & Parker, 2012). For example, the researcher collected data from semi-structured interviews, co-design workshop observations, memos, photos of participants' notes, drawings, prototypes of the activities, and end-of-workshop surveys, which for the researcher represented "layered, intricate, detailed, nuanced" (O'Reilly & Parker, 2012, p. 1409) data that doesn't necessarily represent quantity but quality. Through this research strategy, the researcher provided an in-depth interpretation for readers. Peer review of coding schemes also validated data saturation. Coding schemes were reviewed by Dr. Reyna García Ramos (the researcher's advisor), Dr. Margaret Caspe (the researcher's committee member), Mansi Kakkar, an expert in human-centered design, and Wendy Roldan, a Ph.D. candidate in the Department of Human-Centered Design at the University of Washington (Guba & Lincoln, 1989). In addition, through data saturation, the researcher discovered the study's transferability to other future research studies.

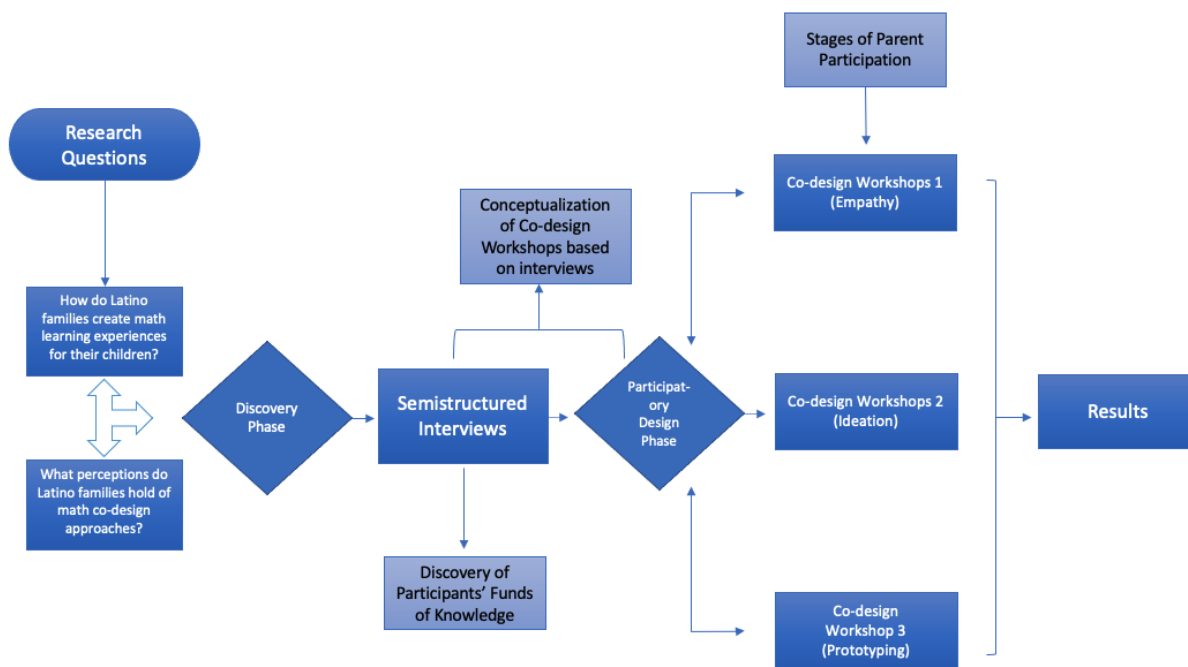
### ***Transferability***

According to Creswell (2007), rich data can help other researchers and practitioners to "transfer information to other settings and to determine whether the findings can be transferred" (p. 209). For example, the researcher explored elements of the data during the coding process

that would suggest transferability, such as research topic, questions, goals, instruments, and methods (Saldaña, 2016). In this study, the researcher described methods, findings, analysis, and full details of instruments used during the research project for other researchers and practitioners to apply this research to their contexts. Although this research study is meant for Latine families exploring co-design practices for a mathematics activity, through the analysis, interpretation, and implications of this study, the researcher found that elements of this study could be replicated in different settings and topics. For example, methods and instruments used to research Latine family perceptions of co-design approaches could be transferred to how Black families could also engage in co-design approaches in science, technology, engineering, and mathematics (STEM) fields. Or researchers could implement the same methods for co-design approaches to literacy or social and emotional learning topics.

### **Presentation of Data Results and Findings**

The following sections present detailed findings from the two main data sources: (a) interviews and (b) co-design workshops (photos of participants' notes, drawings, and prototypes of their activities and end-of-workshop surveys are part of the co-design workshop data collection). The findings from each source are presented as case studies of each participant. These case studies provide detailed descriptions of their lived experiences during the co-design workshops, share descriptions of their funds of knowledge uncovered through their semi-structured interviews, and provide a single case narrative of their participation in the design and creation of a mathematics activity. The following sections also present three coding schemes created after all the data were coded and analyzed, related to: (a) Latino families' interview answers, (b) mathematics learning and experiences from interviews, and (c) Latino families' co-design processes related to their actions (physical and verbal behaviors) and artifacts (the objects and concepts they acted upon). Figure 21 represents the schematic of research activities during the data collection process.

**Figure 21***Schematic of Research Activities***Participants' Case Studies**

This research project was designed to gather rich data from the semi-structured interviews, co-design workshop observations, memos, photos of participants' notes, drawings, prototypes of the activities, and brief end-of-workshop surveys. The following descriptions were designed to help the reader understand each participant. The structure of each single case study starts with:

- Background information of each participant,
- It follows with a description of their lives in the United States (immigrant journey, culture, language, and traditions) and,
- It provides descriptions of their mathematics and learning experiences, their funds of knowledge, and their engagement with their children and families (including description of family activities).

The researcher synthesized these multiple forms of data and used case studies to describe the complexities of each participant central to the phenomena they experienced—semi-structured interviews and co-design workshops (Creswell, 2003; Smith et al., 2009; Yin, 2009). Although the interviews consisted of 10 participants, this section describes only the data from the six Latina mothers who participated in the interviews and the co-design workshops. Six out of the 10 eligible parents continued with the co-design workshops. The other four participants cited time commitment and scheduled conflicts as the main reason for not participating.

In keeping with the idiographic focus of IPA, each participant's account is treated and written about on its own merit and terms with specificity and particularity in mind to make sense of what was obtained from the semi-structured interviews and co-design workshops (Arvola & Linder, 2018; Smith et al., 2009). A qualitative research design allowed the researcher to engage with each participant, listen, and observe how they experienced and understood interview questions and co-design workshops.

### ***Participant Interview Narratives***

To maintain confidentiality in accordance with Pepperdine University's IRB, this study uses pseudonyms to refer to the participants and to compare commonalities and differences among the parents. Participants were invited to take part in semi-structured interviews and co-design workshops to understand more about their lived experiences as Latina mothers in relation to their family lives in Metro City. Participants' semi-structured interview answers also illustrated their perceptions and attitudes about math experiences and home learning environments. The following narratives represent the single case study of each Latina mother's semi-structured interview data starting with Participant Rosa.

**Table 5***Rosa's Semi-Structured Interview Themes Tallies*

Themes/subthemes	Key phrases from interviews	Tallies
Familismo (values/culture as subthemes)	Como mi niña nació aquí, entonces, trato de hacer esa mezcla de mi país, que es Nicaragua y la de mi esposo, que es Honduras/ Since my little girl was born here, I try to make that mix of my country, which is Nicaragua, and my husband's, which is Honduras.	10
Traditional education virtues	Rosa's childrearing included honestidad/ honesty and verdad/truth as traditional moral/cultural ways of teaching her children.	11
Role of language	Y también por que es un potencial [El español], para mis hija y para otro niño, el aprender otro idioma/ And also, because there is a lot of potential [in speaking Spanish] for my daughter and for another child, to learn another language.	9
Ecological environment	No tienen nuestros padres ese habito de la lectura/Our parents don't have that habit of reading.	6
Identity formation related to (math) learning	No me gustaban. No era muy buena. Me costaba mucho aprenderlas y no creo que tenia el aprendizaje del poder a razonar bien/ I didn't like it. I wasn't very good. I had a hard time learning it and I don't think I was able reason well	9
Views on knowledge	La pequeña empieza, pregunta mas come '¿por que eso? ¿Como lo hiciste o como lo puede hacer?/ The little one starts by asking 'Why is that? How did you do it or how can I do it?	6
Interest-driven	Ella [mama] me ayudo en lo mas que podía. Por que había cosas que ella no sabia per lo que sabia era manualidades...como bordar, adornos, hacer cosas de bisutería, las aprendi bastante. Pues en esa parte si fue muy buena maestra mi mami./She [mom] helped me as much as she could. Because there were things that she didn't know but what she did know was handicrafts...like embroidery, ornaments, making jewelry... I learned a lot about it. Well, in that regard, my mommy was a very good teacher.	7

**Rosa.** Rosa's tally of themes in relation to her semi-structured data interviews is represented in table 5. The following case narrative describes in detail the results and findings

from Rosa's semi-structured interview data. Rosa is a 45-year-old mother born in Nicaragua. She immigrated to the United States when she was in her early twenties and because of political issues in her home country. Rosa graduated with a university degree from Nicaragua. She identified as a Latina woman, spoke Spanish, and understood some English. Rosa has a 3-year-old daughter enrolled in Head Start, a 6-year-old daughter in kindergarten, and one daughter in high school and one in college. Rosa stated she is a stay-at-home mother committed to holding onto her home country traditions and culture. When describing her family life in Metro City, Rosa stated the following:

*Como mi niña nació aquí, entonces, trato de hacer esa mezcla de mi país, que es Nicaragua y la de mi esposo, que es Honduras. Entonces, le trato de enseñar a ella [hija] las cosas básicas...lo que son los platos típicos. El idioma que hablamos aquí, que es el español. Siempre les trato de enseñarles los valores de que es la honestidad. Decir siempre la verdad.*

Since my little girl was born here, I try to make that mix of my country, which is Nicaragua, and my husband's, which is Honduras. So, I try to teach her [daughter] the basics... for example typical dishes. The language we speak here, which is Spanish. I always try to teach them the value of honesty. To always tell the truth.

Rosa's description of her family life in Metro City is an example of *familismo*. Traditional education virtues and cultural values are represented through Rosa's description of her multigenerational home and in how she raises her children. Rosa emphasized the importance of proper social behavior, by stating she raises her children with values such as *honestidad*/honesty and *verdad*/truth (Murphey et al., 2017). The value of honesty and truth can be understood as one of Rosa's childrearing values in a broader sense to inference expectations that she has for children's schooling and academic future. It is important to note that these



codes were not explicitly labeled by Rose but emerged through her own comments and explanations.

Rosa also considered their home language as a diverse linguistic capital, both in terms of future economic potential—*“Y también por que es un potencial, para mis hija y para otro niño, el aprender otro idioma”* / “And also, because there is a lot of potential for my daughter and for another child, to learn another language”—and as cultural appreciation, which Rosa illustrated by stating how reading and linguistic abilities are highly valued in her home. Rosa spoke of an abundance of books in her home, citing literacy and reading as a priority with her 3-year-old. Rosa stated that her desire for her children to be well-read and appreciate reading comes from her parents not valuing literacy: *“No tienen nuestros padres ese habito de la lectura”* / “Our parents don't have that habit of reading.”

Rosa carried with her this literacy topic throughout her engagement in the co-design workshops. It is important to note how much Rosa valued literacy achievement both in English and in Spanish for her children and to contrast this with her mathematics learning experiences. When I brought up a question about her mathematics experience, Rosa stated, *“¡Ah, no se!”* / “Oh, I don't know!” Rosa had a very strong negative reaction to the topic of mathematics learning compared to literacy learning, reading, and books. When asked about her experience with math learning, she described it this way:

*No me gustaban. No era muy buena. Me costaba mucho aprenderlas y no creo que tenia el aprendizaje del poder a razonar bien. Creo que la enseñanza del maestro también tuvo que ver...creo que si hubiera tenido un maestro que hubiera explicado mejor en lo que estaba fallando, creo yo que me hubieran gustado [las matemáticas].*

I didn't like it. I wasn't very good. I had a hard time learning it and I don't think I was able reason well. I think the teacher's teaching also played a part... I think, if

I had had a teacher who had explained better what I was failing at, I think I would have liked it [math].

Despite not feeling comfortable with mathematics, Rosa placed a strong value on her children understanding academic content and doing well in their school activities. Her views on education aligned with the traditional Latine cultural values mentioned in Chapter 2 (Murphey et al., 2014; Ramos, 2014). Rosa stated how she and her husband left everything in their home countries—“*Dejamos todo allá, todo, todo, todas nuestras cosas por ese problema político*”—and thus want to “support/”*apoyar*” their children to “learn, but more than anything to focus and do their best”/“*Que ellas aprendan, mas que todo que se enfoquen y le echen ganas.*” Rosa’s traditional values included making sure her children speak Spanish. Rosa’s personal aspirations like this one are a reflection of family values but also her views on knowledge and what her children are capable of learning. Rosa wanted to hold onto her children speaking Spanish as an ability that would not only sustain her children’s Latine identity but also be recognized and prized (Bucholtz et al., 2017). For example, Rosa shared the following:

*Casi la mayoría de las que tengo aquí en casa son libros y me gusta leerle bastante y bastante en español por que es el idioma fuerte de ella. También el Ingles, pero ella habla totalmente el español por que quiero que mantenga esos lazos familiares. Y que ellas puedan entenderse. Y también por que es un potencial, para mis hija y para otro niño, el aprender otro idioma.*

Almost most of what I have here at home are books and I like to read to her quite a bit and quite a bit in Spanish because that is her strongest language. She also speaks English, but she speaks Spanish because I want her to maintain those family ties. And that they can understand each other. And also, because it is good, for my daughter and for another child, to learn another language.

Through Rosa’s interview, language as a cultural value were emphasized as a way to supporting her children. Rosa statement also demonstrated how she keeps her strong family

network through holding on to their home language. This is an important finding, revealing that Latine parents in this study engaged in literacy activities affecting the quality of their home environments. For parents in this study, literacy is ultimately associated with children's school readiness (Farver et al., 2006).

In addition to supporting her children with home learning, Rosa engaged with her children in her community and at school. Rosa stated that before the COVID-19 pandemic, she would take her daughter to the library or would go to church. However, with the COVID-19 restrictions, Rosa thought about making Fridays a family fun day where she would do different activities. Whenever possible, Rosa and her husband would take their children to the park or church. Some of these activities included traditional Latine family board games such as *lotería*.

*Tenemos una actividad que, bueno yo pensaba que era de mi país, per yo me di cuenta estando aquí que es de México. Jugamos las lotería.*

We have an activity that, well, I thought it was from my country, but I realized when I was here that it is actually from Mexico. We play *lotería*.

Rosa also shared how she plays a math letter card game with her 3-year-old daughter, emphasizing once again how much she values reading and literacy, saying:

*Témenos juegos de matemáticas, de juegos de letras, por que nos gusta bastante y la [hija] hace pensar*

We have math games, math letter games, because we like it a lot and it makes my [daughter] think.

Rosa also mentioned how much her daughter had fun playing *lotería* and the letter math games, stating:

*La pequeña empieza, pregunta mas come '¿por que eso? ¿Como lo hiciste o como lo puede hacer?*

The little one starts by asking 'Why is that? How did you do it or how can I do it?'

However, Rosa viewed these questions as representing emotions of excitement rather than a mechanism for cognitive development in her young child. This finding reveals the need to help Latine parents understand the role of children's questions in helping them develop inquiry skills as part of early childhood development. While Rosa views her engagement with her children as part of caregiving practices, Rosa also demonstrated how setting up a learning environment for her daughter was a priority.

In describing some of the activities Rosa engaged in with her daughter, she thought about some of the things she liked when she was little in her country and said how she tries to do some of those activities at home here in the United States with her children. Rosa shared how even though her parents were not present in her education and schooling, the thing that she remembers the most is her mother teaching her crafts. Rosa shared the following:

*Ella [mama] me ayudo en lo mas que podía. Por que había cosas que ella no sabia per lo que sabia era manualidades...como bordar, adornos, hacer cosas de bisutería, las aprendi bastante. Pues en esa parte si fue muy buena maestra mi mami.*

She [mom] helped me as much as she could. Because there were things that she didn't know but what she did know was handicrafts...like embroidery, ornaments, making jewelry... I learned a lot about it. Well, in that regard, my mommy was a very good teacher.

Rosa's interests and her children's home learning environment were connected to personal memories reflecting personal affinity as a driver for motivation and engagement. Rosa was the only participant who mentioned having an affinity for crafts, and this affinity was evident during the creation of her three prototypes during the third co-design workshop. Rosa's nostalgia for home found its way between a lived learning environment and contextualization in the construction of her mathematics artifact which is described in her co-design case narrative.

**Table 6***Daniela's Semi-Structured Interview Themes Tallies*

<b>Themes/subthemes</b>	<b>Key phrases from interviews</b>	<b>Tallies</b>
Familismo (values/culture as subthemes)	Pues los estamos criando mas al estilo de México. Usamos mas las tradiciones, involucramos las tradiciones...que son el día de los Muertos/ Well, we are raising them more in the Mexican style. We use more of the traditions, we involve the traditions... which are the Day of the Dead	9
Role of language	Y le inculcamos que hable el español/ And we make sure to talks in Spanish too.	2
Ecological environment	Me levanto para llevarlos a la escuela, llego a mi casa y me pongo a hacer el desayuno para dársela a la niña pequeña, que es la que se queda conmigo.../ I get up to take them to school. I get home and start making breakfast to give it to the little girl, who is the one who stays with me...	4
Views on knowledge	Mis niños son buenos para las matemáticas, pero si les ha costado mas la lectura, comprensión de la lectura. Pero para matemáticas no hay problema/ My children are good at math, but they have had a harder time with reading and reading comprehension. But there is no problem with math.	4
Identity formation related to (math) learning	Para enseñar matemáticas uso el ábaco...ese el que utilizo con ella y de hi fue donde mire que se le hizo mas fácil, porque yo usaba mucho los dedos y a veces no le alcanzaban los dedos [se rie]/ I use the abacus to teach mathematics... and that's the one I use with her, and I saw that it was easier for her, because I used my fingers a lot and sometimes, she didn't have enough fingers [she laughs].	9
Traditional education virtues	Entonces yo les digo a mis hijo, "tienes que estudiar si quiere tener un futuro bien, por que las cosas no se te va a dar nomas así. Tienes que echarle ganas/I tell my children, "You have to study if you want to have a good future because things won't be easy. You have to do your best."	10
Interest-driven	Daniela mentioned how she tried to make learning fun by doing activities like lotería or board games and playing with her 2-year-old daughter so that she could learn how to multiply.	7

**Daniela.** Daniela's tally of themes in relation to her semi-structured data interviews is represented in table 6. The following case narrative describes in detail the results and findings from Daniela's semi-structured interview data. Daniela is a 36-year-old stay-at-home mother of a 2-year-old, an elementary school student, and a high school student. Daniela was born in Mexico, where she also graduated from college in Guadalajara. She identified as a Latina woman. Daniela speaks Spanish and understands English because of her children, but she cannot speak it. Daniela immigrated to the United States and moved to Metro City because of marriage after graduating from college. She has been living in Metro City for 17 years. Daniela also expressed her connection to her Mexican roots by sharing how her cultural upbringing was present in her life in the United States and especially in how she was raising her children. She shared the following:

*Pues los estamos criando mas al estilo de México. Usamos mas las tradiciones, involucramos las tradiciones...que son el día de los Muertos, la de 16 de septiembre. Hay algunas tradiciones y eventos que seguimos, pero para la mayoría los trato de involucra mas en la cultura de nosotros. Y le inculcamos que hable el español.*

Well, we are raising them more in the Mexican style. We use more of the traditions, we involve the traditions... which are the Day of the Dead, the 16th of September. There are some traditions and events that we follow, but for the most part I try to involve them more in our culture. And we make sure to talk in Spanish too.

Daniela also stated she collaborates with her young daughter's school activities through events like Day of the Dead, where the school asks for parents' participation to set *altares* (an altar dedicated to a departed person with religious meaning) and because of her Mexican culture she feels she is able to contribute: *“En la escuela donde va mi niña también utilizan mucho los eventos [mexicanos] como el día de los muertos donde hacemos altares por que la*

*escuela pide nuestra participación.*” For Daniela, cultural values and traditions enacted in her community are also part of why she remains in Metro City. Familismo in this case is represented in her family and also in her community and the ways that she engages in her children’s education and learning inside and outside of her home.

However, in Daniela’s opinion engagement with her daughter, consists mostly of caregiving, even in relation to school engagement. She shared the following description of a typical day in her life:

*Me levanto para llevarlos a la escuela, llego a mi casa y me pongo a hacer el desayuno para dársela a la niña pequeña, que es la que se queda conmigo...Y de ahí me pongo un rato con ella, a veces esta en su tableta y estamos viendo videos o algún juego que tenga, o saca sus muñequitos y nos ponemos con los muñecos...Después tengo que recoger a su hermana preparar la comida y hacer limpieza, poner hacer la tarea...Luego la llevo al taekwondo y después al futbol y me quedo con la niña pequeña en el parque y así se nos va el día.*

I get up to take them to school. I get home and start making breakfast to give it to the little girl, who is the one who stays with me... And then I spend some time with her. Sometimes she is on her tablet, and we watch videos or some game she has, or she takes out her little dolls and we play with them.... Then I have to pick up her sister, prepare food and clean up, do homework.... Then I take her to taekwondo and then soccer, and I stay with the little girl in the park and that's how our day goes.

Although Daniela viewed her role as a mother in terms of caregiving, when asked about some of the things she did with her 2-year-old as a family, she stated that they were always on the go, driving to places, and thus listening to music.

Daniela stated that they used songs to name things so that her daughter could practice learning words by repetition “*Entonces casi siempre estamos en el carro...estamos cantando*

*para que ella se vaya grabando las cosas, menciono colores por ejemplo 'esto es rojo,' o 'esto es una manzana' y ella repite/* “ Then we're almost always in the car... we're singing so she learns things. I mention colors. For example, ‘this is red,’ or ‘this is an apple,’ and she repeats it.” Daniela did not view engaging in inquiry in the car as learning but as an everyday routine she did because they were always in the car. Daniela’s views on knowledge described the situated and contextual learning as a routine and part of everyday caregiving.

When asked to share more about her family activities at home, Daniela mentioned that although mathematics was not “*mucho de su grado*”/“not my cup of tea,” she tried to help her children with math. However, she viewed her children as inherently good at math, stating that: “*Mis niños son buenos para las matemáticas, pero si les ha costado mas la lectura, comprensión de la lectura. Pero para matemáticas no hay problema.*” / “My children are good at math, but they have had a harder time with reading and reading comprehension. But there is no problem with math.”

Daniela went on to say that although she did not remember or know math, her children did ask for her help and she found ways to help them, demonstrating once again how Latine parents’ involvement and engagement in their children’s education and learning activities varies. This finding also counters deficit thinking in Latine parents, which sees Latine parents as having a lack of motivation and inadequate educational practices for their children (Koyama & Desjardin, 2019), which is the opposite of how Daniela described supporting her children in finding answers to their academic challenges. Daniela stated the following when describing how she support her children’s learning:

*Nos ponemos a investigar. Les digo, 'metemos a google y investigamos.' Y ya le digo, ya me pongo a leerle y ya trato de explicárselo. Para enseñar matemáticas uso el ábaco. Bueno en México se llama ábaco...y ese el que utilizo con ella y de hi fue donde mire que se le hizo mas fácil, porque yo usaba mucho los dedos y a veces no le alcanzaban los dedos [se rie].*



We set out to investigate. I tell them, 'let's google it and do some research.' And I tell her, I start reading to her and I try to explain it to her. I use the abacus to teach mathematics. Well, in Mexico it's called an abacus... and that's the one I use with her, and I saw that it was easier for her, because I used my fingers a lot and sometimes, she didn't have enough fingers [she laughs].

Daniela employed different strategies to engage her children in mathematics learning, even if she believed her children were inherently better at math than she was.

Daniela mentioned how she tried to make learning fun by doing activities like *lotería* or board games. She stated that in her last visit to Mexico, she bought a *lotería* game about multiplication, and she played it with her 2-year-old daughter so that she could learn how to multiply. When describing how she found this *lotería* about multiplication, Daniela stated she found the game in a *papelería* she used to frequent when she was young: *"Ahí es donde la encontré, en una papelería que yo visitaba."* Daniela felt comfortable "teaching" or helping her kids with mathematics, despite her stating that she struggled a lot with mathematics when she was younger: *"Las tablas de multiplicar fueron con las que batalle bastante por que en México nos obligan como aprenderlas."* / "I struggle the most with the multiplication because in Mexico they force us how to learn it a specific way."

When talking about how she engaged in her children's education, Daniela mentioned how supporting her children was a priority. Daniela values education as a priority but she views this priority under traditional Latine cultural values and traditions. For Daniela, telling their children to do well in school was the way she support her children. She shared the following: *"Entonces yo les digo a mis hijo, 'tienes que estudiar si quiere tener un futuro bien, por que las cosas no se te va a dar nomas así. Tienes que echarle ganas.'"* / "I tell my children, 'You have to study if you want to have a good future because things won't be easy. You have to do your best.'" For Daniela, raising a well-behaved child through *consejos* and *apoyo* was a form of supporting their children's educational success (Valdés, 1996).

Table 7

## Carla's Semi-Structured Interview Themes Tallies

Themes & subthemes	Key phrases from interviews	Tallies
Familismo (values/culture as subthemes)	<i>En la casa...pues la cultura mexicana es la que sigue en ellos. Celebramos día de los muertos, la Navidad, el cinco de mayo y todo eso/ In the house...we follow the Mexican culture. We celebrate Day of the Dead, Christmas, Cinco de Mayo and all that.</i>	6
Role of language	<i>En la casa siempre se tiene que hablar español/ In the house they always have to speak Spanish.</i>	6
Traditional education virtues	<i>I want them to be good people and respect elders .../Quiero se sean personas buenas, y buenas con la comunidad, que respeten a los mayores...</i>	11
Ecological environment	<i>Mi día consiste de levantar a los niños para la escuela, hacer quehaceres, ponerme al tanto de la escuela virtual, hacer comida, llevar al niño con la terapeuta. Y así es el día a día./My day consists of getting the kids ready for school, doing chores, catching up with the virtual school, making food, taking the child to the therapist. And that's how it is every day.</i>	8
Views on knowledge	<i>las matemáticas no están para mí/ mathematics are not for me."</i>	1
Interest-driven	<i>Vamos a la iglesia y al parque, pero también no gusta hacer, bueno a mí a mi hija y niño, mas que nada hacemos panes y pasteles/We go to church and to the park, but we also don't like to make... well me, my daughter and child, we mostly make bread and cakes.</i>	2
Identity formation related to (math) learning	<i>La verdad era muy mala para matemáticas. No tenía buenas calificaciones. Era lo que mas se me dificultaba...las multiplicaciones se me hacían difícil. [Tenía] mucha frustración pues por que sentía que no podía. Yo pienso que a veces eran los maestros y yo también/ I was really bad at math. I didn't have good grades. It was the most difficult thing for me...the multiplications were difficult for me. [I was] very frustrated because I felt I couldn't do them. I think sometimes it was because of the teachers and because of me too.</i>	7

**Carla.** Carla's tally of themes in relation to her semi-structured data interviews is represented in table 7. The following case narrative describes in detail the results and findings from Carla's semi-structured interview data. Carla is a mom to a 4-year-old son, a 16-year-old daughter, and a college student son. She was 36 years old and a high school graduate from Mexico, where she was born. Carla identified as a Latina woman who spoke Spanish. She previously moved back to Mexico but had been living in Metro City since coming back 7 years ago. Carla's entire life, she had been moving back and forth between the United States and Mexico. When asked about her life in Metro City, Carla spoke of her cultural and linguistic Mexican heritage as being ever present in her life and her family. She shared the following: "*En la casa siempre se tiene que hablar español entre ellos, pues la cultura mexicana es la que sigue en ellos. Celebramos día de los muertos, la Navidad, el cinco de mayo y todo eso.*" / "In our house we always have to speak Spanish among ourselves, because they follow the Mexican culture. We celebrate Day of the Dead, Christmas, Cinco de Mayo and all that."

Carla's statement reflects her acknowledgment of how her Mexican culture was not put aside to function within U.S. norms and values. For Carla, viewing her culture as a collection of holidays, food, and celebrations was a strength in family ties and learning, and this was even more evident when she referred to speaking Spanish as a highly valuable skill. Carla highly values speaking Spanish and wants her children to speak it but also to feel proud about speaking it. As Carla stated, "The Mexican culture is in them." Carla went on to say that besides speaking Spanish, the most important thing for her when it came to the education of her children was for her kids to be good people and good with their community, respecting elders and focusing on their schooling: "*Quiero se sean personas buenas, y buenas con la comunidad, que respeten a los mayores, y que se concentren en su educación.*" This finding is consistent with Latine culture narratives—Carla's expectations for her children's education were about morals and work ethic (Hill & Torres, 2010), about educación, a common and prevalent theme in current Latine family literature.

Carla also expressed that she is dedicated to her children as a mother. She mentioned her involvement in her 4-year-old's school through parent workshops where she had been learning about the school system and what to do to support her children's education, highlighting how she engaged in her children's education in and out of the home and in her community setting. Carla mentioned that with COVID-19 she had been trying to take some parent workshops online but that it was a difficult balance, with all her duties as a mom, trying to help her children with school. Carla shared the following:

*Obviamente con la pandemia no eh podido seguir ninguna interacción en la escuela o en la comunidad...mi día consiste de levantar a los niños para la escuela, hacer quehaceres, ponerme al tanto de la escuela virtual, hacer comida, llevar al niño con la terapeuta. Y así es el día a día.*

Obviously with the pandemic I haven't been able to have any interaction at school or in the community... my day consists of getting the kids ready for school, doing chores, catching up with the virtual school, making food, taking the child to the therapist. And that's how it is every day.

Carla also opted to keep her camera on during the interview. While she was sharing her day-to-day routine, she maintained a smile and her tone was cheerful in sharing here day-to-day routines. Carla shared how much responsibility she is accountable for as a mother, caregiver, and educator for her daughters.

Carla shared that although her day was busy with so many "mom things"/"cosas de mamas," she tries to engage in fun activities with her children. Carla stated that they went out to church or to the park as a family. But she recalled a special thing that she did with her son and daughter that made her smile widely: "*Vamos a la iglesia y al parque, pero también no gusta hacer, bueno a mi a mi hija y niño, mas que nada hacemos panes y pasteles.*" / "We go to church and to the park, but we also don't like to make... well me, my daughter and child, we mostly make bread and cakes."

Carla's facial expressions, verbal statements, and tone showed a strong connection with her children when engaging in interests that she likes and enjoys and in turn that her children also like and enjoy. For Carla, baking reflects family dynamics—a place for communication, knowledge, culture, and child development, even if the latter is not clear for Carla. Carla's beliefs and behaviors about her child's development center around parenting practices more than understanding what their children's needs are for early learning development.

When asked about what other activities she does with her children, Carla mentioned that her 4-year-old was very interested in letters. She shared: *“Estamos tratando de que se interese por mas cosas, por que nomas quiere hacer o jugar con letras, quiere todo de letras, ver televisión pero con puras letras.”* / “We're trying to get him interested in more things, because he just wants to do or play with letters. He wants everything to do with letters, to watch television, but only with letters.” Carla also shared that she would like her son to also be interested in numbers but fears that because she wasn't good at math when she was little, it might be the same with her young son. Carla shared the following with a facial expression of frustration:

*La verdad era muy mala para matemáticas. No tenia buenas calificaciones. Era lo que mas se me dificultaba...las multiplicaciones se me hacían difícil. [Tenia] mucha frustración pues por que sentía que no podía. Yo pienso que a veces eran los maestros y yo también.*

I was really bad at math. I didn't have good grades. It was the most difficult thing for me...the multiplications were difficult for me. [I was] very frustrated because I felt I couldn't do them. I think sometimes it was because of the teachers and because of me too.

Carla's interview reveals her experience with mathematics relate to the theme of identity formation in relation to learning. This is an important finding because it continues to highlight the role parents play in supporting their children's learning development but also how parents' negative attitudes or beliefs toward mathematics can in turn affect their children's math

readiness. It is also important to consider how cultural factors, specifically, play a role in Latine families' beliefs and attitudes toward math learning.

Carla's interview suggests how math anxiety is characterized by cognitive, emotional, and self-efficacy experiences (Macmull & Ashkenazi, 2019). Carla does not hold negative beliefs about mathematics, but her experiences with math teaching and learning have influenced her expectations and beliefs about what she is capable of learning and doing when it comes to mathematics and how she may influence her young son's math learning. Carla understands that math is important for young child's learning but Carla also believes that she is not capable supporting her child with math and thus employs the support of her family in helping her young children learn math.

Carla shared that when her young son needs help, she depends on her young child's older siblings. They serve as brokers in helping her young child understand mathematics concepts because according to Carla, math is not in her: *"las metematicas no estan para mi."/* "mathematics are not for me."

### Table 8

#### *Sandra's Semi-Structured Interview Themes Tallies*

Themes & subthemes	Key phrases from interviews	Tallies
Ecological environment	Sandra lost her parents and one of her siblings in a car accident and she had to drop off of college to raise and take care for her youngest sibling.	8
Role of language	<i>Miramos mucho a los padres de mi esposo y ellos nomas habla español... Y yo le dije [a mi esposo] que tenemos que enseñarle a hablar en español, por que para mi es muy importante que ella pueda hablar con sus abuelos/</i> We see my husband's parents a lot and they only speak Spanish... And I told [my husband] that we have to teach her to speak Spanish, because it's very important for me that she can talk to her grandparents.	8

Themes & subthemes	Key phrases from interviews	Tallies
Familismo (values/culture as subthemes)	Sandra's daughter only had one set of grandparents, she wanted to make sure her daughter could talk to them/ <i>Pero son los únicos abuelos que va a atender, así que yo quiero que pueda hablar con ellos.</i>	8
Traditional education virtues	<i>Yo quiero que ella sepa mas que yo y tenga una educación mas que yo, por que yo fui al colegio, pero no lo termine...yo quiero que siga subiendo el nivel con cada generación. / I want her to know more than me and have more education than me, because I went to school, but I didn't finish it... I want to keep raising the education level with each generation.</i>	13
Views on knowledge	<i>Tengo espacio pare tener muchos jitomates y trato de crecerlos. También a ella le gusta organizar la ropa...lavar los trastes...la mando hacer cosas sola, pero no le gusta...entonces tratamos de hacerlo todo juntas/ I have room to grow tomatoes and I try to grow them. She also likes to organize clothes...wash the dishes...when I send her to do things on her own, she doesn't like it...so we try to do things together. [A ella] le gusta hacer rompecabezas. Todos los juegos que tiene, casi todos son de rompecabezas...A ella le gustaron mucho los rompecabezas. Cuando fuimos a la tienda y ella reconoció su nombre muy temprano. Y cuando vio un rompecabezas de Martha &amp; Raul, lo agarro y nos pusimos a jugar. Entonces fue un interés que le nacio a ella [She] really likes solving puzzles. All the games she has, almost all of them are puzzles...She really likes the puzzles. When we went to the store, she recognized her name very early on. And when she saw a Martha &amp; Doug puzzle, she grabbed it and we started playing. So, it was an interest that was born out of her.</i>	3
Interest-driven	<i>Cuando vamos a la tienda y me pide galletas le digo "cuanto cuestan estas galletas?" y ella va y mira y me dice \$2.27, y después le digo, "okay, quieres esa galleta con los \$2.27 o quieres otra cosa con el mismo dinero?" /When we go to the store and she asks me for cookies I say, "How much are these cookies?" and she goes and looks and tells me \$2.27, and then I say, "Okay, do you want that cookie with the \$2.27 or do you want something else with the same money?"</i>	7
Identity formation related to (math) learning	<i>Cuando vamos a la tienda y me pide galletas le digo "cuanto cuestan estas galletas?" y ella va y mira y me dice \$2.27, y después le digo, "okay, quieres esa galleta con los \$2.27 o quieres otra cosa con el mismo dinero?" /When we go to the store and she asks me for cookies I say, "How much are these cookies?" and she goes and looks and tells me \$2.27, and then I say, "Okay, do you want that cookie with the \$2.27 or do you want something else with the same money?"</i>	9

**Sandra.** Sandra's tally of themes in relation to her semi-structured data interviews is represented in table 8. The following case narrative describes in detail the results and findings from Sandra's semi-structured interview data. Sandra was born in the United States to Mexican parents. She is 34 years old and a native English speaker, but she stated that she preferred to speak Spanish. Sandra has a 4-year-old enrolled in a community preschool. She also identified as a Latina woman. Sandra stated that she was only able to do some college because her parents and her sibling passed away in a car accident and she had to care for her youngest sibling. Sandra talked about her life in Metro City as a lonely experience. She only has her daughter and husband in Metro City, and her younger sister moved to a different state in the United States. Sandra's experience of challenges in overcoming obstacles reflect navigational funds of knowledge that exist within her lived experience. It is important to provide this ecological background on Sandra's challenging past because the theme of loneliness carried throughout Sandra's experience in the co-design workshops.

Although Sandra's parents passed away, she stated that she is close to her husband's parents who are also Mexican. Sandra places a strong value on her daughter and her speaking Spanish as linguistic capital. Sandra shared the following:

*Miramos mucho a los padres de mi esposo y ellos nomas habla español, no ingles. Cuando la cuidaban de chiquita, le hablan en español y estaba bien pero después empezó a crecer y nosotros le hablamos ingles en la casa. Y yo le dije [a mi esposo] que tenemos que enseñarle a hablar en español, por que para mi es muy importante que ella pueda hablar con sus abuelos.*

We see my husband's parents a lot and they only speak Spanish, not English. When they would take care of her as a child, they spoke to her in Spanish and she was fine, but then she started to grow up and we speak English to her at home. And I told [my husband] that we have to teach her to speak Spanish, because it's very important for me that she can talk to her grandparents.



For Sandra, speaking Spanish is an opportunity, an asset, and a cultural connection to her daughter's grandparents. Additionally, Sandra's view of speaking Spanish as a linguistic capital is intentional and deliberate in building a relationship with her family but it also benefits her daughter in her social and academic future.

Sandra went on to say that she enrolled her daughter in a dual immersion class in a Head Start program. Sandra's statements on speaking more than one language is not only essential to communicating with her family but also part of a culture she wanted to hold on to, which falls under the same theme of Latine traditional cultural values and beliefs. She stated that her husband's parents were okay with her daughter not speaking Spanish to them. However, Sandra shared that because her daughter only had one set of grandparents, she wanted to make sure her daughter could talk to them: "*Pero son los únicos abuelos que va a atender, así que yo quiero que pueda hablar con ellos.*" Sandra's statements also represent the theme of familismo related to her family experiences.

When asked about what other goals or aspirations she had for her daughter, Sandra mentioned expectations, attitudes, and beliefs about their children's education, as parental aspirations. Sandra shared:

*Yo quiero que ella sepa mas que yo y tenga una educación mas que yo, por que yo fui al colegio, pero no lo termine...yo quiero que siga subiendo el nivel con cada generación. Y quiero que sus hijos de mi hija salgan algo mas, no quiere que nade sea menos.*

I want her to know more than me and have more education than me, because I went to school, but I didn't finish it... I want to keep raising the education level with each generation. And I want my daughter's children to end up with something more, not with something less.

Sandra continued sharing that she was engaged with her child's school. She stated that she volunteered in the parent-teacher association (PTA) but that unfortunately with COVID-19, she

had not been able to attend meetings. She also shared that before the COVID-19 pandemic, she would take her daughter to “mommy and me” classes, volunteered with other nonprofits, and took her daughter to the library. But at home, she had to think about different ways to engage with her daughter: *“Tengo espacio para tener muchos jitomates y trato de crecerlos. También a ella le gusta organizar la ropa...lavar los trastes...la mando hacer cosas sola, pero no le gusta...entonces tratamos de hacerlo todo juntas.”* / “I have room to grow tomatoes and I try to grow them. She also likes to organize clothes...wash the dishes...when I send her to do things on her own, she doesn't like it...so we try to do things together.”

It is important to note that when Sandra mentioned she engaged in her child's education, she described it as a volunteer and caregiving activity. However, this interview reveals the many ways Sandra created home learning opportunities for her children, and specifically home math environments. When asked what other activities she did with her daughter, Sandra mentioned reading and books. She shared the following:

*Nosotros leemos mucho. En la noche yo y mi esposo cada uno le leemos un libro y los miércoles la llevamos a la librería, pero paramos durante COVID-19. Pero ya empezamos otra vez de nuevo y ella escoge un libro por uno y agarra lo que ella quiere [leer]. Como este miércoles que la lleve, ella agarró 20 libros chiquitos.*

We read a lot. At night my husband and I each read a book and on Wednesdays we take her to the bookstore, but we stopped because of COVID-19. But then we started again, and she picks one book at a time and grabs what she wants [to read]. Like this Wednesday that I took her, she grabbed 20 small books.

Literacy achievement was prevalent in Sandra's views of academic and school success, especially for her child. While valuing Spanish as linguistic asset, it was evident that access to and achieving English literacy was viewed as a more important skill to development than

anything else. However, when asked about her daughter's favorite books, Sandra stated that it was not really books that her daughter liked but puzzles. She shared:

*[A ella] le gusta hacer rompecabezas. Todos los juegos que tiene, casi todos son de rompecabezas...A ella le gustaron mucho los rompecabezas. Cuando fuimos a la tienda y ella reconoció su nombre muy temprano. Y cuando vio un rompecabezas de Martha & Raul, lo agarro y nos pusimos a jugar. Entonces fue un interés que le nacio a ella.*

[She] really likes solving puzzles. All the games she has, almost all of them are puzzles...She really likes the puzzles. When we went to the store, she recognized her name very early on. And when she saw a Martha & Doug puzzle, she grabbed it and we started playing. So, it was an interest that was born out of her.

For Sandra, centering on her child's interest allowed the two to engage as a family. She further elaborated by stating that puzzles had almost become a self-expression of identity in her daughter. Sandra's interview revealed deep understanding of her child's needs and motivations, which surfaced in the co-design workshops.

In discussing how she engaged with her daughter, Sandra also mentioned that another thing she noticed her daughter liked is when they were driving and she engaged her daughter in singing to count numbers:

*En el carro, un día con mi esposo, fuimos a visitar a sus padres y ya estábamos dos horas en camino, y le empecé a decir a mi niña 'uno' y ella decía 'dos', y mi esposo decía 'tres', después cuatro, cinco, empezó así y ella quería seguirle y entonces había momentos donde decía 'okay ustedes dos continúen yo ya quiero parar' pero si es algo que le gusta, si es como un juego, ella quiere seguir sin parar.*

One day we were in the car with my husband. We were going to visit his parents and we had already been driving for two hours. I started telling my girl, 'one,' and she would say 'two.' Then my husband said 'three.' Then four, five... it started like that, and she wanted to keep going and then there were moments where she said, 'Okay, you two continue, I already want to stop.' But if it's something she likes, if it's like a game, she wants to continue without stopping.

When asked about how comfortable she feels with mathematics, Sandra mentioned that although she is not an "expert," she remembered how her mom and dad would help her understand math, recalling that her dad one day said to her: "*Las matemáticas son algo universal, como el idioma en español, en japonés, el inglés, los números son los números.*" / "Mathematics is something universal, like the language in Spanish, in Japanese, in English, numbers are numbers."

Sandra's experience with math was shaped by her parents' engagement and consejos (sayings to reinforce character). However, even though Sandra mentioned that her parents did talk about math when she was young, when asked what else she remembers, she described another math learning experience as a caregiving practice. Sandra shared the following:

*Cuando vamos a la tienda y me pide galletas le digo 'cuanto cuestan estas galletas?' y ella va y mira y me dice \$2.27, y después le digo, 'okay, quieres esa galleta con los \$2.27 o quieres otra cosa con el mismo dinero?'*

When we go to the store and she asks me for cookies I say, 'How much are these cookies?' and she goes and looks and tells me \$2.27, and then I say, 'Okay, do you want that cookie with the \$2.27 or do you want something else with the same money?'

Sandra viewed her math interactions with her child as caregiving practices, this finding reveals how much math talk Sandra did with her child by asking questions and teaching her child explicit strategies to use in problem-solving tasks, like counting money.

**Table 9***Sol's Semi-Structured Interview Themes Tallies*

<b>Themes &amp; subthemes</b>	<b>Key phrases from interviews</b>	<b>Tallies</b>
Familismo (values/culture as subthemes)	<i>Vivimos como mexicanos. Mi esposo es colombiano, entonces enseñamos las dos culturas. Por ejemplo, celebramos las posadas en Navidad, día de los Muertos.../We live as Mexicans. My husband is Colombian, so we teach both cultures. For example, we celebrate posadas at Christmas, Day of the Dead...</i>	11
Traditional education virtues	<i>Como yo no tuve la oportunidad de ir al colegio, eso es lo que mas yo quiero para mis niñas, el estudio, que sigan adelante, que les digo lo ellas quieran pero que vayan al college/ Since I didn't have the opportunity to go to school, that's what I want the most for my girls: to study, to keep going. I tell them they can do whatever they want, but they should go to college.</i>	8
Ecological environment	<i>Sol's parents were not present in her education, their focus was on "criar"/to raise their children and work a lot to provide "comidad"/food and a home in which to live.</i>	8
Role of language	<i>Habamos español. Quiero que siempre hablen el español/We always talk in Spanish. I want my [children] to always speak Spanish.</i>	3
Views on knowledge	<i>En las matemáticas yo no era muy buena. Mi suegro es un computer engineer, so el tiene que ser bueno en las matemáticas y espero que mi hija herede la habilidad de hacer matemáticas/ I wasn't very good at math. My father-in-law is a computer engineer, so he has to be good at math and I hope my daughter inherits the ability to do math.</i>	3
Identity formation related to (math) learning	<i>No, yo nunca fui buena en las matemáticas, no. Batallaba mucho, no se me, trataba de aprender, pero no. Cosas como algebra fue lo que no se me quedaba nada. Me frustraba, sí. Triste, me frustraba, que no podía estar como los demás estudiantes que estaban al lado mío y que rápido, rápido se les pegaba a aprender. Buscaba ayuda, pero no, no se me pegaba mucho /No, I was never good at math, no. I struggled a lot, I tried to learn but I couldn't. Concepts like algebra, I could never learn. It frustrated</i>	7

Themes & subthemes	Key phrases from interviews	Tallies
Interest-driven	<p>me, yeah. I was sad, I was frustrated, that I could not be like the other students who were next to me and learned quickly compared to me. I looked for help, but no, but I couldn't really understand math.</p> <p><i>A mi niña le gusta salir mucho, ella le gusta estar en la naturaleza. A mi esposo le gusta la naturaleza, ir a camping o a caminar, estar con árboles, ir hiking. We are like outdoor persons. Creo también por que a mi papá le gusta mucho el nature, él con tal de salir a fuera dice "ya mira el aire, mira los pajaritos, mira esto."/</i> My little girl likes to go out a lot, she likes to be in nature. My husband likes nature, going camping or taking a walk, being around trees, hiking. We are like outdoor people. I think also because my dad likes nature a lot, he just wants to go outside and says, "Look at the air, look at the birds, look at this."</p>	9

**Sol.** Sol's tally of themes in relation to her semi-structured data interviews is represented in table 9. The following case narrative describes in detail the results and findings from Sol's semi-structured interview data. Sol was also born in the United States to Mexican parents. She is a 36-year-old stay-at-home mom to a four-year-old and a high school daughter. She completed high school but was unable to pursue a higher education degree. She is a native English speaker but prefers to speak Spanish. She identifies as a Latina woman. When asked about her life in Metro City, Sol stated the following:

*Vivimos como mexicanos. Mi esposo es colombiano, entonces enseñamos las dos culturas. Por ejemplo, celebramos las posadas en Navidad, día de los muertos, somos muy enfocados en la familia como mexicanos. Celebramos los cumpleaños, quinceañeras, día de las madres, todas las celebraciones.*

*Habamos español. Quiero que siempre hablen el español.*

We live as Mexicans. My husband is Colombian, so we teach both cultures. For example, we celebrate posadas at Christmas, Day of the Dead... we are very family-focused as Mexicans. We celebrate birthdays, quinceañeras, Mother's

Day, all celebrations. We always talk in Spanish. I want my [children] to always speak Spanish.

For Sol, her family's Mexican culture is based on her experiences in the country in which she lives, where holds onto family traditions. Even though Sol was born in the United States her Latine beliefs, traditions, and cultural values are passed down to her children in how she focuses on cultural celebrations for her family. This finding aligns to current Latine research on familismo.

Sol also holds traditional education virtues and aspirations for her daughter. She shared the following:

*Como yo no tuve la oportunidad de ir al colegio, eso es lo que mas yo quiero para mis niñas, el estudio, que sigan adelante, que les digo lo ellas quieran pero que vayan al college. Pero que estudio algo, que siga adelante y que sean feliz. No nomas enfocarse en puro estudio, si también que sean feliz, pero que saquen una carrera en mi enfoque [como mama].*

Since I didn't have the opportunity to go to school, that's what I want the most for my girls: to study, to keep going. I tell them they can do whatever they want, but they should go to college. To just study something, move on, and be happy.

Don't focus only on studying, but also be happy and have a career, and that's my point of view [as a mother].

Traditional virtues and familismo themes were present in Sol's interview answers as positive factors of motivation for academic success. Sol shared personal ecological challenges that she experienced as an immigrant, as a child growing up, and as mother. This is important to note because her challenging experiences are what propel her to figure out ways to engage as a mother at home and out of the home settings. Persistence in overcoming challenges, heading ahead in life, and having ethics and values is seen as a successful educación for Sol, even though is not related to schooling or academics for the traditional American education culture.

Sol continued to share that she wanted her daughter to go to college because, unfortunately, her parents were not present in her education. She stated that when her parents immigrated to the United States, their focus was on “*criar*”/to raise their children. She went on to say that her parents had five children, and so they worked a lot to provide “*comidad*”/food and a home in which to live. Sol’s challenging past is what motivated her to engage with her daughters, especially the 4-year-old. Sol stated:

*Me gusta estar en talleres de padres, porque nos enseñan cómo ayudarles [a nuestros] hijos en sus estudios. A mi niña chiquita, me gusta ponerla en todos los talleres que hay en la escuela para ayudarla. [Ya] sea de arte, de juegos, de aprendizaje...a eventos para que les lean los maestros y en todo eso yo la trato de llevar para que su mente siempre este aprendiendo cositas nuevas.*

I like being in parent workshops because they teach us how to help [our] children in their studies. I like to sign up my little girl for all the workshops at school to help her. [Whether it's] art, games, learning... to events where the teachers read to them, and I try to take her so that her mind is always learning new things.

When asked about some of the things that she notices in her 4-year-old daughter, Sol had positive perceptions of her child but also believed that having knowledge or skills are an inherent ability. Sol explained:

*Pues la verdad yo no pude seguir adelante con estudios. En las matemáticas yo no era muy buena. Les busco ayuda en la escuela o alguien que les ayude. Mi suegro es un computer engineer, so el tiene que ser bueno en las matemáticas y espero que mi hija herede la habilidad de hacer matemáticas.*

Well, the truth is that I couldn't continue with my studies. I wasn't very good at math. I look for help at school or for someone to help them. My father-in-law is a computer engineer, so he has to be good at math and I hope my daughter inherits the ability to do math.



Sol wished for her daughter to inherit her father-in-law's mathematics skills because she stated she was never good at math. Sol shared the following regarding her mathematics experiences:

*No, yo nunca fui buena en las matemáticas, no. Batallaba mucho, no se me, trataba de aprender, pero no. Cosas como algebra fue lo que no se me quedaba nada. Me frustraba, sí. Triste, me frustraba, que no podía estar como los demás estudiantes que estaban al lado mío y que rápido, rápido se les pegaba a aprender. Buscaba ayuda, pero no, no se me pegaba mucho.*

No, I was never good at math, no. I struggled a lot, I tried to learn but I couldn't. Concepts like algebra, I could never learn. It frustrated me, yeah. I was sad, I was frustrated, that I could not be like the other students who were next to me and learned quickly compared to me. I looked for help, but no, but I couldn't really understand math.

Sol demonstrated math anxiety in her statements. Results found that Sol's math beliefs and attitudes were shaped by her negative math learning experiences and thus she believe that she cannot be influential in supporting her children's math learning.

Although Sol felt she is unable to help her children with academic content, at home she tries to engage them in different activities. She shared how her young daughter liked to go to the park to watch the ducks. Sol viewed her daughter's interest as something that was passed to her by her husband and Sol's parents. She shared:

*A mi niña le gusta salir mucho, ella le gusta estar en la naturaleza. A mi esposo le gusta la naturaleza, ir a camping o a caminar, estar con árboles, ir hiking. We are like outdoor persons. Creo también por que a mi papá le gusta mucho el nature, él con tal de salir a fuera dice "ya mira el aire, mira los pajaritos, mira esto."*

My little girl likes to go out a lot, she likes to be in nature. My husband likes nature, going camping or taking a walk, being around trees, hiking. We are like outdoor people. I think also because my dad likes nature a lot, he just wants to go outside and says, “Look at the air, look at the birds, look at this.”

This is important to note because the themes of family and nature surfaced in Sol’s co-design generative activities. For Sol, family was an important source of comfort, support, and strength, strong themes that were represented in Sol’s generative activities throughout her engagement in the workshops.

**Table 10**

*Erika’s Semi-Structured Interview Themes Tallies*

Themes & subthemes	Key phrases from interviews	Tallies
Familismo (values/culture as subthemes)	<i>A mi siempre me gustaba estar mucho con mi abuelo. Teníamos muchos árboles de frutas como guayabas, toronjas, naranjas. Había un árbol de guayaba que daba muchísimas guayabas y como en México todo el mundo compra lo que tiene uno es sus casas, pues mi abuela de decía “ve y corta una cubeta de guayabas y las vendes y ese dinero es para ti.” Y, bueno, yo nomas juntaba por decir unas 10 guayabas en un puñito y así las vendía/ I always liked to be around my grandfather a lot. We had many fruit trees such as guavas, grapefruit, oranges. There was a guava tree that gave a lot of guavas and since in Mexico everyone buys what others have in their homes, my grandmother used to say, “Go get a bucket of guavas and sell them, and that money is for you.” And, well, I would just get about 10 guavas in a handful and sold them that way.</i>	10
Role of language	<i>Y como no hable inglés, todos en la casa hablamos español. Que es lo bueno y quiero que mantengan/ And since I don’t speak English, everyone at home speaks Spanish. Which is good because I want them to hold onto speaking Spanish.</i>	3
Identity formation related to (math) learning	<i>Rosa stated she did not like or understand math/ no me gustaban [matemáticas] por que no le entendía muy bien.</i>	7

Themes & subthemes	Key phrases from interviews	Tallies
Ecological environment	<i>Pues mi papa me ayuda hacer mis tareas en México. El le gustaban las matemáticas, entoces el era el que me ayudaba y creo por eso ponía mas atención allá. Pero aquí ya no tenia quien me ayudara, por que papa ya no sabia que hacer aquí/</i> Well, my dad helped me do my homework in Mexico. He liked math, so he was the one who helped me, and I think that's why he paid more attention there. But here, I had no one to help me, because Dad didn't know what to do here anymore.	6
Interest-driven	<i>Erika shared that when they are outside with her familiy, they like to count rocks because they always find rocks with different colors and shapes when they walk around the ranch/ les gusta andar afuera juntando piedras, porque encontramos siempre piedras de diferentes figuras y colores. Lo mas importante es enseñarles a no mentir por que no es bueno mentir. Le enseno a que respeten a los demás también, es como a mi me enseñaros mis valores de respetar a los adultos/</i> The most important thing is to teach them not to lie because it's not good to lie. I teach them to respect others as well. That's part of the values I was taught, to respect adults.	8
Traditional education virtues	<i>Erika stated that she was glad that her kids are intelligent. She said that she could tell they are intelligent because her kids did not ask for help when doing homework. She also could tell that her kids knew and liked mathematics.</i>	7
Views on Knowledge		3

**Erika.** Erika's tally of themes in relation to her semi-structured data interviews is represented in table 10. The following case narrative describes in detail the results and findings from Erika's semi-structured interview data. Erika is a stay-at-home mom to three sons, ages 2 years, 4 years, and 6 years. She was born in Mexico and moved to the United States when she was 12 years old. In the United States, she was only able to complete up to the 9th grade. She spoke only Spanish and identified as a Latina woman. Erika shared that because she moved to the United States very young, she brought and kept all her Mexican traditions. She explained how religion was a big theme in her life because of her challenges immigrating to the United

States, but most of the traditions she kept were related to Mexican celebrations, culture, and values. Erika shared the following:

*Nosotros somos católicos. Tengo una virgencita en mi casa y es parte de las culturas mexicanas que les enseño. Por ejemplo, en navidad ponemos un nacimiento. Como nuestra cultura es mexicana, tratamos de festejar, navidad, día de los Muertos, día de las madres y otros festejos en familia. Y como no hable inglés, todos en la casa hablamos español. Que es lo bueno y quiero que mantengan.*

We are Catholics. I have a little virgin statue in my house, and it is part of the Mexican cultures that I teach them. For example, at Christmas, we put up a nativity scene. As our culture is Mexican, we try to celebrate Christmas, Day of the Dead, Mother's Day and other family celebrations. And since I don't speak English, everyone at home speaks Spanish. Which is good because I want them to hold onto speaking Spanish.

Erika valued and wanted to hold onto her Mexican culture. This finding is important because many educational institutions have wanted Latine families to assimilate into mainstream American society to support their children's academic success (Guarnaccia et al., 2007; Ramos et al., 2009).

Erika also stated that she was very close to her family and sister-in-law, who was also a participant in this study. She shared that she did not really engage that much in her community, stating she preferred to be at home with her children. She went on to say that she lived on a ranch and helped her husband with all the ranch activities, and thus her day was very busy. Erika went on to say that perhaps she was like that because she remembered that back in Mexico she lived in a small pueblo and always liked to stay with her grandparents, who grew fruit trees. She shared:

*A mi siempre me gustaba estar mucho con mi abuelo. Teníamos muchos árboles de frutas como guayabas, toronjas, naranjas. Había un árbol de guayaba que daba muchísimas guayabas y como en México todo el mundo compra lo que tiene uno es sus casas, pues mi abuela de decía ‘ve y corta una cubeta de guayabas y las vendes y ese dinero es para ti.’ Y, bueno, yo nomas juntaba por decir unas 10 guayabas en un puñito y así las vendía.*

I always liked to be around my grandfather a lot. We had many fruit trees such as guavas, grapefruit, oranges. There was a guava tree that gave a lot of guavas and since in Mexico everyone buys what others have in their homes, my grandmother used to say, ‘Go get a bucket of guavas and sell them, and that money is for you.’ And, well, I would just get about 10 guavas in a handful and sold them that way.

This experience for Erika represented a family bond and ties more than a learning experience.

When asked whether she thought there was any learning in this experience. Erika stated she did not know it was mathematics such as counting money. She went on to say that she did not like or understand math/“*no me gustaban [matemáticas] por que no le entendía muy bien.*” Eirka stated she believed it was her experience with teachers that made her not like math. She also shared that she had a similar experience with classroom instruction when she started school in the United States:

*La verdad es que yo tenía un maestro que nos había enseñado. Como yo estaba en la clase de estudiantes que están aprendiendo ingles, teníamos un maestro que no hablaba ni ingles ni español. No se le entendía. El era mexicano, pero no sabía explicarnos. Yo pienso que nomás era maestro de pura suerte porque no sabía enseñar bien.*

The truth is that I had a teacher who had taught us. Since I was in a class with students learning English, we had a teacher who spoke neither English nor

Spanish. It was hard to understand him. He was Mexican but didn't know how to explain things to us. I think he was just a teacher by luck because he didn't know how to teach well.

When Erika was prompted to share more about her learning experience with mathematics, she shared that the way math was taught in the United States was very different from how it was taught in Mexico. Erika went on to share that perhaps the reason it was difficult to learn math in the United States was because her parents were not involved in her education compared to when she was living in Mexico:

*Pues mi papa me ayuda hacer mis tareas en México. El le gustaban las matemáticas, entonces él era el que me ayudaba y creo por eso ponía más atención allá. Pero aquí ya no tenía quien me ayudara, porque papa ya no sabía que hacer aquí.*

Well, my dad helped me do my homework in Mexico. He liked math, so he was the one who helped me, and I think that's why he paid more attention there. But here, I had no one to help me, because Dad didn't know what to do here anymore.

For Erika, her experiences shaped how she viewed learning and engagement with her children. She stated that she was glad that her kids are intelligent. She said that she could tell they are intelligent because her kids did not ask for help when doing homework. She also could tell that her kids knew and liked mathematics. Erika shared that her son knew how to count up to 100. Erika stated that although school and learning were important, she still wanted to make sure she enjoyed time with her children. When asked about some of the things she liked to do with her family, she shared that it was both about taking care of their home but also about spending time together:

*Como vivimos en el rancho, mi día normal es de cocinar, limpiar, lavar. Por ejemplo, tengo que lavar todas las ramas feas y limpiar la basura. Tenemos dos*

*acres y media, entonces se junta mucho la basura. También tratamos de plantar árboles y que los niños no ayuden a regarlos para que crezcan.*

Since we live on a ranch, my normal day is comprised of cooking, cleaning, washing. For example, I have to wash all the ugly branches and clean up the garbage. We have two and a half acres, so there is a lot of garbage. We also try to plant trees and have the children help water them, so they grow.

Erika also shared that she liked the outdoors, and she noticed that her kids liked to be outside too. She shared that when they are outside, they like to count rocks because they always find rocks with different colors and shapes when they walk around the ranch/“*les gusta andar afuera juntando piedras, porque encontramos siempre piedras de diferentes figuras y colores.*” This is important to highlight because Erika the learning components of the activities that she does with her children. In fact, much of what Erika stated involves math talk and home math environments that she sees as everyday life routines and as part of her caregiving duties.

When prompted to share what other things she does with her children, Erika stated that she tries to raise them to be good children. Erika had similar traditional values and beliefs when it came to raising her children. She shared: “*Lo mas importante es enseñarles a no mentir por que no es bueno mentir. Le enseno a que respeten a los demás también, es como a mi me enseñaros mis valores de respetar a los adultos.*”/“The most important thing is to teach them not to lie because it's not good to lie. I teach them to respect others as well. That's part of the values I was taught, to respect adults.”

Erika views traditional educational virtues and aspirations as cultural practices that are resources for the educational success of her children. expressed how they want their children to do more than they did as students. answers also alluded to a social-emotional learning context, which was also evident in their co-design engagement being socially connected and culturally driven.

The following coding scheme represents the most pronounced codes and themes, with definitions and examples, found in participants' semi-structured interview data in relation to their background, history, culture and language (Table 11). The coding schemes provide a breakdown of codes to help readers understand data findings from the participants' semi-structured interviews. These themes and codes are analyzed in a group narrative in Chapter 5.

**Table 11**

*Coding Scheme Related to Latino Families' Semi-structured Interview Answers*

Theme	Code	Definition	Examples
Traditional education virtues	Educación	Moral/culture learning as a base for academic learning.	<p>"Que sean unas personas, pues, buenas con toda la comunidad..."</p> <p>"That they be good people with the whole community..."</p> <p>"Respeten a los mayores..."</p> <p>"Respect the elders..."</p>
	Educational aspirations	A desire for their children to "get ahead in life".	<p>"Como yo no fui, yo no tuve la oportunidad de ir al colegio, eso es lo que más yo quiero para mis niños, el estudio, ah, que sigan Adelante..."</p> <p>"The way I was not, I did not have the opportunity to go to school, that is what I want most for my children, study, ah, keep going Forward ... "</p>
Familismo subtheme: 1) Values 2) Traditions	Holding onto home	Parents' aspirations for their children in keeping their culture.	<p>"Los educamos, en la casa siempre se tiene que hablar español entre ellos, este, pues la cultura mexicana es la que sigue en ellos."</p> <p>"We educate them, at home they always have to speak Spanish among them, because Mexican culture is the one that continues in them"</p>
	Cultural practices enacted	Parents' routines in centering their traditions as a cornerstone for their family.	<p>"Pues, jugamos lotería, compré una lotería, jugamos lotería. Ah, a mi otra niña, a la más grande, pues, como vivíamos en departamento..."</p> <p>"Well, we played the lotería, I bought a lotería, we played the lottery. Ah, my other girl, the oldest, well, since we lived in an apartment..."</p>
	Family-centric	Family comes first based on how parents were raised, importance of	<p>"Tenemos un día específicamente que es de familia, que lo tomamos los viernes, tratamos de no hacer otra tipo de—de actividades, sino que solamente que sean familiar..."</p>



Theme	Code	Definition	Examples
Role of language	Spanish	family at all levels.	"We have a specific day that is family-owned, we take it on Fridays, we try not to do other types of activities, but only to have them in the family..."
		Sees and values Spanish language as important for their children to learn and speak.	"Ella habla totalmente el español, ¿verdad? Una de-- Por eso es que quiero que mantenga esos lazos de familiares, ¿verdad? Y que ellas puedan entenderse..." "She totally speaks Spanish, right? One of ... That's why I want her to keep those family ties, right? And that they can understand each other..."
Ecological environment	Parents' family relations/ socialization	Parents' socioeconomic immigration challenges & opportunities.	"Ah, pues, tal vez...mi mamá nos [apoyo]...[pero] ella como no tuvo la oportunidad de estudiar..." "Ah, well, maybe... my mother [supported us]... [but] she didn't have the opportunity to study..."
		Motherhood	Parents' caregiving and nurturing of their children.
	Parent engagement	How parents engage in their children's learning/education outside of home settings.	"También asisto a los talleres de padres por media de la escuela, ahorita los están dando algunos por Zoom..." "I also attend parent workshops through the school, right now we are doing it by Zoom..."
	Community engagement	How parents engage in their community settings recreationally as a family.	"...Yo tengo todo cerca, tengo la iglesia, tengo el parque, tengo las marketas...La escuela, pues, ahí ya están yendo todos [y así me involucro]" "I have everything close by, I have the church, I have the park, I have the markets... The school, well, everyone is already going there [and that's how I get involved]"
Views on knowledge	Literacy achievement	Parents see reading as an important educational value.	"Pero quiero que también ellas tengan ese entendimiento de-- del inglés y solo lo va a hacer a través de los libros..." "But I want them to also have that understanding of English and they will only do it through books ..."

Theme	Code	Definition	Examples
	Child's way of learning	Parents' beliefs about their children being good at learning.	"Excelentes en matemáticas. Lo pescan rapidito. Mi hija tiene cinco...ella sabe contar de cinco en cinco. ¿Cómo le hacía? Yo no tengo idea." "Excellent in math. They catch it quick. My daughter is five... she knows how to count by five. How did she do it? I have no idea." "Y también le gusta hacer puzzles." "She [child] likes doing puzzles." "Le gusta mucho pintar." "He [child] likes to paint."
Interest-driven learning subtheme: Funds of knowledge	Personal and cultural awareness and curiosity	Activities, crafts, hobbies that parents communicated they enjoy individually or collectively	"Pero dentro de la casa sí, usamos los juegos de mesa y a veces los pongo a que me ayuden a hacer así algún postre para que se les quite lo aburrido que están." "But inside the house, yes, we use board games and sometimes I put them to help me make some dessert so that they forget how bored they are"

The researcher decided to separate the theme of identity formation related to learning (math) to highlight how early math experiences can influence the way parents interact and perceive math learning in their young children (Table 12). The following table represents the most frequent codes in relation to participants' mathematics learning experiences.

**Table 12**

*Coding Scheme Related to Mathematics Learning and Experiences from Interviews*

Theme	Code	Definition	Example
Identity formation related to learning (math)	Self-efficacy beliefs about math	Parents' perceptions about their competence and self-efficacy with math	"Entonces [matemáticas] a mí me costaba. Y decía yo, 'No.'" "Then [math], it was hard for me. And I said, 'No.'" "[Yo] no tuve el aprendizaje de poder razonar bien. Entonces, no aprendí a hacer [matemáticas], sino que todo era memorizado. Entonces, creo que por eso no me gustaba y no me gusta. [rie]" "[I] did not have the intelligence to reason well. So, I didn't learn to do [mathematics], but everything was memorized. So, I think that's why I didn't like [math]. [laughs]"

Theme	Code	Definition	Example
	Math interests	Parents' experiences in developing an interest in math with their children	"...bueno, en México se llama ábaco. Y es el que utilizo con ella y de ahí fue donde miré que se le hizo más fácil, porque yo usaba mucho los dedos y a veces no le alcanzaban los dedos." "... well, in Mexico it's called an abacus. And it's the one I use with her, and that's where I saw that it became easier for her because I used her fingers a lot and sometimes her fingers weren't enough."
	Math teaching contexts	Parents' experiences in school and outside of school for math teaching and learning	"Creo que si hubiera tenido un maestro que hubiera explicado un poco mejor o hubiera dado algunos tips de cómo mejorar en lo que estaba fallando, creo que ami me hubieran gustado [las matemáticas]." "I think if I had had a teacher who had explained a little better or given some tips on how to improve what I was failing at, I think I would have liked [the math]."
	Self-perception of inherent ability	Parents' beliefs that being good at math is genetic	"Y es como le digo, a veces le platico con él, 'Yo no sé a quién saliste porque tienes mucha inteligencia.' Le digo, 'Porque yo no...Ni a tu papá ni a mí, no-no-no, este, tenemos esta capacidad'" "Sometimes I say to him, 'I don't know who you take after because you have a lot of intelligence.' I told him, 'Because I don't...Neither your dad nor me, no, this, we have this ability.'"

### ***Participant Co-design Narratives***

The collected data from the semi-structured interviews informed the co-design workshop structure as well as the design of the generative activity tools. The researcher used the interview data to understand participants' lived experiences for learning, including math experiences and family engagement. Without the interviews, it would not have been possible to empathize and challenge assumptions about Latine family experiences. The following co-design case study narratives provide the results of participants' experiences with co-design approaches in the co-design and co-creation of a math activity for their young children. The structure of each single case study starts with:

- Description of the first co-design workshop activities: Mi Auto Retrato/My Self-Portrait Activity and Estética de Arte/Collage Activity.
- It follows a description of the take-home activity El Periódico/News Story from the Future Activity (for the only participants that were able to complete this take-home activity).
- It presents activity descriptions from the second co-design workshop: Mis Números en Casa/My Personal Number Activity and Viñetas de Platicas/Storyboard Activity.
- It provides description of the Modelos de Presentación/Prototype Activity, and
- It ends with a final description of how participants implemented (tested) their prototypes at home with their children.

Table 13 provides a brief description of the co-design workshop phases and goals that each participants went through. A more details narrative of each co-design workshop and activity is described through each individual single-case narrative after the table, starting with participant Rosa.

**Table 13**

*Description of Co-design Workshop Phases, Goals, and Processes*

<b>Workshops</b>	<b>Phases</b>	<b>Goals</b>	<b>Processes</b>
Co-design workshop 1	Observe & Empathize	The goals for the first co-design workshop were the following: conduct a (a) general introduction (re-reading of consent form), (b) introduce participants to co-design, (c) implement generative activities (Retrato/My Self-Portrait Activity and Estética de Arte/Collage Activity), (d) share results of activities among the group, (e) reflect on what worked, what didn't work, and what could be done better, and (f) take mini-survey after workshop.	The researcher introduced the research study, agenda for the day and rules, description of co-design and what to expect in the first workshop and the following two other workshops. The first generative activity (Retrato/My Self-Portrait) served as an ice-breaker to have participants introduce each other and to get to know each other (observe and empathize). The second generative activity (Estética de Arte/Collage) served to tap into participants funds of knowledge by reflecting back to their semi-structured interview answers and

Workshops	Phases	Goals	Processes
Co-design workshop 2	Define and Ideate	<p>The goals for the second co-design workshops were the following: (a) share back El Periódico activity, (b) present and explained the California preschool learning foundations for mathematics, (c) introduce participants to the framework for individual creativity, (d) introduce and explain storyboarding in co-design approaches, (e) implement generative activities (Mis Números en Casa/My Personal Number Activity and Viñetas de Platicas/Storyboard Activity), (f) reflect on what worked, what didn't work, and what could be done better, and (g) take mini-survey after workshop.</p> <p>The goals for the third co-design workshop were the following: (a) prototype (Modelos de Presentación/Prototype Activity) their math activity based on their storyboards, (b) reflect on what worked, what didn't work, and what could be done better, and (c) take mini-survey after workshop.</p>	<p>answers funds of knowledge questions (mentioned in page 98). By the end of the workshop 1, participants were asked to take home the El Periódico/News Story from the Future activity to do at-home. The researcher asked participants to share their Periodico activity (if completed). Then introduced participants to the framework for individual creativity and the California preschool learning foundations for mathematics. Then, participants engaged in My personal numbers activity to tap into their mathematics knowledge and help them contextualize it. Participants then engage in storyboarding their math activity and share out and feedback at the end of workshop 2.</p> <p>The researcher asked participants to share if any of them refine their Viñetas de Platicas and if they did it themselves, with their family, or with their children and have participants give feedback to each other. After sharing feedback as a group, participants worked on their prototype individually. Participants shared out with everyone.</p>

**Rosa.** Rosa was highly engaged as compared to the other participants. Before the co-design workshops started, Rosa was the only participant who texted the researcher to clarify some of the instructions for the activities in the papelería/cultural probes box. She also stated

she was very excited to start and appreciated the papelería with all the mailed resources. During the first co-design workshop, Rosa was the first one to feel confident in suggesting adding a new rule to the “community ground rules” for the co-design workshops: “*Yo, con respeto al tiempo, cuando vayamos a participar, que no nos tomáramos tanto tiempo en una sola persona, si no que seamos equitativas.*”/ “I [propose], with respect to time, when we go to participate, that we should not take so much time on one person, but that we should be equitable.”

Rosa’s suggestion for a new rule was the initial glimpse into her co-design workshop experience as an active participant rather than just a consumer of information in the sessions. This was also evident during the breakout room activities, where Rosa’s process of collaboration included engaging other participants in inquiry and sense-making to find solutions or answers to the generative activities. Rosa represented the highly engaged and motivated parent. During the *Mi Auto Retrato/My Self-Portrait* generative design activity, Rosa shared that one of her values is family and helping her community, a theme that carried throughout her engagement in all the workshops, especially when collaborating with the other participants. Her artifact (Figure 22) and verbal description of it provided an insight into the subtleties of Rosa as a Latina woman and mother, specifically demonstrating conscientiousness, familismo, and traditional virtues, the latter two of which were also present in Rosa’s interview data.

## Figure 22

### Rosa's Auto Retrato/Self-Portrait Artifact



Rosa shared the following when describing her Auto Retrato/Self-portrait artifact:

*Ese fue uno de los valores que me encanta a mí ponerlo en práctica, porque al ponerlo en práctica, ese valor de servir a los demás, viene lo que es el amor a la familia, que es lo principal, por eso escogí ese. Otra cosita más, este es un sol. Eso significa que el sol brilla para todos cuando nosotros servimos.*

That was one of the values that I love to put into practice, because when I put it into practice, that value of serving others, then love for family comes. That's the main thing, and that's why I chose that one. One more little thing, this one is a sun. That means the sun shines for everyone when we serve.

Rosa's answer illustrates her personal and social responsibility and deeply held values. Rosa's values are tied not only to her background as an immigrant mother but to her idea of social service. The Mi Auto Retrato/Self-Portrait activity allowed Rosa to explore her own process of thinking and make connections with her own lived experiences (Wennberg & Hane, 2005).

**Figure 23**

*Rosa's Estética de Arte/Collage Artifact*



In the second co-design activity, Rosa continued to demonstrate self-reflection practices in what she perceived as valuable for learning in her everyday life with her children. She designed her *Estética de Arte/Collage* (Figure 23) to look like a book. Rosa's *Estética de Arte/Collage* revealed that family is central to her. Her *Estética de Arte/Collage* revealed that themes of familismo and traditional virtues are part of Rosa's lived experiences as an immigrant mom who only spoke Spanish but wanted her children to speak both Spanish and English. Rosa viewed literacy as a survival mechanism to function on a day-to-day basis in an English-speaking country. This was evident in what she previously stated in her interview:

*Entonces, esa parte de la comprensión a mí me costó bastante cuando estaba pequeña...entonces, yo dije quiero que también ellas tengan ese entendimiento del inglés...yo quisiera que ellas hablaran varios idiomas, porque yo sé que eso abre puertas y caminos.*



So, that part of understanding was very difficult for me when I was little... so, I said I also want them to have that understanding of English... I would like them to speak several languages because I know that opens doors and paths.

For Rosa, speaking English and Spanish is a valuable asset because it serves a purpose in the lives of her children. Rosa described how she even saw literacy as helping her children with motor skills. She demonstrated this in her *Estética de Arte/Collage*. Rosa shared the following when describing her artifact:

*Traté de hacer como una especie de libro, porque a mí me gusta leer bastante con mis hijas, porque yo sé que a través de los libros podemos aprender muchas cosas, podemos leer, tener una mejor lectura... Esto es la otra parte que me enfoqué también, es cómo a través de los libros ellos pueden utilizar sus manos, ser creativos, ya sea en la pintura, con la parte de la agricultura, del dibujo... En eso me enfoqué y pensando ya en mis hijas, porque son las cosas que a ellas les gusta hacer y que veo que tienen bastante habilidad, lo que es la lectura y la parte motriz que es la manualidad, que es lo que les gusta a ellas.*

I tried to make a kind of book, because I like to read a lot with my daughters, and I know that through books we can learn many things, we can read, have a better comprehension... This is the other part that I also focused on, is how through books they can use their hands, be creative, either in painting, with agriculture, drawing... That's what I focused on, thinking about my daughters, because these are the things they like to do and I see that they have a lot of skills, which is reading and the motor part, the manual work, which is what they like.

It is worth noting that Rosa's verbal communication was embodied in her physical behavior; her tone of voice was high when she communicated why her *Estética de Arte/Collage* turned out to be as it did. Rosa demonstrated pride and agency but also construction of knowledge when communicating what was valuable to her and her family.

At the end of the first co-design workshop, the researcher asked participants to share three things: (a) what they liked, (b) what they learned, and (c) what they wished. Rosa stated that she liked how every parent in the workshop had their own world. She stated she learned that every parent has skills and a way to teach their children. What she wished was to continue to get to know and learn more about the parents in the workshop.

*¿Qué me gustó? Que cada cabeza es un mundo, como se dice, eso me gustó.*

*¿Qué aprendí?, que cada persona tiene sus habilidades y tiene la forma de enseñar a sus hijos. ¿Qué quisiera aprender? Seguir aprendiendo más de las personas y conocerlas.*

What did I like? As they say, every mind is a world of its own. I liked that. What did I learn? That each person has his or her own skills and has his or her own way of teaching his or her children. What would I like to learn? I would like to continue learning more about people and to get to know them.

In the mini follow-up survey, Rosa shared that the most memorable part of the workshop was doing her self-portrait and discovering that she could learn from other people/“*El saber que puedo aprender de otras personas para enseñar.*”

Rosa also stated that she thought about how creativity can be used to teach/“*Que puedo tener creatividad para enseñar.*” Although Rosa was not explicit in her response, there was clearly empowerment and self-reflection in her communication of her lived experience during the first co-design workshop. Rosa drew upon her knowledge, experience, and background to feel motivated, invested, and empowered to create artifacts that communicated what was important to her as a mother.

Rosa was one of the two participants who completed the take-home activity El Periódico/News Story from the Future. Rosa highlighted once again the theme of literacy and reading. The El Periódico activity was meant to help participants think about the future of a mathematics activity. Rosa stated that she probably didn't understand the instructions, so she

decided to focus on what she values. She described her El Periódico activity as “*Enseñar a mis hijas el amor a la lectura y a los libros*”/“*Teaching my daughters the love of reading and books,*” which highlights again how Rosa emphasizes literacy skills as the primary way for her children to succeed in school and in academics.

During the second co-design workshop and before the Mis Numeros En Casa/My Personal Number activity, the researcher introduced the California Preschool Learning Foundations, Volume 1 for Mathematics (California Department of Education, 2021). Rosa stated that she had not heard of it but was familiar with number sense because of her daughter’s teacher. During this activity, Rosa was the only participant making connections between the interviews and the co-design generative activities, stating:

*Creo que esta actividad esta relacionad con lo que hablamos antes [la entrevista], que empezáramos el taller.*

I think this activity is related to what we talked about before [the interview], we started the workshop.

Rosa described all the mathematics she sees in her home, from furniture to painting to photo frames of different sizes. At this point, Rosa started to contextualize how the theme of mathematics was everywhere around her home setting. This could explain why she chose to use other materials instead of integrating literacy, books, or reading into the design of her mathematics activity.

For the Viñetas de Platicas/Storyboard activity, the researcher decided to place participants in breakout rooms based on Sandra’s feedback. In the first co-design workshop, Sandra had stated she felt lonely doing the activities on her own and wished for the workshops to be in-person. In the breakout rooms, Rosa embodied the expert role by engaging the other participants in cross-collaboration inquiry and sense-making. There was a specific moment where Rosa began the conversation with questions to the other participants. The following vignette conversation demonstrates how participants in this conversation were trying to make

sense of the learning activity, fostered collaboration, and exercised voice and choice. This allowed for powerful engagement. Here, Rosa started by asking simple questions to kickstart the conversation:

*Rosa: Ubiquémonos, por es que yo pensé que nos iban a poner lo que habíamos escogido, sentido numérico. Usted escogió medición. ¿Medición cual es? ¿De que habla medición?*

*Erika: Medición como de que yo dije que contaba los frijoles, garbanzos, arboles.*

*Rosa: Es lo mismo del sentido numérico por que es contar.*

*Erika: Sí.*

*Rosa: ¿Qué sería lo primero que podemos hacer para poder enseñarles a nuestros hijos? ¿Qué haríamos? ¿Qué utilizaríamos? Con lo que tenemos en la caja, ¿qué vamos a planear? ¿Qué vamos a utilizar para que ellos puedan contar?*

*Erika: Si voy a cocer frijoles sacaría primero sacaría primero, por ejemplo, la olla para poner qué cantidad de agua, ahí también estoy midiendo qué cantidad de agua. Luego sacaría el traste donde tengo los frijoles alzados y después un plato para poner cuánto frijol voy a cocer y ya. Yo pienso eso.*

*Rosa: Okay, eso está bien. Es en base a alguna experiencia, eso es lo que ella está-- Porque es que eso es lo que yo no estoy entendiendo. No sé si es en base a lo que tenemos en la caja o en algo que se nos viene, no sé.*

*Rosa: Let's center ourselves, because I thought they were going to give us what we had chosen, number sense. You chose measurement. What is the measurement? What is the measurement talking about?*

*Erika: Measuring, like how I said that I counted beans, chickpeas, trees.*

*Rosa: It's the same as number sense because it's counting.*

*Erika: Yes.*

Rosa: What would be the first thing we can do to be able to teach our children?

What would we do? What would we use? With what we have in the box, what are we going to plan? What are we going to use so that they can count?

Erika: If I am going to cook beans, first I would take out, for example, the pot to put an amount of water. There I'm also measuring the amount of water. Then I would take out the container where I have the beans and then a plate to put the beans I'm going to cook, and that's it. I think so.

Rosa: Okay, that's good. It's based on some experience, that's what she's--

Because that's what I'm not understanding. I don't know if it's based on what we have in the box or on something we know, I don't know.

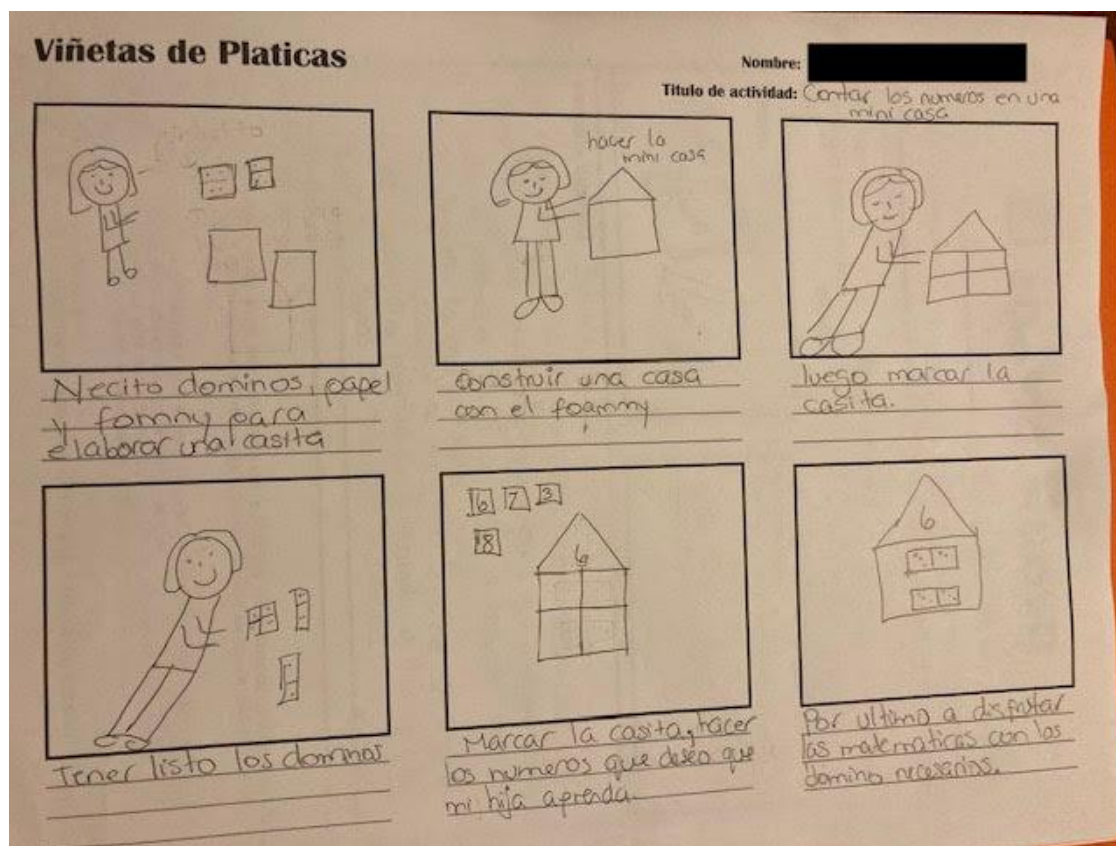
The conversation between Rosa and Erika represents an example of what it means to cultivate mathematics knowledge beyond one's own self-beliefs about competence in learning math.

Although both participants stated in their interviews that mathematics was something they were not "good at," this perception shifted in the co-design workshops where they were told they had the assets and knowledge to design and create a mathematics activity. This conversation also revealed that mathematics can be socially constructed within Latina mothers' ways of knowing.

Figure 24 shows Rosa's Viñetas de Pláticas/Storyboard. It is interesting to note that Rosa wrote "*disfrutar*"/"enjoy" math in the last square, meaning she saw her own mathematics activity as something to enjoy. This was a shift in her perceptions from her interview on how she viewed her mathematics learning experiences.

Figure 24

Rosa's Viñetas de Platicas/Storyboard Artifact

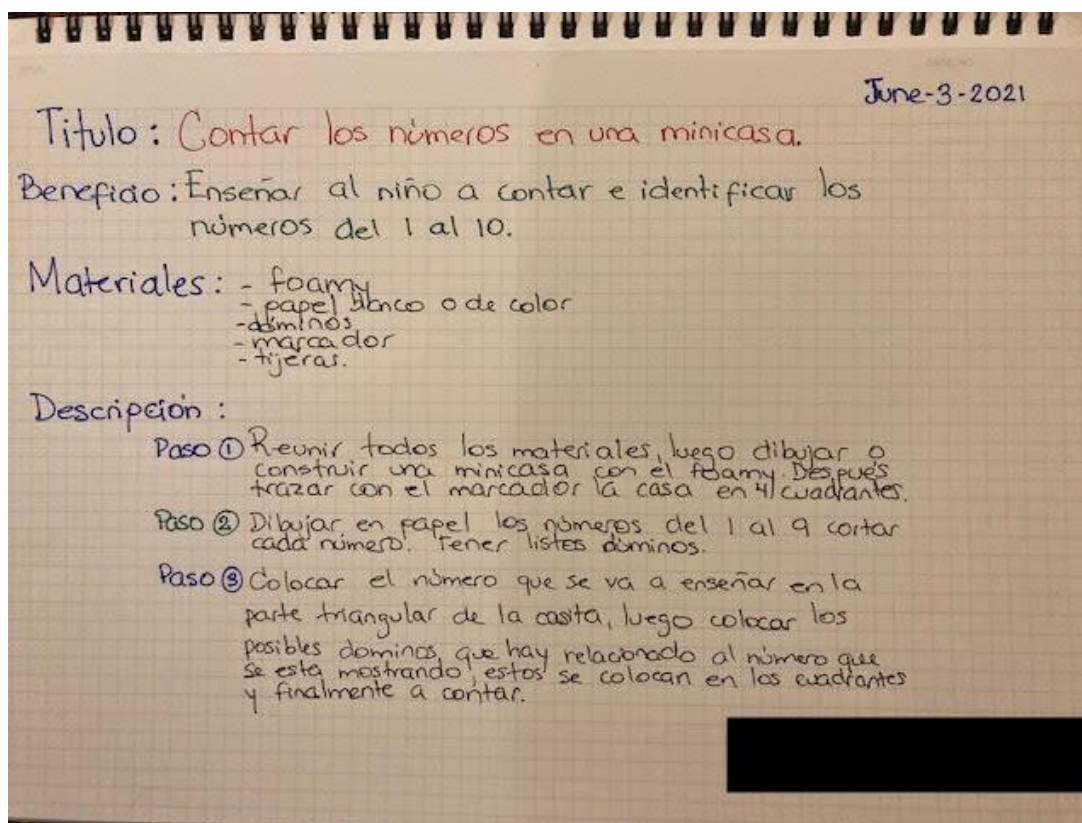


Further, Rosa was one of the three participants who engaged in sense-making prior to creating their mathematics activities by developing a learning goal plan. Rosa engaged in knowledge practice-making when she started designing her activities with her own funds of knowledge. She recognized how she could be a producer of recognizable objects, bridging her own experiences into the design and creation of a math activity.

Rosa demonstrated a deep understanding of rationale by writing and communicating her activity as a “lesson plan” (Figure 25). Rosa’s lesson plan demonstrates how she engaged in construction of knowledge and problem-solving by making sense and thinking of what to add in the description of her mathematics activity. For example, Rosa included the title, the benefits, the materials, and the description of her activity.

Figure 25

## Rosa's Description of Her Math Activity Artifact



At the end of the workshop, Rosa shared:

*Creo que Erika me copió mi idea. [ríe] Me gustó lo que dijo Erika y lo mismo que aprendí, pero lo que yo quisiera es, que aunque no tengan niños acá, que también mi mente y mi cabeza tenga más imaginación. Yo sé que la tengo, pero a veces no puedo trabajar bajo presión. Eso es lo que quisiera, manejar mi presión de otra forma. Sí, me gusto bastante esta actividad que realmente la voy a poner en práctica esta semana con mi hija. [ríe]*

I think Erika copied my idea. [Laughs] I liked what Erika said and what I learned, but what I would like is, even if they don't have children here, that my mind and my head also have more imagination. I know I have it, but sometimes I can't work

under pressure. That's what I would like, to handle my pressure in another way.

Yes, I really liked this activity, and I am going to put it into practice this week with my daughter. [Laughs].

It was powerful to see Rosa make an asset-based statement about how she has the skill to do a math activity, but sometimes we have external barriers like time and resources that don't allow us to think and create with what we have at our disposal. Rosa's mini follow-up survey responses made it clear how much she started to feel comfortable with mathematics. She shared that the things she remembered from the workshop were the mathematics learning goals for preschool children/“*Lo que recuerdo del taller es sentido número, razonamiento número y geometría.*” And she said she now saw math everywhere/“*Todo es matemática.*” What Rosa found most memorable about the second co-design workshop was “*compartir las experiencias de como enseñar a nuestros hijos las matemáticas*”/“sharing experiences of how to teach our children math.”

This finding is important to highlight. The goal of the co-design workshops was to observe how participants engaged with co-design approaches, and through the co-design activities participants shifted their mathematics perceptions, beliefs, and practices. Although the researcher did not measure math identity in this study, there was evidence that participants were constructing their math identities while connecting mathematics learning to everyday experiences, figuring things out by engaging in inquiry practices, and using math language to support math conceptual development.

For the last co-design workshop, participants engaged in Modelos de Presentación/Prototype to design their mathematics activity. The researcher told participants to think about how other parents could also use their mathematics activity but the researcher did not give guidance on how to do this activity. Rosa continued to contextualize and demonstrate construction of knowledge and sense-making during the co-design generative activities. When the researcher asked participants to change their mode of interaction from verbal to visual, it

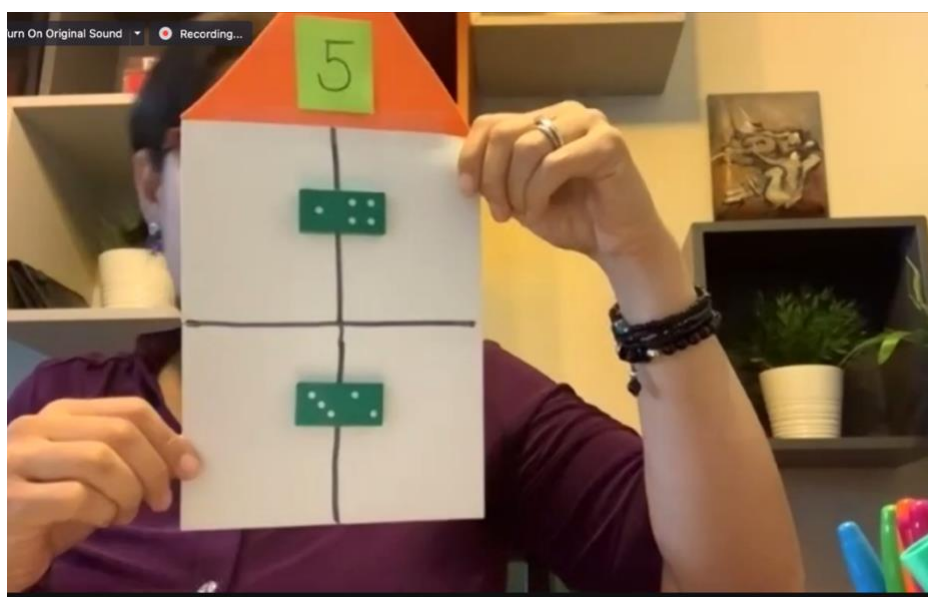


was interesting to see Rosa relate this to something she heard, knew, or had seen in her everyday life. In this case, she related the Modelos de Presentación/Prototype activity to architects, which gives insight into Rosa's idea of who can design and create things. She shared the following: "*Eso es como los arquitectos cuando están haciendo sus creaciones, se las cambian. Hoy sí entendí, siempre relacionado con el tema que escogimos, ¿verdad?*" / "That's like architects when they are making their creations: they change them. Now I understand, always related to the topic we chose, right?"

However, Rosa stated that she was very excited about everything she did in the first two co-design workshops that she worked on some of the prototype before attending the third and final co-design workshop. she also engaged her young children to help prep some of the prototype elements. During the third co-design workshop, she decided to prototype two more mathematics activities (Figures 26, 27, and 28). It is important to note that Rosa stated in her semi-structured interview how she didn't think she was smart enough for math but here she is, being excited and creating three prototypes for her math activities.

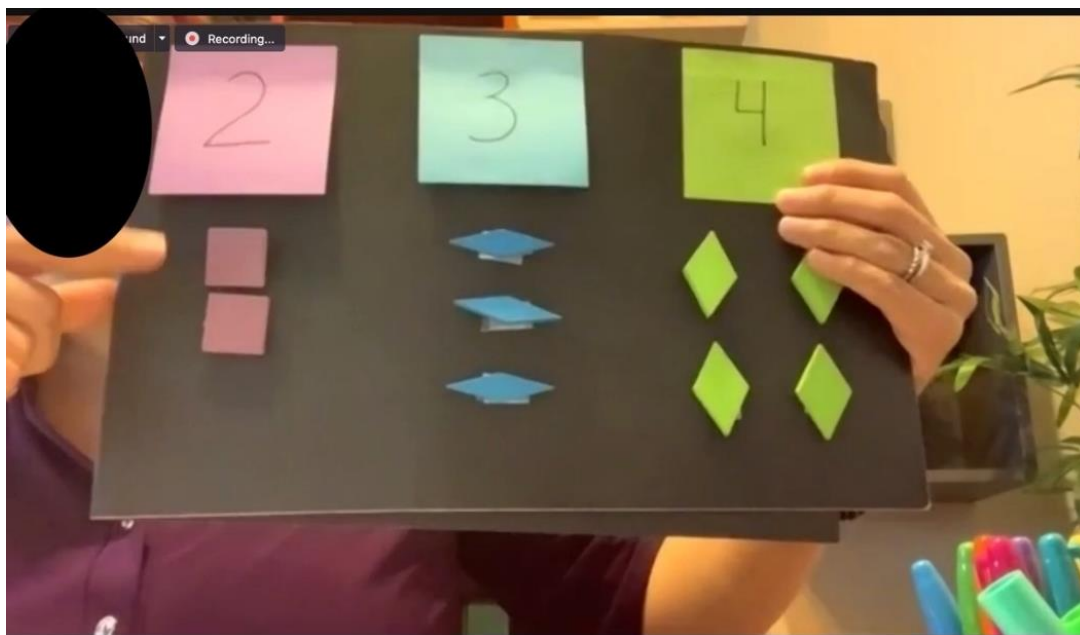
### Figure 26

*Rosa's Modelo de Presentación Artifact 1*



**Figure 27**

*Rosa's Modelos de Presentación Artifact 2*

**Figure 28**

*Rosa's Modelos de Presentación Artifact 3*



When it was time to describe her artifacts, Rosa shared the following:

*El otro que se me vino a la mente, se me vinieron varios, pero el otro es siempre usando la matemática del sentido numérico, utilicé esto, los post-its con los colores, pero siempre contando, uno, dos y tres, uno, dos, tres, y de acuerdo a los colores. Ese es una, es la segunda que se me vino, también, que es para contar, que es para los niños. La otra, que esta ya no la pude pegar pero también se me vino, quiero enseñarles, son canicas con los números. Está una canica, dos canicas, tres canicas, con las cosas que uno tiene en casa. Eso. Iba a hacer una más pero se las voy a decir, porque me quiero quedar con las ganas, con estas cartas se puede colocar el número y el niño puede-- Porque es que me iba a mojar el dedo y colocar uno, dos, tres, ya sea con tempera o con algo de color, uno, dos, tres. Esos fueron los que se me ocurrieron, pero realmente la original, que me gustó bastante, fue el de mi casita, o este, que es lo mismo.*

The other one that came to my mind, several came to my mind, but the other one is always using the mathematics of number sense. I used this, the Post-its with the colors, but always counting, one, two and three, one, two, three, and according to the colors. That's one, that's the second one that came to mind. It's for counting too, that's for children. The other one, which I couldn't put there but it also came to mind, and I want to show you, is one about marbles with numbers. There is one marble, two marbles, three marbles, with the things you have at home. And like that. I was going to do one more, but I'm going to tell you, because I don't want to miss this opportunity. With these cards you can place the number and the child can-- Because I was going to wet my finger and place one, two, three, either with paint or with something colored, one, two, three. Those

were the ones I came up with, but really the original one, which I quite liked, was the one about my little house, or this one, which is the same thing.

In Rosa's last survey answers, she stated that what she remembered most from the workshops was how to make a prototype. She also stated that now she saw math as easy and fun for her daughter/“*son faciles y divertidas para mi hija.*” And the memorable thing she took away from the last co-design workshop was how everybody shared their ideas, “*compartiendo las ideas con todas las participantes.*”

In the last co-design workshop, the researcher asked the participants to share photos or videos if they did the activity with their children at home. Rosa was one of four participants who shared photos of how they implemented the activities with their children (Figures 29 and 30). Based on Rosa's photos, she implemented two out of her three prototypes (math activities) with her young daughter. These two math activities describe number sense and counting as the main learning goal Rosa wanted to teach her child.

### Figure 29

*Rosa's Modelos De Presentacion with Daughter Artifact 1*



### Figure 30

#### *Rosa's Modelos De Presentacion with Daughter Artifact 3*



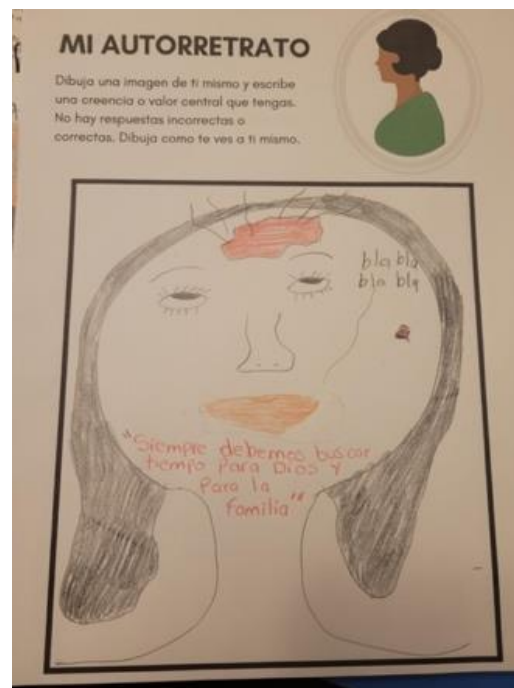
**Daniela.** Daniela's engagement in the co-design workshops speaks to peripheral participation (Lave & Wenger, 1991). According to Lave and Wenger (1991), "legitimate peripheral participation is proposed as a descriptor of engagement in social practice that entails learning as an integral constituent" (p. 35). And peripherality is participation enabled by non-participation (Wenger, 1998, p. 167). It is important to note that peripheral participation is an "analytical viewpoint on learning, a way of understanding learning" (Lave and Wenger, 1991, p. 40). To understand Daniela's "nonengagement" or limited engagement in the co-design workshop, we need to understand how she peripherally learned and how that learning looked similar to or different from the other participants' learning.

Throughout the three co-design workshops, Daniela was at the hospital taking care of a family member. Yet, she still wanted to be part of the co-design workshops. Daniela let the researcher know via the Zoom chat that she was unable to do the generative activities during

the live session but that she would do them during the weekend. After the first co-design workshop, the researcher followed up with Daniela via email to ask whether she had any questions about the first two generative activities. Daniela stated via email that she took notes and if she had questions, she would let the researcher know/“*Si anote más o menos que estábamos haciendo. El fin de semana se lo envío. Si tengo duda le mando texto, mil gracias!!*” Figure 31 represents Daniela’s Mi Auto Retrato/Self-Portrait activity.

### Figure 31

#### *Daniela’s Mi Auto Retrato/Self-Portrait Artifact*



When Daniela shared photos of both of her artifacts via email, there was no comment or any other explanation provided. However, we still see a glimpse of Daniela’s deep-rooted family values in the statement she wrote on her Mi Auto Retrato/Self-Portrait: “*Siempre debemos buscar tiempo para dios y para la familia.*”/“We must always have time for God and for the family.” Daniela’s core belief matches her interview statement about having deep-rooted

religious and familismo beliefs that could also be related to her immigration, race, and memories of living in this country.

For the Estética de Arte/Collage activity, Daniela chose “Manualidades. Juegos”/“Crafts. Play” as the concept that she identified with the most. The Estética de Arte/Collage activity was meant to continue to tap into participants’ funds of knowledge based on their interviews. In her interview, Daniela mentioned how she wanted to make learning fun for her children and stated that they played board games and did crafts. Similar to her Mi Auto Retrato/Self-Portrait, Daniela did not provide information about her Estética de Arte/Collage artifact. Figure 32 represents Daniela’s Estética de Arte/Collage activity. The theme of playful learning is evident in her artifact. Play appears to be an important part of what Daniela considered important to what she liked and brought to her engagement with her children.

### **Figure 32**

*Daniela’s Estética de Arte/Collage Artifact*



It is important to note that even though Daniela could not participate to the full extent in the first co-design workshop, she still grasped the necessary knowledge and observed and listened for the physical and verbal behaviors of the other participants. She had the tools

(papelería) required to move toward deep engagement outside the co-design workshops. The active participants during the co-design workshops shared experiences, stories, tools, and ways of addressing both of the generative activities, and thus Daniela was peripherally learning. Her motivation to do the generative activities outside the workshops is evidence of how co-design approaches allow the participant to take an active role in the design process of artifacts and contribute to the learning process as an equal stakeholder (Sanders & Stappers, 2008).

In the mini follow-up survey, Daniela stated that what she remembered the most from the first co-design workshop was her Auto Retrato/Self-Portrait. When asked about what was memorable about the co-design workshop, Daniela stated, “seeing other points of view and other ways of seeing things”/“*el ver otros puntos de vista y otras formas de veer las cosas.*” Daniela’s answers demonstrated how she views her learning and the different ways of learning. Daniela’s survey feedback emphasized again how she learned peripherally. Although she had limited engagement during the live co-design sessions, she retained information to do the activities at home, demonstrating her motivation to be part of co-design workshop experiences. It was also evident that the co-design sessions and generative activities guided her development in becoming an expert, even without the researcher’s help to do the activities.

During the second co-design workshop, Daniela let the researcher know she was at the hospital again but was able to do the activities. She kept her camera off but remained engaged verbally throughout the session. During the presentation of the framework for individual creativity, Daniela engaged by answering questions the researcher would pose to the group. One thing to notice is that Daniela was the only participant who asked for music during the time when participants would be working on their activities. She had a very specific request to listen to Selena’s music.

*Daniela: Pon música de Selena.*

*Researcher: ¿De Selena? Okay.*

*Daniela: Estoy mirando la serie en Netflix, I love it.*



*Researcher: Ahí va.*

Daniela: Play Selena's music.

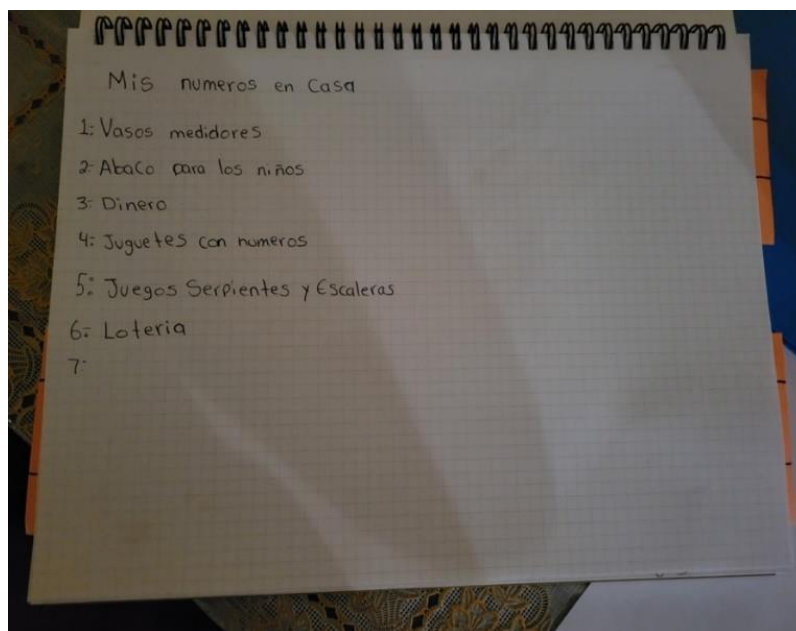
Researcher: Selena's? Okay.

Daniela: I'm watching the series on Netflix, I love it.

Researcher: Here it goes.

Daniela's request can be interpreted as a need to have music play to not feel isolated from the rest of the group. Although Daniela did not explicitly say she felt lonely, the interpretation is that although technology affords connectivity, there is still a sense of communal learning that cannot be replicated through online technologies.

During the second co-design workshop activities, Daniela had not seen the California Preschool Learning Foundations, Volume 1 for Mathematics (California Department of Education, 2021). She said she was familiar with the basic mathematics concepts because of her daughter's daycare. For the *Mis Números en Casa/My Personal Numbers* activity, Daniela created a list to make sense of the different ways she sees math at home (Figure 33). Daniela included two bullet points about playing: (a) *juguetes con numeros/toys & numbers* and (b) *juegos serpientes y escaleras/snakes and stairs boardgame*. Daniela's ideation process at this stage of the co-design workshops would eventually become her prototype for her mathematics activity.

**Figure 33***Daniela's Mis Numeros en Casa/My Personal Number List Artifact*

As mentioned, the researcher added breakout rooms to the second co-design workshop. Daniela, Sandra, and Carla were in a group. This group was very quiet and did not talk to one another unless the researcher asked questions or asked for updates. When asked about what ideas she had in mind for her Viñetas de Platicas/Storyboard, Daniela explained her idea as the following: “*Tal vez voy a hacer un tipo de juego de serpientes y escaleras, pero solamente con números que circulen sumas, restas, así más o menos.*” / “Maybe I'm going to do a Snakes and Ladders type of game, but only with numbers circulating additions, subtractions, like that more or less.”

Daniela's themes of fun, play, and learning were carried from the interviews when she stated that she wanted to “make learning fun” into the co-design workshops. And during her ideation process, we could see how Daniela used her funds of knowledge to build a game narrative connected to her history, needs, interests, and perceptions of what was fun and valuable. Despite having an idea of a mathematics activity that she had not seen before,

Daniela communicated how she did not think she was good at drawing, and she sounded very worried about how her drawing was going to look.

*Daniela: Ahí voy, más o menos, dibujándolo a ver si-- No soy buena dibujando, pero a ver si me queda.*

*Researcher: No se preocupe, recuerden que no hay mala o buena respuesta.*

*Daniela: A ver cómo me va a quedar a mí esto.*

Daniela: Here I go, more or less, drawing it to see if-- I'm not good at drawing, but let's see if it's good.

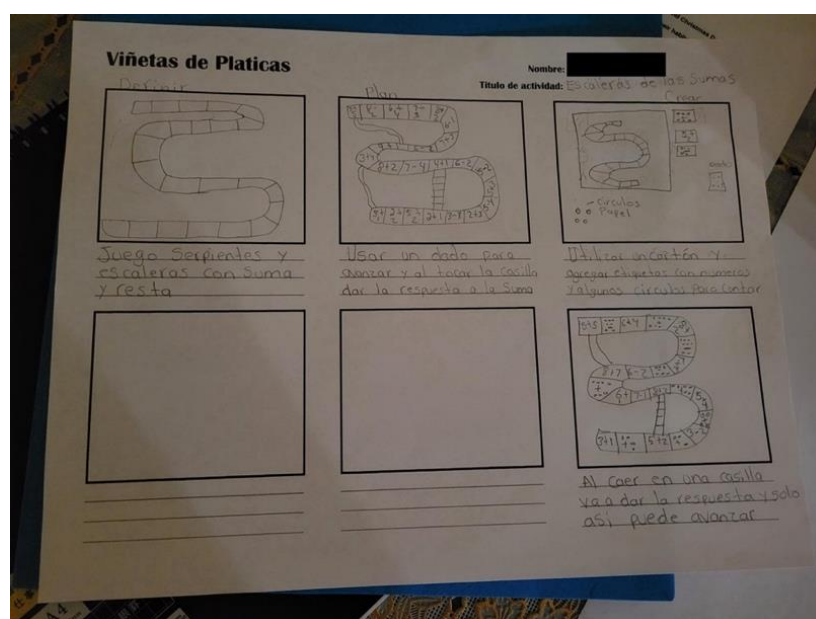
Researcher: Don't worry, remember there is no right or wrong answer.

Daniela: Let's see how this is going to turn out.

Daniela's Viñetas de Platicas/Storyboard was a continuation of her Mis Números en Casa/My Personal Number ideation, providing a more concrete description of her divergent thinking and the fluid ideation of her mathematics activity (Figure 34) and revealing that parents' understanding of mathematics can be socially constructed through approaches like co-design.

### Figure 34

*Daniela's Viñetas de Platicas/Storyboard Artifact*



It is worth noting that Daniela's Viñetas de Platicas/Storyboard is complex. Daniela thought about steps, goals, and the game complexity to make it challenging for her child. In using her funds of knowledge lens, Daniela contextualized how she saw mathematics in a board game she used to play when she was little and thus developed her idea for a math activity. Daniela demonstrated a clear articulation of mathematics for counting and addition, an idea that built on number sense. While Daniela was not explicit in telling the group that she was supporting her child's early mathematics knowledge by developing the child's number sense skills, she clearly demonstrated this learning goal in her Viñetas de Platicas/Storyboard.

In the mini follow-up survey, Daniela alluded to the theme of the construction of her knowledge and sense-making of the Viñetas de Platicas/Storyboard. She shared that what she remembered from the workshop was how to create an activity that she could put into practice with her child: *"La actividad de crear algo para ponerlo en práctica con los niños."* She also shared that the most memorable things from the second co-design workshop were *"El tratar de pensar en crear una idea, todo lo que tuve que buscar para darme una idea y el ver la creatividad de las compañeras"* "[In] trying to think about creating an idea, I have to think and find things to give me an idea, and also seeing the creativity of the other participants."

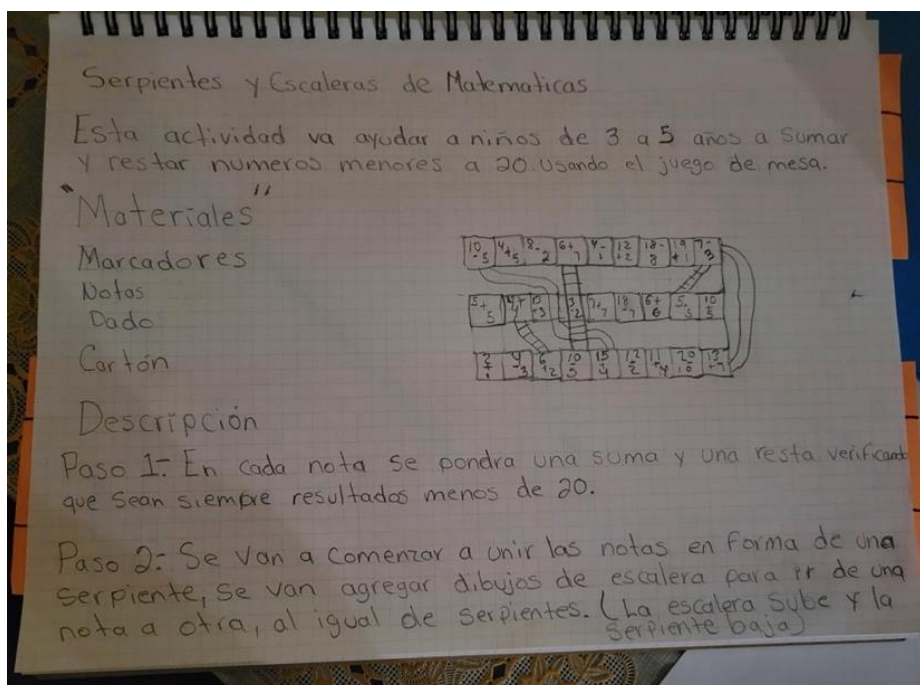
In the last co-design workshop, Daniela continued to have her camera off but still engaged verbally when the researcher asked participants to volunteer to share. For the third co-design workshop breakout room, the researcher made some changes in the group to encourage more interaction and conversation. For this workshop, Daniela was placed with Sandra and Erika in a breakout room. However, this group was also quiet and had their cameras off. Daniela was not fully interacting verbally or physically with other participants, but her peripheral participation and learning was evident in the creation of her artifacts and activities.

Daniela created a "lesson plan" for her mathematics activity (Figure 35). Her math lesson plan included a learning goal, materials, and steps to implement the activity. Daniela's lesson plan provided a more in-depth look inside her construction of knowledge in the ideation

process and established a link between the design and the activity process. Daniela's activity plan described her idea as a game that would build on each challenge, making it more complex for the player, in this case her child. Daniela's idea for her math activity was born out of her existing understanding of something she had played when she was little. When she applied mathematical concepts, her math activity became a translation and transformation of knowledge, applying what she knew and knows and also what is of interest of her. This is important because for going back to Daniela's semi-structure interview answers, she recalled games as something she enjoyed when she was little.

### Figure 35

#### *Daniela's Description of Her Math Activity Artifact*



Daniela stated in her interview she was not good at mathematics, but it was evident that her math beliefs and attitudes were shifting and she was having cognitive gains as an adult learner herself when designing her math activity. This is important to highlight because parents' with positive math beliefs and attitudes can develop math self-efficacy to support their children's

mathematics learning (Lindberg et al., 2008; Murimo, 2013). Daniela's lesson plan for her math activity represents her determination, independence, and creative problem-solving process.

In re-reading her transcript the apprehension she had when sharing something she thought was not very good. In the following conversation, Daniela shared her apprehension about not knowing if she was doing a "good" job. However, she was intentional in the learning goal of her mathematics activity and it showed a complex thought process of playing a game that would help the player to add and subtract.

*Daniela: Más o menos, este que ya está bueno, pero no tengo un cartón más grande.*

*Researcher: No se preocupe. Recuerden que es un prototipo.*

*Daniela: Más o menos, lo verde, estos, el hilo, se supone son las serpientes, que es la que va a bajar y caen aquí. Aunque dé la respuesta correcta, pero tiene que regresarse a más abajo y volver a comenzar. Estas serían las escaleras, que de aquí puede subir al otro nivel. Estas son las sumas y son restas.*

Daniela: More or less, this one is already good, but I don't have a bigger carton.

Researcher: Don't worry. Remember that this is a prototype.

Daniela: More or less, the green, these, the thread, is supposed to be the snakes, that's the one that's going to go down and fall here. Even if you give the correct answer, but you have to go back further down and start over. These would be the stairs, from here you can go up to the other level. These are additions and subtractions.

When describing her Modelo de Presentación/Prototype, Daniela shared the following with the rest of the participants:

*El mío es el de serpientes y escaleras. Primero, es diseñarlo e imprimirlo para ponerlo en un cartón y se va a utilizar el dado regular para ir por turnos. Al utilizarlo, se van a agregar etiquetas con números donde van a incluir sumas y*

restas. Ya dependiendo del turno del niño, si le toca, va a ser cinco más dos, al dar él la respuesta puede avanzar, si la da mal, entonces se queda en el mismo casillero.

Mine is the one with Snakes and Ladders. First, it needs to be designed and printed to put it on a cardboard and the regular dice will be used to take turns.

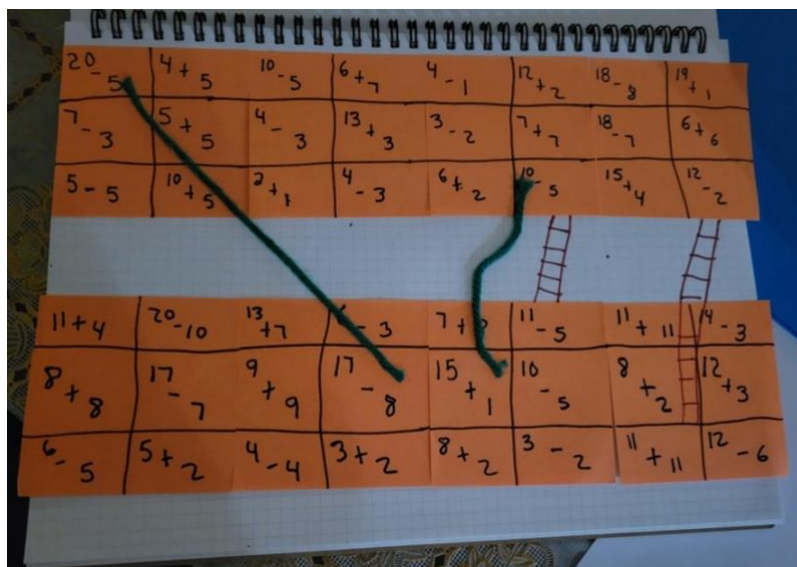
When using it, labels with numbers will be added to include addition and subtraction. Depending on the child's turn, if it is his turn, it will be five plus two.

When the child gives the answer, they can move forward. If they give a wrong answer, then they stay in the same box.

Daniela's description of her game demonstrated how co-design approaches and generative techniques help "non-designers" develop visual thinking to construct alternative approaches to learning. It is important to note that this was possible because Daniela was encouraged to see her interest as valuable, and that interest was born out of a personal experience growing up in Mexico, even she herself didn't think she was "good" at math. Figure 36 represents Daniela's prototype.

**Figure 36**

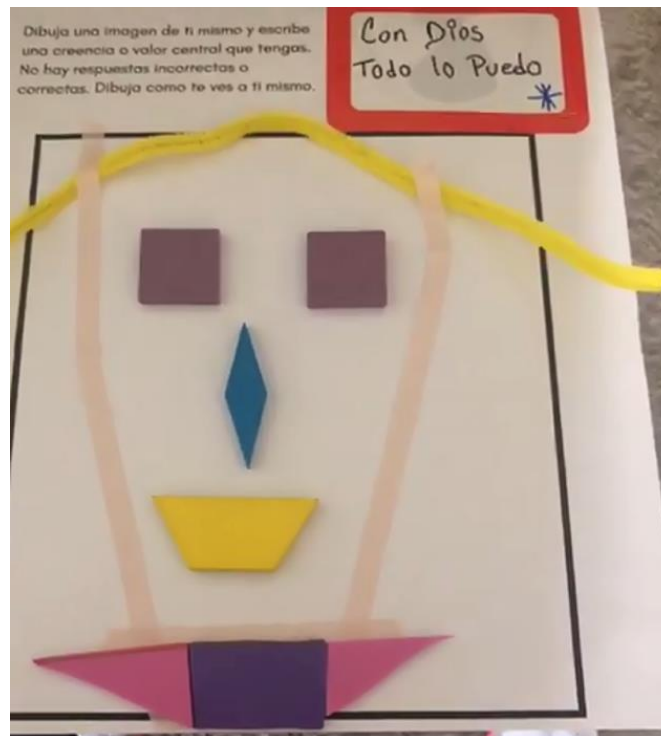
*Daniela's Modelo de Presentación Artifact*



**Carla.** Carla felt comfortable both in the main group and the breakout rooms. She decided to have her camera off throughout the workshops because she would have fits of laughter/“*No pongo la cámara porque me da un ataque de risa, disculpe.*” For Carla, being around other participants made her feel shy, and the remote co-design session allowed her to feel empowered to turn her camera off but continue to engage. Carla’s reserved participation was also represented through her short statements about her artifacts. Even though, Carla’s comments were brief, she provided a lot of information to get to know her. Carla described her Auto Retrato/Self-Portrait (Figure 37) in the following way: “*Mi nombre es Carla. Tengo tres hijos y mi creencia es que con Dios todo lo podemos, y ese es mi dibujo.*”/ “My name is Carla. I have three children and I think that we can do anything if we have God on our side, and this is my drawing.”

### Figure 37

Carla’s Mi Auto Retrato/Self-Portrait Artifact





Carla's Auto Retrato/Self-Portrait was a continuation of what she described in her interviews as traditions and values. Daniela explained that she likes to go to church, and when it was time to let other participants know more about her, she wanted to make religion a key description of who she was. It is important to note that in her artifact, Carla chose specific math-related tools to design her Auto Retrato/Self-Portrait, in contrast to the other participants.

For the second generative activity, Carla once again provided a brief description of her *Estética de Arte/Collage* artifact (Figure 38). She shared the following:

*[Estética de Arte] habla sobre la cocina. Me gusta cocinar con mis hijos y recuerdo también mi niñez que yo siempre cocinaba con mi abuela, con mi mamá para el día de navidad y sobre los días festivos que nos gusta mucho hacer en familia.*

[My collage] talks about cooking. I like to cook with my children, and I also remember that, when I was a child, I always cooked with my grandmother and my mom for Christmas day and on holidays. We really like to do that as a family.

**Figure 38**

*Carla's Estética de Arte/Collage Artifact*



Carla's Estética de Arte/Collage artifact reflected who she is in terms of her history and background. Her artifact allowed us to enter her memories to get a real insight into her world. Carla chose images of children engaging in cooking activities to represent this. For Carla, her experience of cooking with family continued to embody her idea that if a parent asserts that she had a good experience and remembers this, then her children will have a good experience and will be able to relate to it, too. The theme of cooking was first noted in Carla's interview, when she mentioned that she likes to have fun with her kids in the form of baking with them. Through Carla's Estética de Arte/Collage, we learned to see her and her family through a contextualized representation of what she values and is interested in.

At the end of the workshop, Carla shared via the survey that what she remembered the most was how to use her creativity/“*Nos hace usar nuestra creatividad,*” which was interesting to see in her survey feedback because at the end of her Estética de Arte/Collage description, she stated she lacked creativity/“*Me falta creatividad, tambien.*” Carla also shared that the most memorable part of the workshop was learning how each participant had different learning dynamics/“*Conocer cómo cada familia tenemos diferentes dinámicas para aprender.*”

In the second co-design workshop, Carla was the only other participant to do the El Periódico/News Story from the Future (Figure 39) take-home activity. Carla wrote about the big dreams in her life instead of doing a math activity. It could be interpreted that Carla forgot the instructions on how to do the activity and decided to focus on big dreams for them as parents and mothers instead of thinking about a potential math activity.

Figure 39

Carla's *El Periódico/News Story from the Future Artifact*

Formulario de **diario Nuevo**


VOLUME Y EMISION

con estrellas Michelin

HISTORIA DE

NOMBRE:

IMAGEN



TESTIMONIO

Un Restaurante familiar con comida autentica Mexicana

HISTORIA CENTRAL

RESTAURANTE Mexicano "Rocio"

Cuenta con estrellas Michelin, ENPEZANDO EL AÑO 2030, con Mucho éxito en la ciudad de garden grove.

INSTRUCCIONES

1. ESCRIBA ALGUNOS TITULARES DEL FUTURO PARA NOTICIAS (PERIÓDICOS, ARTÍCULOS EN LÍNEA, ETC.) DE 2030. IMAGINE QUE TODO LO QUE DESEA RESALTAR EN LA CREACIÓN DE SU ACTIVIDAD MATEMÁTICA.

2. REDACTE TODOS LOS TITULARES QUE PUEDA IMAGINAR EN CINCO MINUTOS. NO TIENEN QUE ESTAR DIRECTAMENTE SOBRE LA ACTIVIDAD MATEMÁTICA—PUEDEN SER SOBRE UN EVENTO O ESTADO DE COSAS QUE ESTÁ TANGENCIALMENTE RELACIONADO CON EL APRENDIZAJE MATEMÁTICO DE SU COMUNIDAD, ESTADO, REGIÓN O PAÍS.

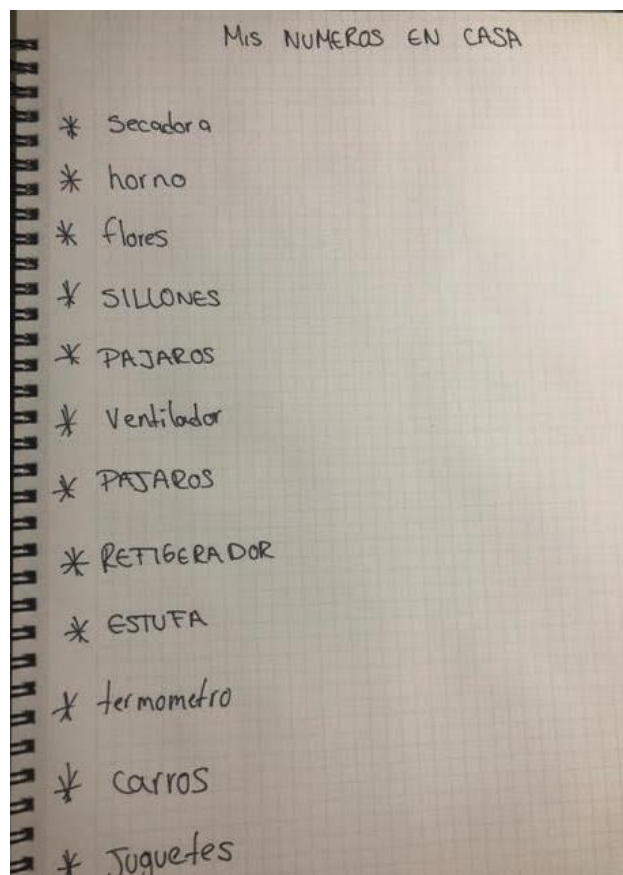
3. ELIGE TU TÍTULO FAVORITO!

4. INCLUYA UNA CITA DE EJEMPLO DE ALGUIEN QUE PUEDA ENTRAR EN ESTE ARTÍCULO IMAGINARIO

For the *Mis Números en Casa/My Personal Number List* activity, Carla created a list to help her contextualize her surroundings with what she saw and perceived as mathematics moments (Figure 40). In describing her list, Carla noticed that her thought process was very similar to that of the other participants. Carla stated that when making her *Mis Números en Casa/My Personal Number list*, she thought about her interactions with her children and her home environment and learning spaces.

**Figure 40**

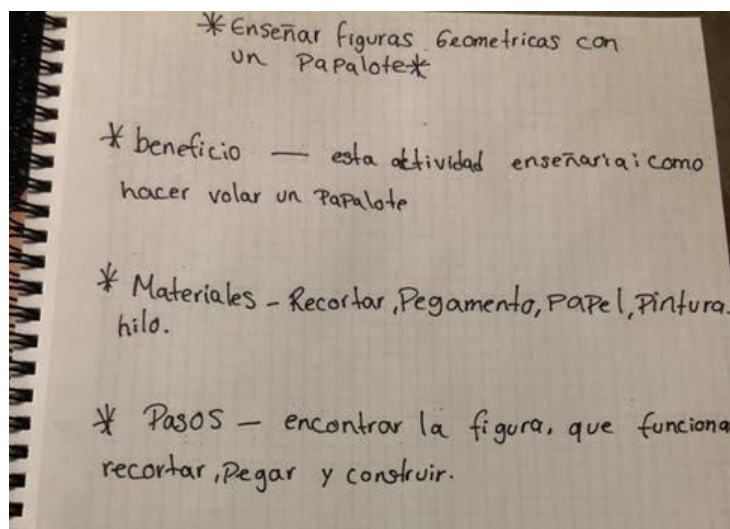
*Carla's Mis Numeros en Casa/ My Personal Number List*



Carla wasn't able to participate for the rest of the second co-design workshop due to internet issues at her home. The researcher followed up with Carla via email to see whether she had time to do her Viñetas de Platicas/Storyboard artifact. Carla let the researcher know that she was going to try to do it during the weekend. Carla did not have time to do her Viñetas de Platicas/Storyboard, but she emailed the researcher a breakdown of a math activity that she brainstormed at home (Figure 41).

## Figure 41

### Carla's Description of Her Math Activity



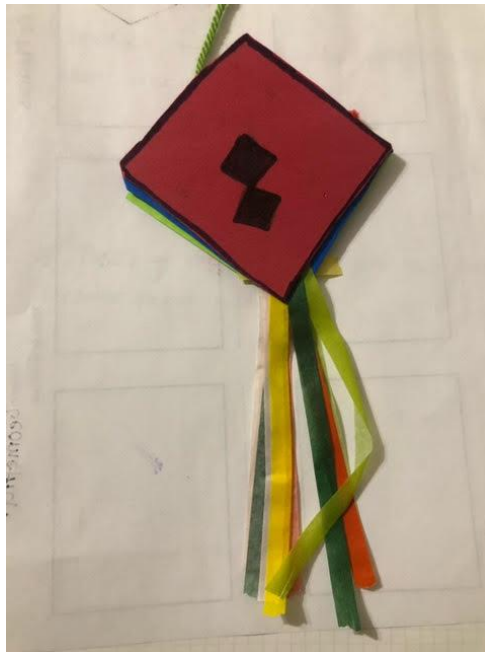
In the last workshop, Carla explained that although she wanted to do something with cooking, she couldn't think of anything and thus thought about doing her mathematics activity based on something that she used play when she was little: *papalotes/kites*. Carla explained once again that she didn't feel she had creativity/“*Bueno como no puedo pensar en nada, voy con otro. Voy hacer un papalote. Y puedo escoger geometria para este verdad?*” She chose something that she knew from her life and thought could be aligned to geometry. Carla shared: “*Si, este [papalote] le puede ayudar, porque yo iba a utilizar esto [ensena su estetica], pero no como geométrico, sino que para contar, cuántos rojos o cuántos verdes, pero entonces lo puede utilizar para la geometría.*”/ “Yes, this [kite] can help my child, because I was going to use this [shows her collage], but not as geometric, but to count how many reds or how many greens, but I think I can use this for geometry.”

Carla communicated that she did not think she was creative enough to figure out a mathematics activity with the theme of cooking. Despite this, Carla used her funds of knowledge by thinking back to her cultural background. Carla used her fond memories of her childhood to contextualize a different solution for her prototype (Figure 42). Carla also demonstrated how

one's perception of mathematics goes beyond competence and is shaped by one's learning environment. This finding revealed that a strong sense of asset-based perspectives might help deepen Latine parents' negative attitudes into positive mathematics beliefs, including mathematics knowledge and practice.

**Figure 42**

*Carla's Modelo de Presentación/Prototype*



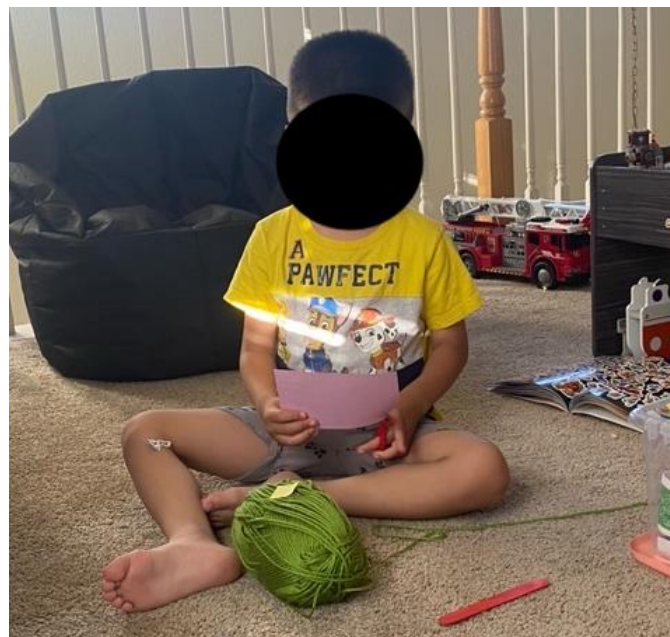
Carla shared photos of how she implemented her math activity with her child (Figures 43 and 44). Carla's photos illustrate how as a mother she was able to engage in a process of culture, memories, and interest translation to feel motivated to make a mathematics activity that would help her child learn shapes, colors, and patterns. Her prototype speaks to the idea of exploring knowledge to translate it into participatory design practices. This translation of knowledge and engagement in co-design approaches influenced how Carla made use of her funds of knowledge and the generative activities she used to address constraints (not being able to do the cooking activity) and possibilities (using another memory to be the foundation of her math activity).

**Figure 43**

*Carla's Modelo de Presentación/Prototype Implementation with her Son 1*

**Figure 44**

*Carla's Modelo de Presentación/Prototype Implementation with her Son 2*



In the last co-design workshop survey, Carla stated that one of the things she remembered from the session was how to use her activity (prototype) with her children/“*La actividad de crear algo para ponerlo en práctica con los niños.*” She added that it was a very creative process and she felt motivated to design something else/“*Fue muy creativo y nos motivó a diseñar algo.*” Carla also shared a memorable part of the workshop was that she felt creative for the first time/“*Primera vez que me siento supeitamente creative.*”

**Sandra.** Sandra participated when she felt comfortable participating and would have her camera on and off throughout the three co-design workshops. However, Sandra was more open to being vulnerable and stated how isolating the co-design workshops felt and how she did not feel creative or smart. Sandra’s interview answers demonstrated that she felt personally motivated to help her daughter succeed in life and academically. However, that strong motivation and confidence disappeared during the co-design workshops. We could see this in Sandra’s comments when she described her Auto Retrato/Self-Portrait artifact (Figure 45):

*Mi nombre es Sandra. Lo que escribí, ‘La educación empieza antes de la escuela.’ Para mi hija, yo sé que primero estamos nosotros los padres, está mi familia, los vecinos, aprende de todos antes de que conozca a una maestra. La educación empieza antes de ir a la escuela. Yo no sé dibujar. Este es el mío. Me di cuenta que no tengo nada creativo en mí [ríe]. Yo lo hice primero con el lápiz y después several pencils. Mi hija está jugando aquí, le puse sticky notes para la blusa.*

My name is Sandra. What I wrote was, ‘Education begins before school.’ For my daughter, I know that first there's us as parents. There's my family, the neighbors... she learns from everyone before she meets a teacher. Education begins before going to school. I don't know how to draw. This is mine. I realized I don't have any creativity in me [Laughs]. I did it first with pencil and then I used several pencils. My daughter is playing here. I put sticky notes as her blouse.



Despite showing a lack of confidence, Sandra's statement demonstrated how she values education and believes that home is where she can teach her daughter first. She has supportive expectations for herself as a mother, which is what made her attend the workshop, knowing that she was going to face unknown realities. Sandra's Auto Retrato/Self-Portrait was simple, but when describing her core belief, it was clear how much her family means to her. Especially how much her daughter is her priority both in raising her well be a "good person" but also for academics. The next two co-design sessions and through her artifacts, the researcher could start to see Sandra's confidence grow.

### Figure 45

*Sandra's Mi Auto Retrato/Self-Portrait Artifact*



For the second co-design activity, Sandra continued to keep her artifacts simple. In her description, Sandra mentioned that she included the word "puzzle" because it was something that her daughter loved to do, and she herself, has also found joy in doing it along with her

daughter. This reflected her interview answers of her daughter's discovery of puzzles. Sandra chose one image of a mom and a child to represent that family is central to her, and the words she used in her *estética* also represented what she valued and considered important in raising her child (Figure 46).

### Figure 46

*Sandra's Estética de Arte/Collage Artifact*



For Sandra, including puzzles was a representation of how much she cared for her daughter. It is important to note that when Sandra was describing her artifact, she turned her camera on. She looked shy and at moments would use her hands to hide her face. Her voice intonation would change from quiet to very quiet. Sandra described her *Estética de Arte/Collage* as the following:

*Usé muchas palabras, no encontré muchas pictures. Como dije que el collage es con lo que nos identificamos, pues para mi hija es todo lo que ella. Por eso me mostró este libro donde está con los niños y todo alrededor puse, es children, help, translating, supporting, techniques. Tambie mostro el rompecabezas. Porque a ella le gustan mucho los rompecabezas, todo lo que hacemos es*

*juntas pero no encontré nada de rompecabezas, todo eso use palabras. Nomás es que todos son diferentes, pero tú tienes que tener diferentes techniques y translating porque en veces le enseño cosas en español y en inglés y ya.*

I used a lot of words; I didn't find many pictures. Since you said that the collage is what we identify with, well for my daughter, it is everything she is. So, she showed me this book where she is with the children and all around, I put, is children, help, translating, supporting, techniques. She also showed the puzzle. Because she really likes puzzles, that's all we do together. But I didn't find anything about puzzles, so I used words. It's just that everyone is different, but you have to have different techniques and translating because sometimes I teach her things in Spanish and in English and that's it.

By the end of the first co-design workshop, Sandra was the only participant to share how lonely she felt throughout the first workshop. Sandra shared the following:

*¿Qué me gustó? Me gusta la idea de todo esto. ¿Qué aprendí? Que supuestamente soy creativa. [risas] ¿Qué querría? Yo pienso que si fuera en persona, hablar con otras personas para sentirme que estoy con otras personas. Por que cuando estaba haciendo esto, no sabía qué hacer, estaba sola, sé que estabas ahí, pero yo me sentía más sola que nada.*

What did I like? I like the idea of it all. What did I learn? That I am supposedly creative. [Laughter] What would I want? I think if it were in person, talking to other people to feel like I'm there with them. Because when I was doing this, I didn't know what to do. I was alone. I know you were there, but I felt more alone than anything.

It was not surprising to see one of the participants comment on the lack of relationship-building with other participants. Learning is a social activity. Unfortunately, some of the Zoom affordances cannot translate to in-person relationships. Sandra's lack of confidence can be

interpreted as an obstacle because perhaps the way that she learned was socially and she had a need to feed off other people's ideas and comments to feel more confident in doing her co-design activities.

Based on Sandra's feedback, the researcher modified the second and third co-design workshops to add breakout rooms. During the second co-design workshop, Sandra continued to make statements about how she thought she was doing the activities wrong/" *Yo pienso que yo lo hice un poquito mal, porque mi niña me estaba hablando.*" But she was still willing to share with the rest of the participants. For the Mis Números en Casa/My Personal Number activity, Sandra did not make a list, but she stated that she wanted to share the things she thought had math in her home:

*Yo puse cosas del cómo hacemos las matemáticas cuando lavamos ropa, me ayuda a sorting o cuenta cuántos calcetines son entre los tres, una lavadora de puros calcetines, está contando calcetines, números de contar los trastes cuando los sacamos del lavaplatos, contando los pasos de subir arriba, abajo de las escaleras, contando los pasos afuera, like stepping on bricks. Afuera hacemos muchas cosas con chalk, como Hopscotch o nada más ponemos números y brincamos. Le digo, 'Brinca al 77', y ella brinca. Hacemos muchas carreras y time it, saber cuánto le dura ir en la bicicleta alrededor una vez y después trata de hacerlo más rápido o más despacio la segunda vez. Yo puse cosas así.*

I put in things from how we do math when we do laundry. She helps me sorting or counting how many socks we have between the three of us, a washing machine filled purely with socks. She counts socks, learns numbers from counting the dishes when we take them out of the dishwasher, counts the steps up and down the stairs, counts steps outside, like stepping on bricks. Outside we do a lot of things with chalk, like Hopscotch or we just put numbers and jump

around. I tell her, 'Jump to 77,' and she jumps. We do a lot of races and time them. We count how long it takes her to go on the bike around once and then she tries to do it faster or slower the second time. I put things like that.

Through this statement, Sandra demonstrated how she has interactions with her child and how she creates home learning and home math environments that were not evident to her—until she contextualized mathematics in her home through the Mis Números en Casa/My Personal Number activity.

Sandra's description of how she saw math at home and with her daughter illustrated a math-rich learning context. Sandra recognized that mathematical moments were part of her and her child's life at home. It is important to note that Sandra's lens on the engagement and connection she had with her daughter are why she focused on puzzles for her math activity, even though at first she thought she lacked the skills to do a puzzle. Sandra stated the following:

*El que yo quería hacer es rompecabezas, que ese puede ser de razonamiento matemático. No sé cuál de los dos hacer, porque no sé hacer un rompecabezas. No sé cómo hacer esto. Porque eso lo que hacemos the most, pero todos son comprados de la tienda, nada así en casa que yo pienso que es un rompecabezas.*

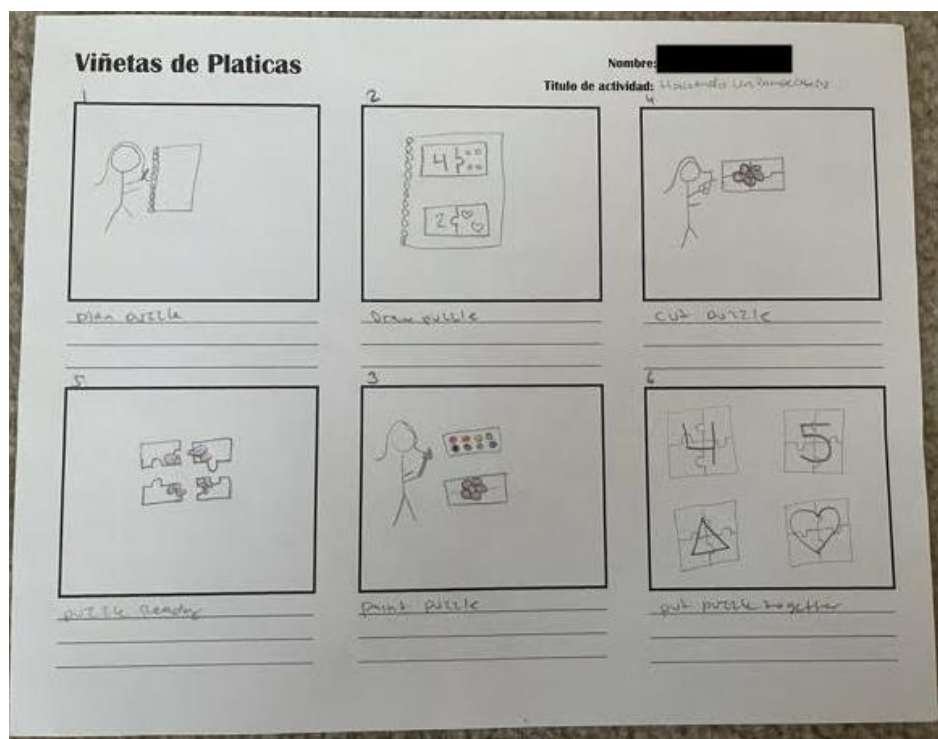
What I wanted to do is puzzles, which can be mathematical reasoning. I don't know which one to do, because I don't know how to make a jigsaw puzzle. I don't know how to do this. Because that's what we do the most, but they're all store bought. We do nothing like that at home, nothing like a puzzle.

When Sandra asked the researcher to help her decide which topic to choose for her math activity, the researcher reminded Sandra to do what she liked to do the most with her daughter, even if she thought she didn't know what to do. The researcher reminded Sandra and the rest of the participants that there was no wrong or right answer when doing their Viñetas de

Platicas/Storyboard artifacts. After discussing her math topic with the researcher, Sandra chose to do a puzzle for her mathematics activity (Figure 47). In her Viñetas de Platicas/Storyboard, Sandra provided a brief explanation of her math puzzle activity.

**Figure 47**

*Sandra's Viñetas de Platicas/Storyboard Artifact*



Sandra's Viñetas de Platicas/Storyboard (Figure 47) provided a visual representation of her idea of a math puzzle. It also demonstrated how she saw herself doing the activity with her daughter. Sandra's sketches continue to give us a peek into how she positioned herself in her daughter's learning engagement, which was similar to her verbal descriptions when she contextualized math at home in her Mis Números en Casa/My Personal Number activity. When describing her Viñetas de Platicas/Storyboarding artifact, Sandra shared the following:

*No sé si hice bien el dibujando. Estaba pensando en usar papel, cortarlos para hacer los little squares. No sé qué más usar, puedo usar la pintura y todo para*

*pintar las cosas adentro del rompecabezas, pero pienso que mejor es hacerlo en papel primero.*

I don't know if I did the drawing right. I was thinking of using paper, cut it to make the little squares. I don't know what else to use. I can use paint and everything to paint things inside the puzzle, but I think it's best to do it on paper first.

At the end of the second co-design workshop when asked what they liked, learned, and wished, Sandra shared that she felt she could not concentrate on the activity because her daughter was with her! *“Igual que Erika, al principio mi niño estaba conmigo y no me podía concentrar.”* She restated that one of the reasons she wanted to be in person was because then she could pay attention and engage with other parents! *“por eso digo, si ella tuviera algo que hacer, yo estuviera en persona o en otro lado donde ella no estaría, hiba hacer esto mayor.”* However, she shared that she liked how much she learned by listening to the other participants: *“Me gusta que todos comportan cosas que no se como lo que aprendí lo de la electricidad y el agua que dijo Rosa.”*

For the last co-design workshop, the researcher placed Sandra in a different breakout room to see whether she would feel more connected to other participants. However, Sandra continued to be shy and reserved and not engage with the other participants in the breakout room. This was evident as Sandra herself also stated that she would benefit from being in person for this kind of workshop. Despite some of these challenges, Sandra continued to engage by trying to do the co-design activities even if she felt she lacked the skills to do them. For the last co-design activity, Sandra only shared brief comments about her experience doing the Modelos de Presentación/Prototype (Figure 48).

*Yo ya lo hice, haci. Es difícil enseñarlo por que no se si lo hice bien. Son rompecabezas chiquitos. El primero nomás tenía de cuatro. Es como una flor, que la tienes que poner junto. Lo hice con post-its y marcadores. El otro es igual,*

*es un círculo y un cuadro y un círculo y un cuadro, like a pattern, y están más chiquititos los pedazos.*

I already did it, like this. It is difficult to teach it because I don't know if I did it right. They are small puzzles. The first one had only four pieces. It's like a flower that you have to put together. I did it with post-its and markers. The other one is the same. It's a circle and a square, and a circle and a square, like a pattern, and the pieces are smaller.

### Figure 48

*Sandra's Modelos de Presentación/Prototype for Her Math Activity*

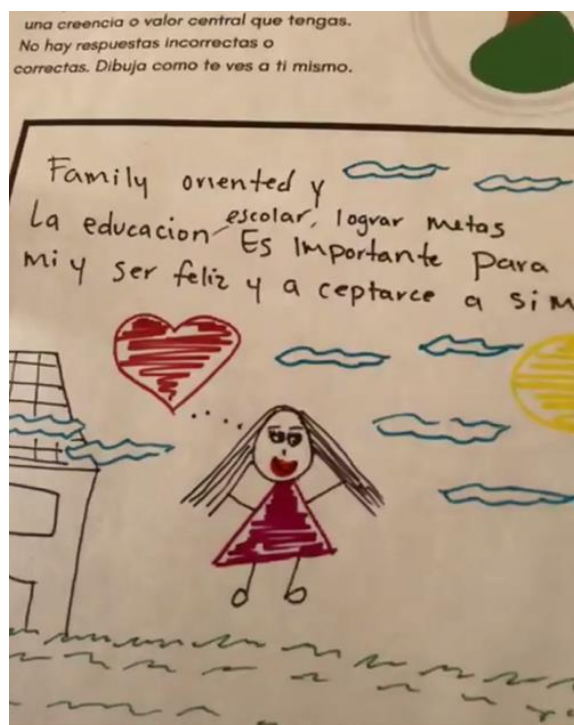


**Sol.** Sol was the only participant to draw a full picture of herself and her community to represent her values and beliefs. Unlike the other participants who drew self-portraits, Sol included what she believed was a reflection of her everyday life. Sol continued to emphasize her family-centric values. Citing that she wants her daughter to do good in school but also be “good” people. Sol was also the only participant to mention education in the traditional way of schooling compared to the rest of the participants. In describing her Auto Retrato/Self-Portrait (Figure 49), Sol stated that her artifact was simple but that she tried her best.



Figure 49

## Sol's Mi Auto Retrato/Self-Portrait Artifact



Sol shared the following when describing her Mi Auto Retrato/Self-Portrait activity

*Sol: El mío está muy sencillo. No tengo mis lentes, hice lo que pude. Me llamo*

*Sol. Tengo dos hijas, una tiene 16 años y la otra tiene cuatro años. Para mí, la familia, ¿cómo se dice family oriented?*

*Researcher: "Está enfocado en su familia" o "Está concentrado en su familia."*

*Sol: Como en familia estar unida, esa es mi creencia. La educación de mis hijas, escolar, es muy importante para mí, también ser feliz y aceptarse así mismo, es lo que le quiero enseñar yo a mis hijas, seguir adelante en su educación y no se den vencidas, ser feliz y aceptarse a sí mismo.*

*Sol: Mine is very simple. I don't have my glasses; I did what I could. My name is*

*Sol. I have two daughters; one is 16 years old and the other is 4 years old. For me, family, how do you say family-oriented?*

Researcher: "Focused on family" or "Centered on family."

Sol: As a close-knit family, that is what I believe. My daughters' education, school, is very important to me. Also being happy and accepting oneself. That's what I want to teach my daughters, to go ahead in their education and not to give up, to be happy and to accept themselves.

Sol also had some self-doubt when creating her artifact. However, Sol's Mi Auto Retrato/Self-Portrait activity represented work that was multidimensional and extremely personal, both familiar to participants and readers but also new to the researcher. Sol emphasized that her personal values included traditional Latine educational inspiration for her daughters but also how a social and emotional foundation matter to her. She wanted her daughters to be happy and accept themselves. This is not surprising, knowing that Sol moved between two cultures—the one she was born in and the one her parents instilled in her.

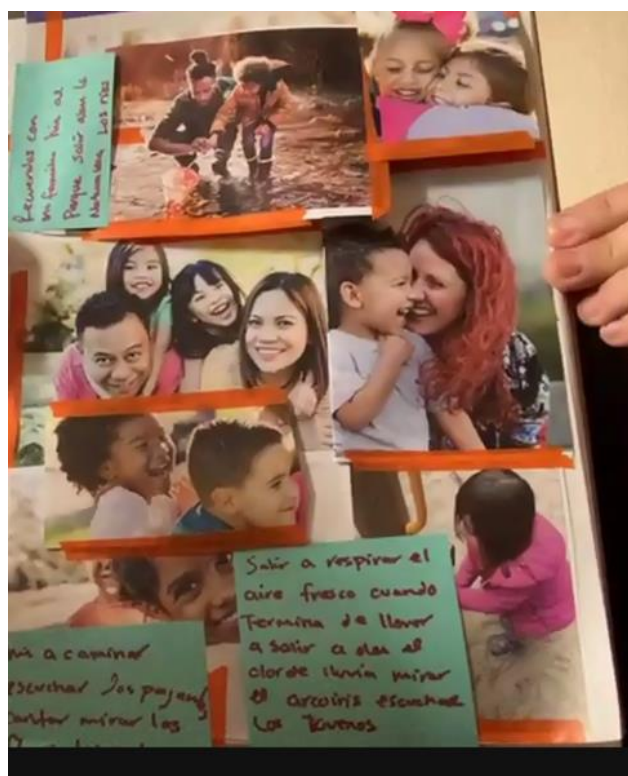
For her *Estética de Arte/Collage* (Figure 50), Sol continued with the familismo values to describe how she centered family in her everyday life. Her collage included things that she liked, like nature. She felt connected to nature and exploring the outdoors because it reminded her of her family and the time she spent with her parents going out camping or to the lake. Sol shared the following when describing her *Estética de Arte/Collage*:

*Escogi naturaleza porque cuando era niña, mi papá le encantaba la naturaleza, ir al río, cuando llovía hablábamos de los truenos, cuando salíamos a oler el aire. Cuando llueve sale ese aroma, olor, que a mí me encanta. Tierra mojada. Cuando no está muy oscuro cuando termina de llover, a mí me gusta mucho mirar los arcoíris, porque a veces salen los arcoíris y eso es lo que hacemos con mi niña, la chiquita y la grande también, nos gusta mucho el arcoíris, nos gusta ir mucho al parque. No sé si ven aquí, los niños están felices cuando están afuera porque no solamente aprenden en la casa con libros, pero también salen afuera a mirar la naturaleza, los pajaritos, los animales, a caminar ese aire fresco.*

I chose nature because, when I was a child, my dad loved nature, going to the river. When it rained, we would talk about thunder, when we would go out and smell the air. When it rains, it gives off that aroma, that smell, that I love. Wet soil. When it's not too dark after it finishes raining, I really like to look at the rainbows, because sometimes rainbows come out and that's what we do with my girl, the little one and the big one too. We like rainbows a lot, we like to go to the park a lot. I don't know if you see it here: the children are happy when they are outside because they not only learn at home with books, but they also go outside to look at nature, the birds, the animals, to walk in that fresh air.

### Figure 50

#### *Sol's Estética de Arte/Collage Artifact*



Sol holds memories of her family dear to her. For Sol these are positive memories that she wants to pass on to her children. Sol wants her daughter to think about the outdoors as a

space where they can learn, have fun, and spend time with family. Sol visually expressed these ideas through images but also in the words she wrote on post-its and included them in her *Estética de Arte/Collage*. Sol conceptualized the connections between her values, beliefs, and goals to communicate the theme of familismo while also showing her funds of knowledge through the things that she likes and enjoy—nature.

At the end of the first co-design workshop, Sol shared how much she appreciated having a space to share and learn from one another as participants. Sol stated that she felt she was in elementary school with her papelería/cultural probes box full of resources she could use to be creative, which made it fun. She once again mentioned how she did not know how to draw but she was happy to be around a group of people who cared for their children and the education of their children:

*Lo que me gustó puede ser todo, que es divertido, saber que tenemos una meeting, que nos manda las cositas, nos ponemos creativas, como si estuviéramos a lo mejor en la escuela de elementary, porque las actividades que hacemos, es cosas fáciles.*

What I liked is mostly everything. It's fun, knowing that we have a meeting, that she sends us little things. We get creative, as if we were in elementary school, because the activities we do are easy things.

This is an important finding that emphasizes on the importance of designing and creating positive learning environments for families. Co-design approaches can be used to foster adult learning interactions, as they were in this study. For Sol and the rest of the participants, co-design approaches influenced their construction of knowledge and learning and also fostered excitement about learning more about a topic that participants had held strong negative beliefs about.

In her survey answers, Sol shared similar feelings about her experience in the first co-design workshop. She shared that she remembered the connection to the other participants/“La

*connection de los demas madres similares respuestas.*” She also shared how she was starting to think about making math fun for her children/“*Estoy pensando que puede ser divertido jugar con los niños y enseñarles como usar las matemáticas.*” Sol’s perceptions about mathematics were changing to the point that she stated she was thinking about how to make math fun and playful for her children. Co-design approaches helped participants situate their beliefs within their individual subjective and experience-based knowledge.

In the second co-design workshop and for the Mis Numeros en Casa/My Personal Number activity, Sol had a similar experience to the other participants. Sol contextualized her Mis Números en Casa/My Personal Number list to everyday activities, objects, and resources she could relate to and that were available in her everyday life. It is important to note that Sol also related her number list to exploring the outdoors with trees, fruit, and the animals she saw in the neighborhood. She shared the following:

*Yo voy a decir mucho parecido a las compañeras anterior. Tengo árboles de peaches, afuera pueden contar los tres diferentes árboles de peaches que tengo, las uvas, los cherries, las fresas, las piedritas, las maripositas que andan por ahí a veces, antes eran los gatos de la vecina todo para contar.*

Similar to the previous parents who shared, I have peach trees, outside you can count the three different peach trees I have, the grapes, the cherries, the strawberries, the pebbles, the little butterflies that fly around sometimes. We used to count the neighbor’s cats as well.

Sol engaged in conversations with other participants. Before I placed them in different groups, Sol had concerns about the topic of her activity and wanted the researcher to help her choose a topic because she saw the researcher as the “expert.” Sol stated the following: “*Tú me dices Susie (researcher), porque tú eres la experta, cómo se llama el que yo quiero, pintar? porque ahí ya uso los colores. Usar el nature? Por eso te digo que está como un poco confuso. Tu ayudame.*”/ “You tell me Susie (researcher), because you are the expert, what’s the topic I want

to do related to paint? because I already use the colors there. Do I use nature? That's why I tell you it's like a little confusing. You help me.”

The researcher let Sol know that there was nothing wrong with being confused or still deciding what to choose regarding topics. The researcher told Sol that she could brainstorm in the breakout room to help her decide, encouraging Sol with the idea that she was the expert and that she had the knowledge. In the following conversation, we can see how Sol, Rosa, and Erika engaged in inquiry thinking, math talk, and curiosity-driven learning when discussing the topics they wanted to focus on for their mathematics activity. This conversation demonstrated how they engaged one another around mathematical ideas. For example, this excerpt highlights the importance of clearly communicating, asking questions, and drawing others out:

*Sol: Cada quien tiene que escoger lo que a usted le guste más, como a Erika, ¿qué es lo que le gusta? Ella escoge. Ella le gusta sumar, separar?*

*Erika: No, me gustó la medición.*

*Sol: Oh, sí, medir. Medir los hilos, como dijo Susie. Medir qué zapato es más grande, por decir, si el de él o el de su hermanita, o qué lápiz es más grande.*

*Eso es lo que tenemos que hacer.*

*Rosa: ¿Qué escogeríamos acá? ¿Qué se pondría acá?*

*Sol: Allí yo creo que qué es lo que va a usar para medir, el hilo. Puede usar el hilo Erika, para medir. ¿Usted también va a hacer lo mismo, Rosa, el mismo topic?*

*Rosa: Sí.*

*Sol: Ese va a ser tu enfoque. ¿Qué es lo va a hacer? Medir. ¿Qué es lo que hay en las cajas que vas a utilizar? Dale vuelta a las cajas que tienes ahí, eso es lo que vas a usar. Después en la siguiente caja, vas a—*

*Rosa: Okay, esos no. Descartado, eso no. [ríe] Por lo menos está bien.*

*Sol: En la segunda caja vas a escribir qué es lo que vas a usar en la caja y cómo. Como esos hilitos, el hilo. Vas a decir—*

*Sol: Puedes usar cualquiera, un papel en blanco como estaba haciendo Susie. Yo la vi que usó un papel en blanco para sus notas. La podemos llamar, le podemos preguntar también. Dijo que iba a estar ahí si la necesitábamos.*

Sol: Everyone has to choose what you like the most, like Erika, what does she like? She chooses. She likes to add, to separate?

Erika: No, I liked the measurement.

Sol: Oh, yes, to measure. Measure the threads, as Susie said. Measure which shoe is bigger, or whether it's his shoe or his sister's shoe. Or which pencil is bigger. That's what we have to do.

Rosa: What would we choose here? What would you put here?

Sol: There, I think what you are going to use to measure, the thread. You can use the thread, Erika, to measure. Are you also going to do the same, Rosa, the same topic?

Rosa: Yes.

Sol: That's going to be your focus. What are you going to do? Measure. What is in the boxes you are going to use? Turn over the boxes you have there, that's what you're going to use. Then in the next box, you're going to--

Rosa: Okay, not those. Discarded, not that. [Laughs] At least it's okay.

Sol: In the second box, you are going to write what you are going to use in the box and how. Like those yarns, the thread. You're going to say...

Sol: You can use any, a blank piece of paper as Susie was doing. I saw her use a blank piece of paper for her notes. We can call her; we can ask her too. She said she would be there if we needed her.

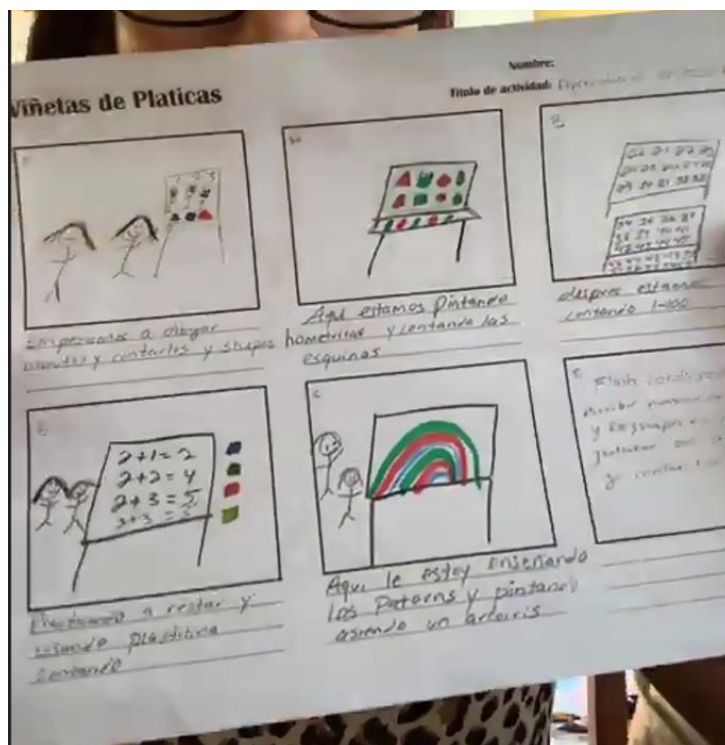
It is important to note that in this excerpt, all three participants were communicating their ideas without the researcher being present. The researcher placed one group in the main Zoom room and Sol, Erika, and Rosa in a breakout room. The researcher jumped between groups to check on them. Before the researcher placed all participants in groups, Sol asked her again to give her ideas/“*Escógeme a mí, escógeme a mí. Para que me des ideas.*” But in the conversation with the rest of the parents in her group, she was sharing and giving ideas to the other participants. It is important to note that Sol told the researcher, that I was the expert and that I needed to help her with her topic. However, in their group conversation, we can see how much knowledge and initiative Sol had when engaging with the other participants.

For her Viñetas de Platicas/Storyboard artifact (Figure 51), Sol decided to focus on traditional counting from 1 to 100. Sol could not think of how to use her interest, which is nature, for her mathematics activity. Sol decided to focus on a more traditional way of teaching math to her children. It is important to note that although Sol focused on a “traditional” way to teach math, she still described her math activity as “creative” with lots of “curiosity” for her daughter to have a sense of “discovery” when she engaged with the activity. Sol reflected on what she thought could help her daughter while still providing a fun mathematical experience.



Figure 51

Sol's Viñetas de Platicas/Storyboard Artifact



In the last co-design workshop, Sol felt hesitant to translate her storyboard into a prototype. The researcher suggested she write down her ideas on a piece of paper to get the ideas out of her head. In Figure 52, we can see how Sol thought about her activity in a way that would make it challenging for her daughter to help her learn more. We can also see how Sol used a strategy that would either help her daughter memorize the numbers or learn them by achieving each step. Sol's Modelos de Presentación/Prototype illustrated a need to understand how to contextualize math learning.

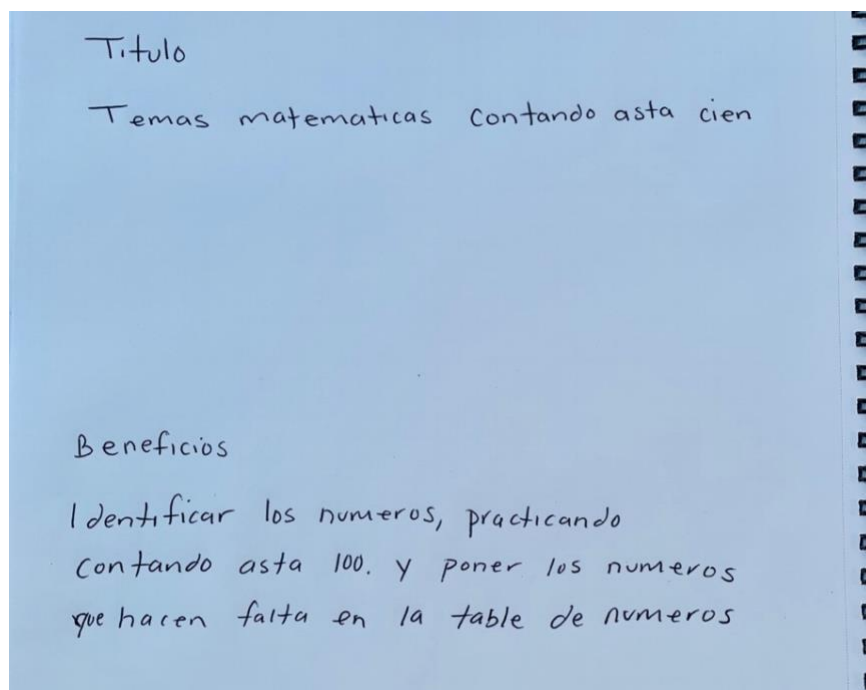
**Figure 52***Sol's 1–100 Math Activity Plan*

Figure 53 represents Sol's prototype. Sol described a very thought out math activity for her daughter, despite her stating in the semi-structured interviews that she was not a math person.

Sol shared the following when describing her prototype:

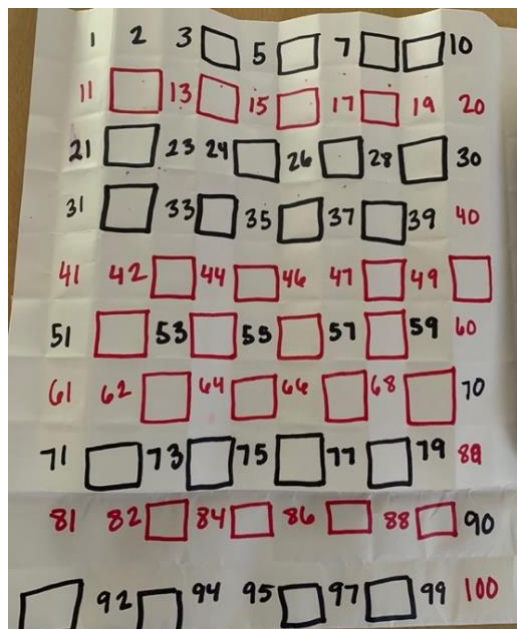
*Aquí le estoy enseñando yo a contar a uno al 100. Ya sabe 35, contar, ya quiero que siga contando hasta el 100. Ahí en la cajita que nos mandaste están de esos papelitos que a ella le gustan mucho. Ella escribe un número, luego lo quita y lo pega. Escribe y luego lo pega en la pared. Yo tengo un board donde puedo pintar ahí le gusta ponerlo. Aquí ya le estoy enseñando cómo sumar.*

Here I am teaching her how to count from one to 100. She already knows how to count to 35. I want her to keep counting to 100. There in the little box you sent us are some of those little papers that she likes very much. She writes a number, then removes it and pastes it in. She writes and then pastes it on the wall. I have

a board where I can paint, and she likes to put it there. Here I am already teaching her how to add.

**Figure 53**

*Sol's Modelo de Presentación/Prototype*



Although Sol chose not to base her math activity around nature, she still thought about what she knew and what her daughter liked and combined both of those things to make an activity that her daughter would recognize and find fun to do. In her last comment, Sol shared:

*Lo que yo aprendí fue, como dijo Sandra, ya una vez, creo que ella dijo la última vez que tiene creatividad o algo así, porque yo estaba dando vueltas y digo, '¿Qué voy a hacer?' Como tú dijiste, Susie [researcher], 'Algo que te llame la atención, que tú quieras aprender o enseñarle a tus hijos,' como yo dije, quiero que aprenda a contar de 1 al 100 y eso se me ocurrió hacer, nomás que lo voy a hacer un poquito mejor para mandarte la foto, porque ahorita lo hice así, muy rápido, y no se mira muy bien.*

What I learned was, as Sandra said already once... I think she said last time she has creativity or something like that, because I was thinking and I say, 'What am I

going to do?’ Like you said, Susie [researcher], ‘Something that catches your attention, that you want to learn or teach your children.’ Like I said, I want her to learn to count from 1 to 100 and that’s what I thought of doing, but I’m going to do it a little bit better to send you the picture, because right now I did it like this, very fast, and it doesn’t look very good.

Sol acknowledged how they, as parents, have extensive bodies of knowledge that have developed through their home lives, community resources, and cultural backgrounds. For Sol, it was a matter of helping her shape her existing knowledge into a math activity that she could enjoy with her daughter (Figure 54). When Sol shared the photo of her daughter doing her math activity, she wrote “*diviertendonos*”/“*we are having fun.*” Sol was helping her daughter with math skills by engaging in a game she designed with her values while having fun.

#### **Figure 54**

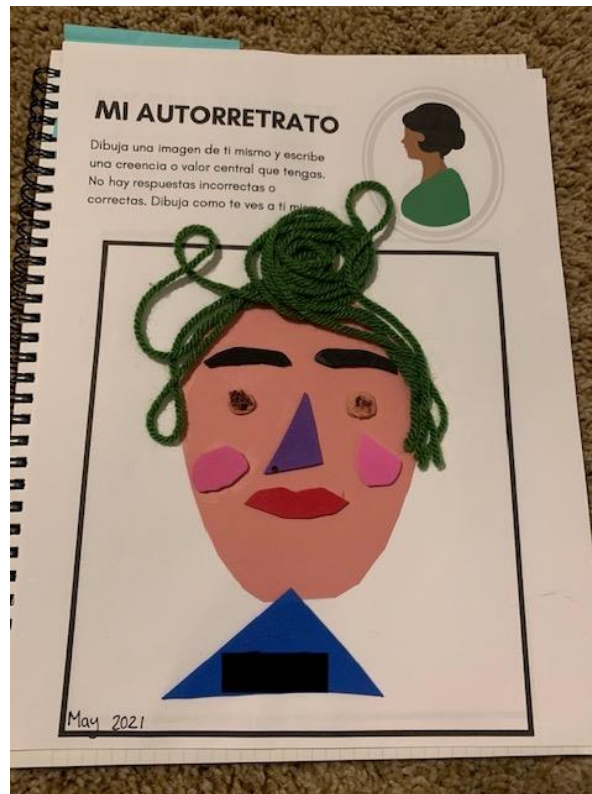
*Sol’s Modelo de Presentacion With Daughter*



**Erika.** Erika joined the study after being recommended by Sol, her sister-in-law. Erika was her own individual during the co-design workshops. For the first co-design activity, Erika made a self-portrait (Figure 55) that showed her values as a mother.

**Figure 55**

*Erika's Mi Auto Retrato/Self-Portrait Artifact*



Erika shared the following when describing her artifact:

*Sí, yo me llamo Erika y tengo 33 años, para mí lo más importante son mis hijos. Tengo tres hijos y todo lo que rueda a mi alrededor son ellos. Si yo tengo dinero prefiero comprarles cosas a ellos que para mí y la familia también. Soy yo. Como siempre traigo mi chongo. [ríe]. Mis niñas me ayudaron también un poquito, porque no tengo mucha imaginación.*

Yes, my name is Erika, and I am 33 years old, for me the most important thing is my children. I have three children, and everything revolves around them. If I have

money, I'd rather buy things for them than for me, and the family as well. That's me. As always, I'm wearing a bun. [Laughs]. My girls helped me a little bit too because I don't have much imagination.

Erika stated that she didn't have much imagination to create her self-portrait. She stated that she called on her daughter to help her. Very similar to her interview answers, Erika restated the familismo values and beliefs she held close for herself and her daughters. This is key to point out because for Erika her sense of self was grounded on her family relationships and the culture, traditions, and knowledge within her family.

For the second co-design activity, *Estética de Arte/Collage*, Erika created a similar collage to Sol's. The reason for this is that both are family and they shared similar family interests. Erika's artifact represented the outdoors and nature that she mentioned in her interview that she liked and enjoyed with her children (Figure 56).

### **Figure 56**

*Erika's Estética de Arte/Collage Artifact*



Erika's interest in nature and the outdoors was very much informed by her family's relationship with it. Erika illuminated her life-worlds and her felt and lived experiences by sharing her beliefs regarding what was personally valuable to her about nature and the outdoors. She shared the following:

*Yo también como Sol, es de la naturaleza porque es como yo le dije en la otra entrevista que a mis niños les gusta juntar piedritas, todas las que encuentran acá atrás en mi yarda. Ellos cuentan o siempre andan todos llenos de lodo y así también, como ella dice, Sol, nos gusta lo mismo, estar afuera, como los patos, nos emocionamos con cada animal que vemos afuera. Me encanta ir a acampar, me desestreso. A mí me gusta también el olor después de que llueve y todo eso, todo lo que se trate de la naturaleza.*

For me, just like Sol, it's nature because it's like I told you in the other interview, that my kids like to collect pebbles, all the pebbles they find back here in my yard. They count or always walk around all muddy and so too, as Sol says, we like the same thing, being outside, like ducks. We get excited with every animal we see outside. I love to go camping, I de-stress. I also like the smell after it rains and all that, anything that's about nature.

In the second co-design workshop and for the Mis Números en Casa/My Personal Number activity, Erika shared similar contextualization of how she saw math in her home with the other participants. She shared:

*Yo, lo mismo, parecido, también fríjoles, podemos contar frijoles, garbanzos, los cuadros, las cucharas, porque tenemos cucharas de diferentes tamaños, a afuera, los árboles. Como yo tengo una colección de gatitos, que son de diferentes tamaños la mamá y los gatitos de cerámica [ríe]. Los marcadores, las crayolas, los dominós, el hilo lo podemos cortar de diferentes tamaños. Todo lo que los demás dijeron yo lo apunté también, como el microondas y todo eso.*

For me it's the same, similar, also beans. We can count beans, chickpeas, the paintings, the spoons, because we have spoons of different sizes, and outside, the trees. I have a collection of kittens, which are different sizes. There's a ceramic mom and ceramic kittens [Laughs]. The markers, the crayons, the dominoes, and the thread can be cut into different sizes. Everything the others said I wrote down too, like the microwave and all that.

Erika's description of her artifact included things that she recognized as part of her everyday life routines: real objects, activities, and types of engagement or topics. Here, Erika was constructing knowledge through the accumulation of her personal experiences and those of her children. This recognition of her math context and her construction of knowledge was integrated into her storyboard activity. Although she initially stated that nature was her interest for her storyboard, she decided to do a cooking math activity with frijoles/beans, which she mentioned in her description of her number activity.

Since participants were placed in group for the second co-design workshop, Erika was placed with Rosa and Sol to brainstorm their Viñetas de Platicas/Storyboard activities. In the following conversation, we can see how Erika and Rosa engaged in an inquiry-based conversation to communicate and develop a method of how to approach their storyboard:

*Rosa: En el sentido numérico es cuando uno puede contar, puede restar, puede sumar, y eso pueden recitar los niños. ¿Cómo puedo yo aplicar eso para que puedan los niños aprender de acuerdo con las cajas? Lo que se me vino a la mente, lo que se me ocurrió es contar los números utilizando la plastilina, haciendo formas con la plastilina.*

*Erika: Por ejemplo, podemos usar los dómimo.*

*Rosa: Correcto, yo esos sí los tengo. Eso está perfecto, eso está bien.*

*Erika: Sí.*

*Rosa: Es cierto, enseñarle a contar con los—*



*Erika: Con los d3minos.*

*Rosa: No s3 si son d3minos esos. Hablando de d3minos, y no tengo d3minos.*

*Lo que me mandaron fue otra cosa.*

*Erika: Con las canicas, podemos usar las canicas.*

*Rosa: Tambi3n con las canicas, las formas.*

*Erika: S3.*

*Rosa: Tenemos varios elementos. Podemos usar las canicas, est3 bien.*

*Erika: S3.*

*Rosa: Qu3 raro, yo ten3a estas. Por lo menos tengo cosas igual.*

*Erika: Como le digo, el hilo; el hilo de cocer.*

*Rosa: Tambi3n con el hilo, es cierto. Pong3monos qu3 es lo que tenemos igual.*

*Erika: Las canicas, el hilo.*

*Rosa: Esto es lo que est3, el d3minos, canicas, hilo. Ubiqu3monos con eso, porque no nos va a dar chance de todo. ¿El plan cu3l ser3a?*

*Erika: Ya son tres cosas. Tenemos que hacer A y B una cosa, A y B otra, tenemos ya las tres que vamos a usar. ¿En la A c3mo empez3r3amos? Por ejemplo, podemos juntar todas las canicas como en un cuadr3to y ya despu3s separarlas, como que vamos a sumar.*

*Rosa: Okay, colocar las canicas en un bowl, en un recipiente, ah3 para que no se vayan a caer. Que puedan sacarlas y que las cuenten de uno en uno.*

*Erika: S3, es lo que yo tambi3n digo.*

*Rosa: The number sense is when you can count, you can subtract, you can add, and children can recite that. How can I apply that so that children can learn according to the boxes? What came to my mind, what I came up with is to count the numbers using the play dough, making shapes with the play dough.*

*Erika: For example, we can use dominoes.*

Rosa: That's right, I do have those. That's perfect, that's fine.

Erika: Yes.

Rosa: That's right, teaching them to count with the...

Erika: With the dominoes.

Rosa: I don't know if those are dominoes. Speaking of dominoes, I don't have dominoes. What they sent me was something else.

Erika: With the marbles, we can use the marbles.

Rosa: Also with marbles, shapes.

Erika: Yes.

Rosa: We have several things. We can use the marbles, that's fine.

Erika: Yes.

Rosa: Strange, I had these. At least I have things just like it.

Erika: As I tell you, the thread; the sewing thread.

Rosa: Also with the thread, it's true. Let's see what things we all have.

Tere: The marbles, the thread.

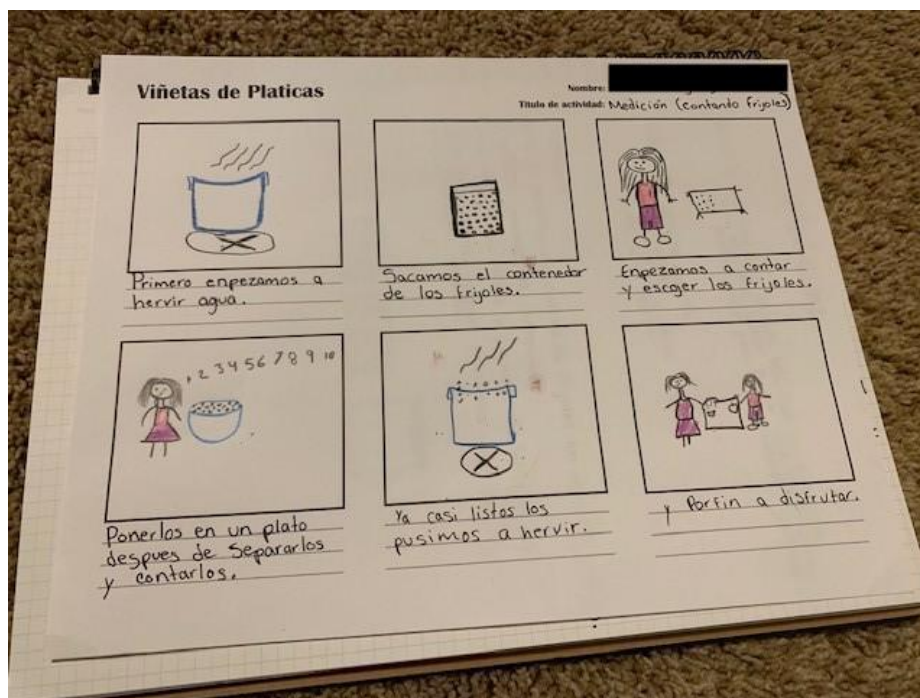
Rosa: This is what it is, dominoes, marbles, thread. Let's get comfortable with that because we won't have time for everything. What would the plan be?

Erika: That's three things. We have to do A and B one thing, A and B another, we already have the three that we are going to use. How would we start on A? For example, we can put all the marbles together in a little square and then separate them, as if we were going to add them up.

Similar as the other conversations, it was interesting to go back to go back to Rosa and Erika's semi-structured interviews and noticed how they mentioned that they were not "smart". But their conversation suggest, differently. For Erika, her Viñetas de Platicas/Storyboard 1 (Figure 57) described an everyday routine she did at home with cooking, and she figured out ways to integrate it with her design idea for her mathematics activity.

Figure 57

Erika's Viñetas de Platicas/Storyboard Artifact 1



Erika described her storyboard as the following:

*Yo ya lo había hecho en otro papel, pero lo estoy haciendo de nuevo. Puse que primero puse a hervir agua, el primer paso. Después, saqué los frijoles del contenedor, luego mi niña me ayudó a escoger los frijoles, a separarlos. Luego, puse que los pusimos en un plato, después de separarlos y contarlos, porque a mi niña le gusta contar todo lo que pueda contar. [ríe] Luego, puse aquí una ollita que dice, 'Ya casi listos.' Los pusimos a hervir, luego a la última puse, ya casi también hace, 'Por fin podemos disfrutar.'*

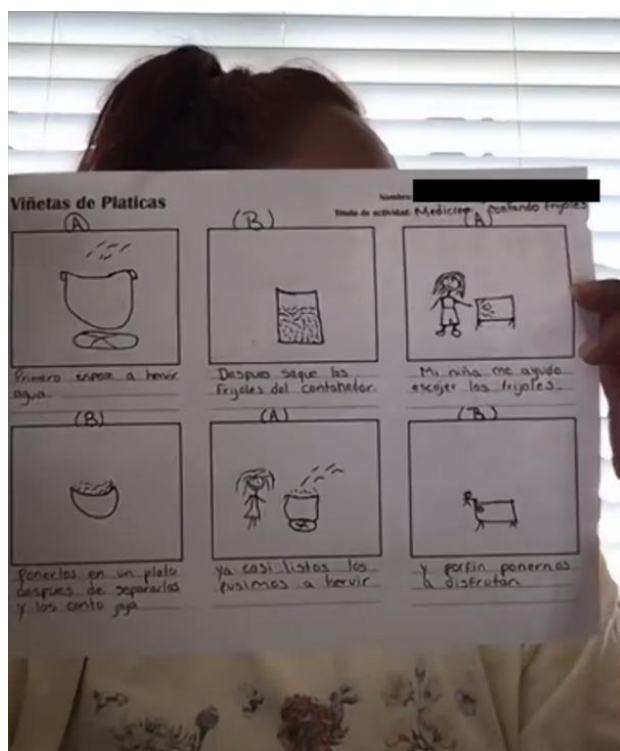
I had already done it in another piece of paper, but I'm doing it again. I wrote that I first put water to boil, the first step. Next, I took the beans out of the container. Then my little girl helped me pick out the beans, separate them. Then, I wrote that we put them on a plate, after separating them and counting them, because

my little girl likes to count everything she can count. [Laughs] Then, I put a little pot here that says, 'Almost ready.' We boiled them, then in the last one I put, almost done too, 'We can finally enjoy.'

When asked why she did two storyboards (Figure 58), Erika mentioned she felt she didn't have creative imagination and she kept wanting to do one the researcher could understand as the "expert." Although Erika mentioned she didn't feel creative, her storyboard showed thoughtful development and implementation of steps that were personalized to her own experience as a mother.

### Figure 58

*Erika's Viñetas de Platicas/Storyboard Artifact 2*

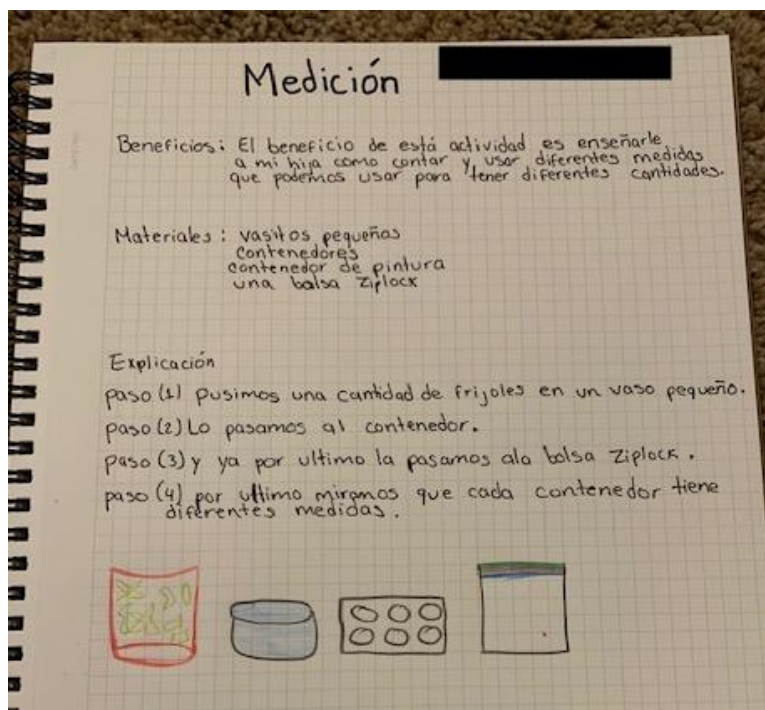


Erika wrote a "lesson plan" for a math activity (Figure 59) where she broke down every process from the title of the activity to the materials and steps. We can interpret that upon hearing the researcher say that their activities could also be used by other parents in their community, Erika wanted to create a lesson plan that other parents could follow. Additionally, it

could be interpreted as how Erika broke down her thought processes knowing in order to make sense of her mathematics activity.

**Figure 59**

*Erika's Math Activity Plan*



Despite Erika's statement about not feeling creative or having an imagination, in her last comment for the co-design workshop, she stated that she discovered that all the participants had a lot of ideas. She also stated that one of the challenges in focusing was because she needed to take care of her children. We noticed that from an outsider's perspective, Erika paid full attention and went the extra mile when she wrote a plan for her math activity. It is interesting to see how she perceived herself and her capabilities and knowledge.

*A mí me gustó que hay muchas ideas que todos tenemos y juntarlos todo.*

*Aprendí que siempre tenemos cosas en la casa que podemos usar para contar.*

*Quisiera que mi cerebro pusiera más atención, pero mis niños no me dejan. Uno está llorando, otro me pide otra cosa [risas].*

I liked that we all have ideas and have to put them all together. I learned that we always have things in the house that we can use to count. I wish my brain would pay more attention, but my kids won't let me. One is crying, another one is asking me for something else [Laughter].

For the last co-design workshops, Erika decided to focus on a cooking and measurement activity. Although Erika chose nature as her interest, when it was time to storyboard her activity, Erika focused on cooking. It is important to note that Erika was the only participant to choose materials from her home (Figure 60). The other participants chose materials from the papelería/box. Erika chose beans to represent how she would teach her children about measurement. As she was explaining her prototype, Erika realized she could also take the beans outside and measure some trees.

### Figure 60

*Erika's Modelo de Presentación/Prototype*



In her last comment, Erika appeared to have done a 180-degree turn between how she felt at the beginning of the workshops and how she felt then. She shared:

*Sí. A mí me gustó que entre todas nos damos ideas, pone uno atención a lo que otra persona- la imaginación que tiene y le ayuda también a que la imaginación de uno despierte. Aprendí cosas nuevas, como el de serpientes y escaleras. Ese me gustó mucho para yo poderla enseñar a mi niña, también. Como el de Sol, que también contar y quitar números, los que faltan, y el de Sandra, el rompecabezas, también me gustó mucho. Yo nunca hubiera imaginado hacer con unos papeles chiquitos y cortarlos. También el de Rosa, me gustó mucho todo lo que hizo ella también, me sirve para yo tenerlo y enseñar a mis niños también con eso.*

Yes. I liked the fact that we all give each other ideas, pay attention to what someone else's imagination has, and it also helps to awaken one's imagination. I learned new things, like the one about Snakes and Ladders. I really liked that one, so I could teach it to my little girl, too. Like Sol's, which also counts and removes numbers, the missing ones, and Sandra's, the puzzle, I also liked it a lot. I would never have thought about making that with small papers and cutting them. Also, Rosa's, I liked everything she did very much. It's useful for me to have it and to teach my children with it.

In her last email to the researcher, Erika wrote, “Vemos matemáticas por todo”/“We see math everywhere” and shared the three photos of her young child exploring their home outdoors and using rocks to count (Figures 61 and 62). She also shared a photo of just trees, which we can interpret that Erika and her son were counting, too (Figure 63). Based on Erika's semi-structured data, this finding suggest that Erika did a shift in attitude, behaviors and possibly math-self efficacy. Through her email, Erika reported she was “seeing” and doing math with her children, thus indicating she self-reports with higher levels of math attitudes.

**Figure 61**

*Erika's Implementation of Her Math Activity With Her Son 1*



**Figure 62**

*Erika's Implementation of Her Math Activity With Her Son 2*





**Figure 63**

*Erika's Implementation of Her Math Activity With Her Son 3*




The following coding scheme (Table 14) represents the most pronounced codes and themes with definitions and examples found in participants' engagement during the co-design workshops.

**Table 14**

*Coding Scheme of Latino Families' Co-design Processes Related to Actions (Physical and Verbal Behaviors) and Artifacts (Objects and Concepts Participants Acted Upon)*

<b>Theme</b>	<b>Code</b>	<b>Definition</b>	<b>Examples</b>
Teamwork & collaboration	Questions & request for help	When parents ask a question or ask to clarify instructions/steps/activity either to researcher/facilitator or other participants	<p>“¿Se puede utilizar dos cosas, digamos, música y baile o solamente va a ser enfocado en una sola?”</p> <p>"Can you use two things, say, music and dance, or is it only going to be focused on one?"</p> <p>“¿Puede poner el nombre de la actividad que vamos a tener? ¿Cómo se llama?”</p> <p>“Can you tell me the name of the activity we're going to do? What's it called?”</p>
	Cooperation	When parents offer suggestions to the facilitator/researcher or other participants	<p>“Yo, con respecto al tiempo, cuando vayamos a participar, que no nos tomáramos tanto tiempo en una sola persona, sino que seamos equitativas.”</p>

Theme	Code	Definition	Examples
	Oral & written communication	When parents describe in detail their storyboarding/prototyping/artifacts	<p>"I [propose], regarding the time, when we go to participate, that we do not take so much time in a single person, but that we be fair."</p> <p>"El mío es el de serpientes y escaleras. Primero, es diseñarlo e imprimirlo para ponerlo en un cartón y se va a utilizar el dado regular para ir por turnos. Al utilizarlo, se van a agregar etiquetas con números donde van a incluir sumas y restas. Ya dependiendo del turno del niño, si le toca, va a ser cinco más dos, al dar él la respuesta puede avanzar, si la da mal, entonces se queda en el mismo casillero."</p> <p>"Mine is the one with snakes and ladders. First, it is to design and print it to put it on a cardboard and the regular die will be used to go in turns. When using it, labels with numbers will be added where they will include addition and subtraction. Depending on the child's turn, if it is his turn, it will be five plus two, when he gives the answer he can advance, if he gives it wrong, then he stays in the same box."</p>
	Embodied behaviors (physical behaviors)	Parents doing facial expression and using body language to express feelings and emotions	
Sense-making	Problem-solving	Parents analyze and generate ideas for solutions	<p>"Ubiquémonos. Porque es que yo pensé que nos iban a—por lo que habíamos escogido, sentido numérico. Usted escogió medición. ¿Medición cuál es? ¿De qué hablaba medición?"</p> <p>"Let's center ourselves. Because I thought they were going to—because of what we had chosen, number sense. You chose measurement. What measurement is it? What is measurement all about?"</p>
	Construction of knowledge	Parents apply active listening, communication	<p>"Erika, te estaba dando la idea era de colocar las canicas en un recipiente para que el niño las pueda sacar y contar. Si</p>

Theme	Code	Definition	Examples
		intellectual interest and curiosity	son dos canicas, una, dos. Si uno le dice tres canicas, que cuente una, dos, tres." "Erika, I was giving you the idea, it was to place the marbles in a container so that the child can take them out and count them. If it's two marbles, one, two. If you tell him three marbles, let him count one, two, three."
	Views on expertise	When parents refer to the facilitator/ researcher as the expert throughout the sessions	"Tú me dices Susie, porque tú eres la experta, cómo se llama el que yo quiero, pintar, porque ahí ya uso los colores." "You tell me Susie, because you are the expert, what is called the one I want, to paint, because there I already use the colors."
	Self-beliefs about competence	When parents state that they don't have the competence or ability to do something or think about something	"El que yo quería hacer es rompecabezas, que es el de razonamiento matemático. No sé cuál de los dos hacer, porque no sé hacer un rompecabezas." "The one I wanted to do is puzzles, which is mathematical reasoning. I don't know which one to do, because I don't know how to do a puzzle."
	Perceptions of creativity	How parents perceive their creativity and reality of creations	"Mis niñas me ayudaron también un poquito, porque no tengo mucha imaginación." "My girls also helped me a little bit, because I don't have much imagination." "El mío está muy sencillo. No tengo mis lentes, hice lo pude." "Mine is very simple. I don't have my glasses, I did what I could." "Yo pienso que yo lo hice un poquito mal, porque mi niña me estaba hablando..." "I think I did it a little wrong, because my girl was talking to me ..."
Intrapersonal Openness	Emotional expressiveness	When parents feel emotional toward a statement or artifact	"¿Qué querría? Yo pienso que si fueran personas, hablar con otras personas para Así cuando estaba haciendo el de este, no sabía qué hacer, estaba sola, sé que estabas ahí, pero yo me sentía más sola que." "What would I want? I think that if they were people, talk to other people so that when I was doing this one, I didn't know what to do, I was alone, I know you were there, but I felt more alone then."

Theme	Code	Definition	Examples
	Pride/ agency	When parent feels motivated and proud to participate or share without being prompted	<p>"El mío, yo miré nature en las palabras que pusiste, este es el mío."</p> <p>"Mine, I looked at nature in the words you put in, this is mine."</p> <p>"Yo [comparto] Me inspiré escribiendo."</p> <p>"I want to share. I was inspired by writing."</p>
Interest-driven learning subtheme1: Funds of knowledge	Generating ideas	When parents use personal experience (values, culture, history, traditions) in the generative activities	<p>"Pintar, porque en la misma escuela te mandan a pintar, ahí se puede usar uno sumar."</p> <p>"Painting, because in the same school they send you to paint, there you can use one to add."</p> <p>"Sí, creo que sí. Tal vez voy a hacer un tipo serpientes y escaleras como las que jugaba, pero solamente con números que circulen sumas, restas, así más o menos."</p> <p>"Yes, I think so. Maybe I going to create a game like the ones I used to play, but only with numbers that circulate sums, subtractions, like that."</p>
	Contextualiza-tion of activities/artifacts		<p>"Para mí todas las cosas que hay en mi casa son matemáticas...en la cocina, tengo unos medidores de cuchara, tengo la licuadora, tengo un termómetro de alimento, la estufa, el microondas..."</p> <p>"For me, all the things in my house are mathematics... in the kitchen, I have spoon meters, I have the blender, I have a food thermometer, the stove, the microwave..."</p>
	Personal & cultural awareness and curiosity		<p>"La bisutería es cuando hacemos cosas de pulseras, manualidades de pulsera o hacemos aretes, collar, que lo hacemos nosotros o que lo venden, esa es la bisutería."</p> <p>"Costume jewelry is when we make things from bracelets, bracelet crafts or we make earrings, necklaces, that we do or that they sell, that is costume jewelry."</p> <p>"Esto es mi naturaleza porque cuando yo era niña, mi papá le encantaba la naturaleza."</p> <p>"This is my nature because when I was a child, my dad loved nature."</p>
Familismo	Holding onto home		<p>"Como en familia estar unida, esa es mi creencia. La educación de mis hijas, escolar, es muy importante para mí,</p>

Theme	Code	Definition	Examples
Traditional education virtues	Education values		<p>también ser feliz y aceptarse así mismo, es lo que le quiero enseñar yo a mis hijas, seguir adelante en su educación y no se den vencidas, ser feliz y aceptarse a sí mismo."</p> <p>"As a family to be united, that is my belief. The education of my daughters, school, is very important for me, also to be happy and accept myself, it is what I want to teach my daughters, continue with their education and do not give up, be happy and accept themselves."</p> <p>"Lo que escribí, "La educación empieza antes de la escuela." Para mi hija, yo sé que primero estamos nosotros los padres, está mi familia, los vecinos, aprende de todos antes de que conozca a una maestra. La educación empieza antes de ir a la escuela."</p> <p>"What I wrote, 'Education begins before school.' For my daughter, I know that we are the parents first, there is my family, the neighbors, she learns from everyone before she meets a teacher. Education starts before going to school."</p>
Conscientiousness	Self-reflection	When parents self-reflect and share opinions, thoughts, feelings	<p>"Lo que yo aprendí fue, como dijo Sandra ya una vez, creo que ella dijo la última vez que tiene creatividad o algo así, porque yo estaba dando vueltas y digo, '¿Qué voy a hacer?' Como tú dijiste, Susie [researcher], 'Algo que te llame la atención, que tú quieras aprender o enseñarle a tus hijos,' como yo dije, quiero que aprenda a contar de 1 al 100 y eso se me ocurrió hacer, nomás que lo voy a hacer un poquito mejor para mandarte la foto, porque ahorita lo hice así, muy rápido, y no se mira muy bien."</p> <p>"What I learned was, as Sandra said once, I think last time she said that she has creativity or something like that, because I was going around and thinking, "What am I going to do?". As you said, Susie [researcher], "Something that catches your attention, that you want to learn or teach to your children," like I said, I want them to learn how to count from 1 to 100, and I had the idea to do so, I'm just going to do it a little better to send</p>

Theme	Code	Definition	Examples
			you the picture, because I did it real quick right now and it doesn't look very good.”

## Key Findings

From the data presented in this chapter, the researcher generated six key findings through interpretative engagement with data—created from codes & through coding. Table 15 represents the key findings from the semi-structured interviews in relation to each theme. These key findings will be discussed in Chapter 5.

**Table 15**

*Key Themes and Findings from Semi-structured Interviews*

Themes	Subthemes	Findings
Traditional education virtues Familiismo Interest-driven learning	Values and Traditions Funds of knowledge	(1) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves.
Role of language Views on knowledge		(2) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues.
Ecological environment		(3) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences.
Identity formation related to (math) learning		(4) Latina mothers engage in “direct numeracy ” and “indirect numeracy” environments (Hart et al., 2016).
Teamwork and collaboration Sense-making Interpersonal openness Conscientiousness		(5) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and (6) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.

## Summary

This qualitative phenomenological study explored the lived experiences of Latine families in co-design workshops. The researcher sought to understand how Latine families would design and create a math activity for their young children and how funds of knowledge, as part of families' cultural repertoires, can help them situate themselves as adult learners. The sample in this study was composed of six Latina mothers who spoke Spanish, had children ages 2–5 years, and wanted to support their children with mathematics learning. Latina mothers participated in a semi-structured interview and three co-design workshops. Data collection included data from the semi-structured interviews and observations during the co-design workshops.

Chapter 4 provided an overview of the data findings; described participants' setting, population, and sample; and presented the data, including data collection sources and development codes, as well as the findings through case studies of each participant. In this study, the researcher aimed to understand Latine families' lived experiences in co-design workshops and understand how they would create a math activity for their young children. All data collected and presented in Chapter 4 were analyzed through IPA, which revealed the following themes: (a) traditional education virtues, (b) familismo, (c) role of language, (d) ecological environment, (e) views on knowledge, (f) interest-driven learning, (g) identity formation related to (math) learning, (h) teamwork and collaboration, (i) sense-making, (j) interpersonal openness, and (k) conscientiousness. Some of the codes and themes discovered in the interview session also repeated during the co-design workshops. For example, familismo, traditional virtues, interest-driven, and identity formation related to learning were common themes found both in the interview and co-design data as well as the subthemes of values and traditions.

The semi-structured interview results and co-design workshop results indicated a continuous need to understand and connect Latine families' knowledge to learning experiences, such as this study's creation of a mathematics activity. Additionally, this study's findings

revealed a need to approach family engagement from a social justice lens through decolonized design methodologies. When resources are specifically designed for the end-user, in this case Latine families, family engagement can be reframed as family learning, where it becomes a social practice. Therefore, it is inherently situated in personal, historical, cultural, and social contexts. The data findings also suggest that co-design approaches are a practical framework and activity for using parent knowledge as a resource for learning.



## Chapter 5: Discussion

Chapter 5 addresses each research question, specific to the findings analysis. The purpose of this study was to utilize a qualitative phenomenological approach to explore and provide an in-depth analysis as to how Latine families perceive and engage in co-design workshops to develop a mathematics activity for their young children. This chapter begins with a description of the researchers' positionality in reference to the analysis and follows with descriptions of analysis and interpretations of findings in relation to the following research questions:

1. How do Latine families create math learning experiences for their children?
2. What perceptions do Latine families hold of math co-design approaches?

Qualitative data collected included (a) semi-structured interview data and (b) co-design workshop which included data from the co-design workshop recordings, transcriptions, and media (photos and screenshots). In this chapter, the researcher draws connections to the existing theoretical framework and literature review discussed in Chapter 2. This chapter concludes with a summary and notes future directions for research.

A total of 11 themes and three subthemes were identified among the participants. These include a) traditional education virtues, (b) familismo, (c) role of language, (d) ecological environment, (e) views on knowledge, (f) interest-driven learning, (g) identity formation related to (math) learning, (h) teamwork and collaboration, (i) sense-making, (j) intrapersonal openness, and (k) conscientiousness. Subthemes include values, traditions, and funds of knowledge. This study found six major findings, four key findings from (a) semi-structured interviews and these include: (a) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves (this finding was also present in the co-design workshops), (b) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues, (c) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math

experiences, (d) Latina mothers engage in “direct numeracy ” and “indirect numeracy” environments (Hart et al., 2016); and (b) findings from the co-design workshops which are (a) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and (b) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice. Table 16 display all six major findings.

**Table 16**

*Semi-structured Interviews and Co-design Workshop Key Findings*

<b>Findings</b>	
<b>Semi-structured interviews</b>	<b>Co-design workshops</b>
(1) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves (this finding was also present in the co-design workshops).	(5) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge.
(2) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues.	(6) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.
(3) Latina mothers’ mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences.	
(4) Latina mothers engage in “direct numeracy ” and “indirect numeracy” environments (Hart et al., 2016).	

### **Revisiting the Theoretical Foundation**

This study was grounded in the literature of ecological systems theory, funds of knowledge, and connected learning; the theoretical framework for this research drew on each of these areas to explain how Latina mothers perceived and experienced co-design workshops. The themes and conclusions revealed in this study align with the theoretical foundation of this study. The purpose of the theoretical framework was to look at three theories to provide a foundation for understanding the importance of family engagement. Additionally, the

researcher's own family engagement learning experiences were a driving force of inspiration to bring and shape the three theories into a conceptual framework.

Based on the theoretical foundations of this study, the researcher developed a conceptual framework for understanding the roles and relationships of family learning through the integration of different settings that served to demonstrate how families can support the learning of young children; this theoretical framework incorporated ecological systems theory, a funds of knowledge approach, and the connected learning framework. Through this conceptual framework (presented in Figure 64), the researcher moved from just understanding how these three theories and frameworks illustrate the importance of supporting families to understanding both how and what works when reframing and advancing family learning in the pursuit of any educational effort that “actively pursues social justice and the reduction of inequalities in power and resources in theory, research and action” (Nelson & Prilleltensky, 2005, p. 27).

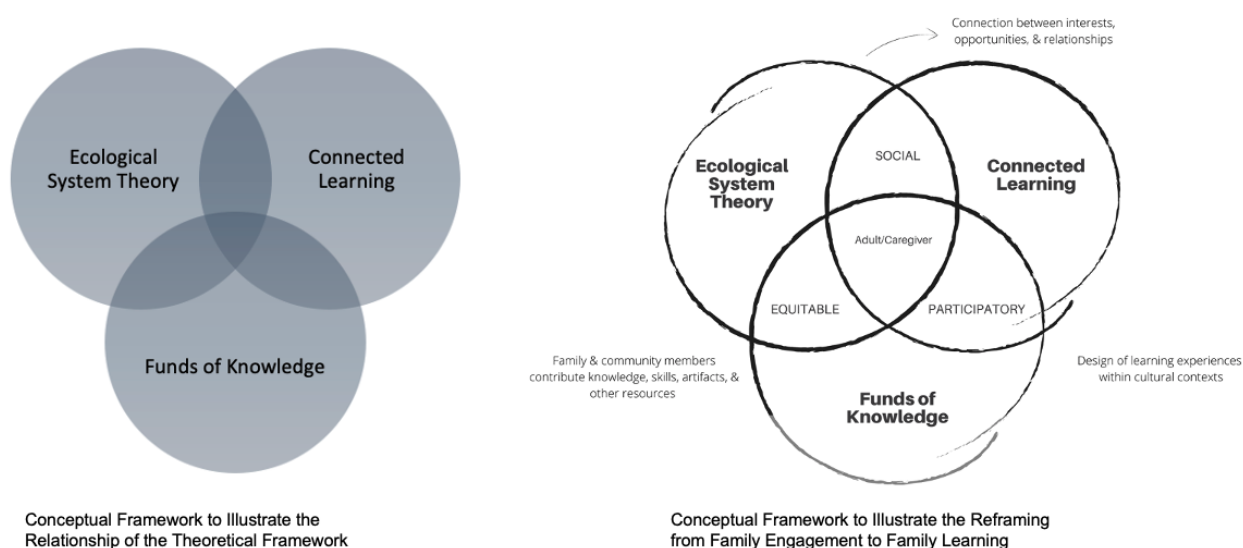
Based on this conceptual framework, child development and family engagement is a social process rooted within the child's relationships with other people, environments, and cultures. This research study was informed by a belief that families often hold the answers to questions about supporting their children's education but do not have the power to influence change. Broadening family participation with co-design practices would allow space for transformative approaches, addressing equity and access while engaging participants around civic and racial dynamics within family engagement activities.

This dissertation explored how ecological system theory (Bronfenbrenner, 1979a) serves as the main foundation for understanding family engagement as an active process within a set of relationships and actions that can influence a young child's learning development. The researcher also discussed how the funds of knowledge framework (Moll & González, 1996) served as a “response to contextual uncertainty and scarce resources” (Ramos & Kiyama, 2021, p. 442) for Latina mothers, allowing them to share their ways of knowing and to leverage that knowledge to design and create a math activity. Funds of knowledge helped the researcher

(facilitator) to extend participants' interests and connected and transformed learning by building on families' strengths and assets. Additionally, the connected learning framework (Ito et al., 2013) was crucial in the research design of this study. In integrating connected learning, this study was grounded in sociocultural learning with an equitable social and participatory approach (co-design workshops).

## Figure 64

### *Conceptual Frameworks Based on Study's Theoretical Framework*



The conceptual model (presented in Figure 64) illustrates the proposed process of adults as primary caregivers and learners in a young child's life. For this study, it was important to design and implement co-design workshops through the lens of this theoretical framework to amplify Latine family learning and engagement, not only as consumers of resources and information but as adult learners and co-creators of their young children's early math learning. This study explored the manifestation of Latine family learning and engagement through the lenses of community, collaboration, content, and the power of adaptive learning experiences to support the critical role of participatory research design (co-design workshops) to move the needle for effective family learning and engagement and therefore to support young children's

development. This study suggests that that if researchers and educators provide the tools to educate parents and help facilitate connections across multiple platforms, parents will feel empowered to use these tools and to engage their children with math activities at home.

### **Interpretation of Findings: Making Sense of the Data**

The purpose of this study was to explore how Latine families perceived and engaged in co-design workshops to develop a mathematics activity for their young children. This study analysis was framed within the qualitative IPA method (Smith et al., 2009) and placed within this study's theoretical framework from Chapter 2. In this discussion chapter, the researcher argued that decolonized co-design methodologies provide a space for Latina mothers to navigate their ways of knowing, their situational contexts, and their relationships to make sense of learning processes. In the present study, findings suggest, (a) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves, (b) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues, (c) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences, (d) Latina mothers engage in "direct numeracy" and "indirect numeracy" environments (Hart et al., 2016), (e) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and (f) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.

A subfinding of the sixth finding is the concept of family learning as separate from traditional family engagement. This study found that parents take on different roles as co-designers and co-learners (Roque, 2020). Co-design methodologies had an impact on parents' confidence, self-esteem, enjoyment, and contribution (Williamson et al., 2015) to reposition them as learners and creators of their knowledge, specifically in the construction of mathematics knowledge. The researcher grounded the discussion of family learning versus family

engagement in this study's co-design methodologies to argue that families' learning experiences are different from engaging in *banking models* of traditional family engagement interventions, where families' relationships with institutions tend to be transactional.

This study positioned Latina mothers as experts of their own mathematical experiences in co-designing culturally relevant, authentic, and meaningful math learning experiences to reframe family engagement beyond dissemination of information. For the purpose of this study and inspired by Roque's (2020) family learning with digital tools, the working definition of family learning for this study is an interactive, contextualized process connected to an evolving ecosystem of social contexts, home practices, and community settings to engage adult and scaffold learning through adult guidance and in collaboration with other adults.

This study's intent was to make sense of the lived experience of Latina mothers in three co-design workshops. Before Latina mothers participated in the co-design sessions, it was important to understand their funds of knowledge to design decolonized co-design instruments as described in Chapter 4. It was important to empathize and understand participants' family histories, educational and learning experiences, values, traditions, beliefs, and knowledge transmission to learn more about their needs and wants. This first step was done through semi-structured interviews, and the following section describes the key themes, findings, analysis, and interpretation from the participants' semi-structured interviews. This section addressed research question 1: How do Latine families create math learning experiences for their children?

### **Semi-structured Interview Findings and Themes**

Four key findings emerged from the semi-structured interviews and in relation to research question 1, which are (a) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves, (b) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues, (c) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences, (d) Latina mothers engage in "direct

numeracy ” and “indirect numeracy” environments (Hart et al., 2016). The data findings from the semi-structured interviews identified seven themes and two subthemes (Table 17) that emerged from parents’ perspectives from their everyday lives. In coding and analyzing the data, the researcher was guided by the theoretical framework from Chapter 2 that focused on funds of knowledge and the connected learning framework from a sociocultural learning paradigm. The following section describes each theme with a brief statement about the connection to the current literature, analysis and interpretation.

**Table 17**

*Participants’ Semi-structured Interview Themes & Subthemes*

<b>Themes</b>	<b>Subthemes</b>	<b>findings</b>
Traditional education virtues		Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves.
Familismo	Values and Traditions	
Interest-driven learning	Funds of knowledge	
Role of language		Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues.
Views on knowledge		
Ecological environment		Latina mothers’ mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences.
Identity formation related to (math) learning		Latina mothers engage in “direct numeracy ” and “indirect numeracy” environments (Hart et al., 2016).

***Traditional Education Virtues***

During the interview process, all the participants recognized and acknowledged the importance of academic achievement for their children. All parents at several points in the interviews shared how much they wanted their children to have an educación (Espino, 2016). Many of them stated the efforts (*sacrificions*) they make on behalf of their children, wishing for their children get ahead in life (Calzada et al., 2010). The Latina mothers in this study desired to

have educación success has been found in previous studies (Espino, 2016; Poza et al., 2014; Reese et al., 1995; Zarate, 2007), “*Como yo no fui, yo no tuve la oportunidad de ir al colegio, eso es lo que más yo quiero para mis niños, el estudio, ah, que sigan adelante...*”/ “Since I didn't go, I didn't have the opportunity to go to school, that's what I want most for my kids, the study, ah, to keep going...”. This is not a surprising finding. This finding is consistent with Valdéz's (1996) early work investigating the socialization, cultural values, and education of immigrant Mexican families, specifically highlighting the theme of educación.

Furthermore, in recent research, Espino (2016) also highlighted the American definition of education versus Latine immigrant families' definition. For Latine families, as also found in this study, educación is about strong, honorable work ethics and values that help raise their children to be happy and good people. Latina mothers emphasized socioemotional learning concepts because for all of them the idea of being good people equates to educational success and is grounded and bounded to their immigration experiences (socio-historical and political contexts). This is also why the Latina mothers in this study value and emphasize literacy and reading in home learning environments over mathematics—for them, speaking English is the way to overcome oppression that has held down their success in the United States, while also position them on an equal footing with other English-speaking counterparts.

What is worth noting, analyzing, and interpreting is that Valdéz's work was written in 1996 and the present study took place in 2021. What this means and why it is an important finding in the context of this study is that there is a need to continue to understand how marginalized communities' cultures of origin serve as protection and a resiliency strategy in the face of immigrant challenges (Thomson & Hoffman-Goetz, 2009). Despite decades of acculturation and naturalization discourses arguing and establishing laws like “English only” for immigrants (García, 2014), culture is not something that we can detach from Latine families, as this study found, and it has implication for understanding how to support Latine families' engagement and learning practices with mathematics.



In fact, Latina mothers hold onto their culture to reaffirm their identities. And this idea of holding onto culture, which includes values and traditions, is critical for family engagement interventions. What if family engagement interventions were not about asking Latine families to mold into traditional American schools that require them to learn the cultural equivalent for American schooling norms? This is critical question to ponder because there are still deficit thinking narratives around Latine family engagement. And research has pointed out that school systems, and therefore school family engagement programs, tend to be designed to be Anglo-normative in nature (Leonardo, 2013; Leonardo & Grubb, 2013).

Although participants in this study stated in their semi-structured interviews that they didn't remember or know how to do mathematics, many illustrated how they create home learning and math environments. This demonstrates how Latine parents' involvement and engagement in their children's activities varies. This finding also counters deficit thinking in Latine parents, which sees Latine parents as having a lack of motivation and inadequate educational practices for their children (Koyama & Desjardin, 2019).

In finding out that Latine families still hold onto their values and culture, this emphasizes the prevalent need to create culturally specific programs to explore, honor, and extend heritage and community practices. In turn, Latine families will develop positive self-beliefs and attitudes, as in the case of this study. In understanding and integrating culture in co-design approaches, participants were able to develop positive mathematics beliefs and attitudes and develop self-efficacy to design and create a mathematics activity, revealing social cognitive development as participants spent time with one another and tools, guided by participation (active adult learners).

Here is where the distinction between family engagement and family learning is critical. Quiñones and Marquez Kiyama (2014) have argued for family engagement to be "reframed as a multidimensional concept inclusive of family-school engagement practices and educational expectations and aspirations, anchored in Latino-centered views of education" (p. 150). I further

argue that there is a distinction between family learning and family engagement and that families possess the knowledge and skills to learn about their own assets and how those assets and ways of knowing can turn into critical consciousness to support their children's mathematics learning. In doing this, Latine families are better equipped to deal with educational institutions and spaces that continue to ignore what they can bring to the table.

### **Familismo**

Another theme from the interviews is the strong familial bond that Latine families carry within their nuclear and extended families. Within the familismo theme, values and traditions were two subthemes frequently evident in participants' semi-structured interviews. Familismo has been described as a strong cultural value that emphasizes family ties above anything else (Campos et al., 2014), and this was evident in the participants' answers: "*No sé si, estar con mi hija, yo quiero estar con familia, yo quiero estar con todos, quiero ir a las fiestas o quinceañeras. Convivir con la familia.*" / "I don't know if, to be with my daughter, I want to be with family, I want to be with everyone, I want to go to the fiestas or quinceañeras. To have a nice relationship and get along with one another with my family."

It is important to note that all participants also referred to their community as part of their family. This implies that Latine parents are also cultural brokers in their community—they share resources and knowledge and establish trust. What is interesting to note is that Latina mothers in this study, did not see this as an asset and ability, but as a duty to their community members: "*Vivimos en una comunidad donde se habla bastante el español y-- y yo sé que también a través de este idioma pueden aprender otras cosas.*" / "We live in a community where Spanish is spoken a lot and-- and I know that also through this language they can learn other things."

This analysis is critical for family engagement and culture-sustaining pedagogy discourses. Traditional family engagement programs are often created through an individualistic lens, failing to address the social and political contexts of Latine communities within the collective and social capital paradigms (Ishimaru, 2013). This finding raises the importance of

understanding the ecological lens and how to conceptualize cultural communities for family engagement pedagogies. In fact, this finding was prevalent in this study despite years of efforts to acculturate Latine families to the American culture and school systems (Thomson & Hoffman-Goetz, 2009).

There are several family engagement programs, models, and frameworks, and many of them were created through a conventional Anglo-centric parent-engagement lens. Ferlazzo and Hammond (2009) have argued for the distinction of parent involvement and empowering parent engagement. Further, Ferlazzo and Hammond (2009) noted that often Anglo-normative family engagement programs see families as “clients” instead of true partners. The present study revealed that Latina mothers are experts of their histories, culture, and values, which contribute to their understanding of early mathematical concepts in the California Preschool Learning Foundations (California Department of Education, 2021) and math learning environments. Latina mothers were not “clients.” This study positioned them as experts of a mathematics artifact, expanding their cultural repertoires and conceptualizing their knowledge through co-design approaches.

Moreover, familismo can be a gateway and an opportunity for families to see themselves within family engagement and family learning programs. For example, when families were given the opportunity to express themselves and share their culture, language, and histories, the designer and facilitator (the researcher) was able to design an intervention (co-design workshops) that centered on building stronger connections among Latina mothers. Valenzuela (1999) has argued about the adding or subtracting of the wealth and richness of Latine families. It is important to note that in the current research literature, this is viewed as an asset and a funds of knowledge. Other participants also viewed their traditional virtues and familismo as assets—a way of learning from family and lived experiences (Kiyama, 2010; Moll & González, 1996).

This was also supported by Ito et al.'s (2013) connected learning framework, which suggests that designers, researchers, and practitioners think about the merger of interests, opportunities, and relationships. For this study, all Latina mothers had a specific interest that was not mathematical in nature but through co-design approaches, the researcher merged their interests to early mathematics concepts to reflect mathematical thinking and understanding. Therefore, familismo does not have to be an adjective for Latine families; we should reframe it as an asset to guide Latine families and family engagement practitioners toward more engaging, resilient, and useful family learning that will help Latine parents become effective contributors to their children's learning but also become adult learners themselves while remaining true to their families' skills, abilities, ideas, practices, and bodies of knowledge (Ito et al., 2013; Moll & González, 1996).

### ***Interest-Driven Learning***

As mentioned in the theoretical framework in Chapter 2, connected learning (Ito et al., 2013) has roots in the funds of knowledge framework, which is part of the sociocultural theories of learning (Moll & del Río, 2007). The connected learning framework states that learning happens in social settings and finding what people like or are interested in can provide a sense of efficacy and identity for the learner (Ito et al., 2013). Although not surprising, the finding of interest-driven learning as a theme is crucial because it aligns to what the connected learning frameworks suggest for designers of experiences—situate the learner in an authentic, real-world learning experience (Ito et al., 2013). It is worth noting that the connected learning framework has been mostly used as an agenda for research and design for youth media engagement. However, its tenets of leveraging personal interests, supportive relationships, and learning opportunities also speak to families as adult learners. Family engagement should not use the banking model of information and partnerships. Family engagement should center families as active adult learners, and this was evident in the co-design workshops of this study.

Through the semi-structured interviews, participants shared what they were interested in, including hobbies, crafts, games, etc., as individuals beyond the title of “mother.” This was crucial to understanding how to design the co-design instruments to help the Latina mothers bridge their interests to learning experiences.

*Sandra: Todos los juegos que tiene, casi todos tienen es un puzzles, tiene de puzzles que pones un mapa, puzzles de una forma...pues nos gusta hacer puzzles.*

All the games that she has, almost all of them are puzzles, you have map puzzles, puzzles in a way...well, we like to make puzzles.

*Sol: A mí esposo le gusta mucho el nature y a nosotros, so, le puso zacate, plantó árboles...we get excited when we start—cuando miramos la bolitas que van saliendo.*

My husband really likes nature, and we also like it...he planted trees...we get excited when we start—when we look at the fruit coming out.

*Daniela: Normalmente jugamos juegos de mesa. Pero dentro de la casa sí, usamos los juegos de mesa y a veces non ponemos a jugar para que se les quite lo aburrido que están.*

We usually play board games. When we are at home, we play board games and I tell my kids to play so that we don't get bored when we are at home.

This finding adds to the importance of understanding funds of knowledge to help families bridge informal learning to formal learning. But it is even more crucial now, as Reschly and Christenson (2012) have noted: we know families are essential; what we need to figure out is how and what works in terms of support, programs, and resources. Therefore, this study finding is important for sociocultural development spaces to add to the idea of family learning as a design-oriented pedagogy for family engagement programs. Understanding Latine parents' ways of knowing, their assets, and their funds of knowledge can help move the family engagement narrative from

a fixed lens of engaged “clients” (Ferlazzo & Hammond, 2009) to active learners in a participatory learning environment.

### ***Role of Language***

All participants noted the importance of learning Spanish but also wanting their children to have literacy achievement. All participants stated the importance of their Spanish language preservation as cultural wealth for their children: “*Ella habla totalmente el español, ¿verdad? Una de—Por eso es que quiero que mantenga esos lazos de-de-de familiares, ¿verdad? Y que ellas puedan entenderse...*”/ “She speaks completely Spanish, right? One of—that’s why I want you to maintain those family-to-family ties, right? And that they can understand...”. The role of language as a theme was a very critical finding that helped the researcher understand how to reframe co-design practices in pedagogical terms that included traditional culture (language) as a way of knowing. From the very first conversations with Latina mothers interested in joining the study, their first question was whether the study would be conducted in Spanish, even if they were native English speakers. Two of the participants who are native English speakers wanted to do the semi-structured interviews and join the co-design workshops in Spanish.

Understanding Latina mothers’ Spanish language “as a resource to be sustained or a source for sustaining [Latina mothers’] identities” (Bucholtz et al., 2017, p. 54) allowed the researcher to center Latina mothers’ most powerful asset (speaking Spanish) to create design instruments that were healing and restorative, rather than problematic or divisive. This theme is very important from a research methodology perspective. Smith (2012) argued to acknowledge how oppression and colonialism have impacted research methodologies. However, Smith also acknowledged that this does not mean rejecting all Western research training but to have researchers think about the “margins.” According to Smith (2012),

Meaningful, rich, diverse, interesting lives are lived in the margins; these are not empty spaces occupied by people whose lives don’t matter, or people who spend their lives on the margins trying to escape. Many groups who end up there

'chose' the margins, in the sense of creating cultures and identities there: for example...minority ethnic groups, and indigenous groups. (p. 205)

This study found that decolonizing design instruments, meaning creating, modifying, and designing every co-design workshop activity from a Spanish-first method and using culturally relevant pedagogy, helped participants unpack and scaffold their histories to make family learning a purposeful activity embedded in meaningful relationships and practices. According to Ito et al. (2013), "Learning and cognition 'in the wild' also tends to happen in social and collaborative contexts, where individuals work together, share knowledge, and engage in joint inquiry" (p. 75). And these were exactly the themes discovered in the co-design workshops through the decolonized (language- and culture-specific) design instruments and activities: (a) teamwork and collaboration, (b) sense-making, (c) intrapersonal openness, (d) interest-driven learning, and (e) conscientiousness. These themes will be discussed under co-design workshop analysis.

Furthermore, finding that Latina mothers value Spanish as much as successfully learning English for their young children adds to the bilingual discourse mentioned in the literature in Chapter 2. Many of the parents, while praising the importance of sustaining language as a cultural value, wanted to make sure their children spoke English and learn how to read, spell, and communicate well in English.

*En en nuestros países no tenemos ese- no tienen nuestros padres ese hábito de-de la lectura, ¿verdad? Entonces, yo siempre dije, 'Cuando tenga a mis hijos, quiero que sea diferente, que tenga otro tipo de educación y que lo hagan a través de los libros,' porque yo sé que a través de los libros uno aprende bastante lenguaje, bastantes palabras y más que todo, también la ortografía.*

In our countries we don't have that—our parents don't have the habit of reading, right? I always said, 'When I have my children, I want it to be different, I want them to have another kind of education and that they do it through books,'

because I know that through books one learns language, a lot of words and more than anything else, spelling.

However, four out of the six participants thought of this from a deficit-thinking perspective. This is why it is important to also view this analysis through a race-grounded phenomenology (Mackey, 2020). Latina mothers were so insistent on literacy and reading over mathematics, not only as an academic achievement but also as a way of successfully reaching the “American dream.” This is important to highlight because mathematics has generally not received the same attention from Latine families as reading with respect to family engagement and learning environments, and this study finding can explain why Latine families choose to teach reading rather than math in their home environments. It also offers an opportunity to think about ways to integrate literacy and mathematics such as traditional books and reading apps.

It is interesting to note that although for two participants who experienced positive family engagement with her parents and math and created and engaged in home math environments, literacy achievement both in English and Spanish took priority over learning math. This finding is also important in relation to this study’s setting and location. In California, bilingual education has become a priority to fully equip students with world language skills (CDE, 2018), yet many family engagement programs and even research (Crosnoe, 2010) continues to emphasize the importance of learning English, especially for immigrant parents, without acknowledging that language has remained an “instrument of identity and power” (Carreon et al., 2005, p. 470) for many Latine families.

This finding also has implications for future research. Civil et al. (2005) are one of the few research groups to acknowledge how perceptions of language plays a critical role for Latine families when it comes to understanding mathematics. However, what has not been researched is how language can play a role in the context of mathematics. The present study started with very preliminary methods by decolonizing co-design methodologies and creating design instruments from a Spanish-first approach. The results proved that Latina mothers were able to



construct their own mathematics knowledge when Spanish was centered not only with co-design instruments but within a sociocultural learning paradigm. Future research needs to explore this in more detail. The findings also revealed that all participants in this study emphasized and valued social–emotional and literacy development over mathematics learning. Their past math experiences, beliefs, attitudes and behaviors are related to their attitudes and behaviors toward mathematics learning and experiences.

### ***Views on Knowledge***

The theme of views on knowledge is different from the funds of knowledge framework. This theme is more about how Latina mothers perceive and judge literacy achievement and their children’s ways of learning based on their personal experiences. This finding aligns with what research says about Latine family engagement—Latine families support learning and literacy at home as their main form of parent engagement (Conteh & Kawashima, 2008; Ladky & Peterson, 2008), while also continuing to have lower literacy rates among their children (Gándara & Contreras, 2009; The Education Trust, 2018).

*Rosa: Porque yo sé que a través de los libros uno aprende bastante lenguaje.*

Because I know that through books you learn a lot of language.

*Sandra: Pero quiero que también ellas tengan ese entendimiento de—del inglés y solo lo va a hacer a través de los libros...*

I want them to learn English and it's only going to do it through books...

It is critical to understand this finding through Anzaldúa’s (2001) description of language duality. Latina and immigrant mothers whose language is Spanish are living in a distinct in-between state—the urgency to hold onto their roots and culture (Spanish language) and pressure from research, practitioners, and education institutions telling them to understand American schooling (Crosnoe, 2010). For example, Crosnoe (2010) suggested that schools provide non-English speaking parents opportunities to learn English. And while providing opportunities to learn English is important, unfortunately for many Latine families, including the Latina mothers in the

present study, the idea of learning English and being proficient in literacy is attached to the idea that values English and diminishes Spanish.

This is a critical finding because one of the goals of this study was to understand how Latine families view mathematics learning. It was evident that for all participants, literacy was viewed as valuable for academic reasons but also to fit in with the American culture and achieve the “American dream.” This provides contextualization as to why perhaps it is challenging for many Latine families to view mathematics learning the same way as literacy and reading. Therefore, highly valuing literacy over mathematics is not only grounded in participants’ negative math learning experiences but also in sociocultural and political contexts. Zavala (2014) noted that very little research is grounded in a sociocultural perspective for linguistic and mathematics identities of Latine students. Zavala (2014) highlighted a promising study where high school students were given the option to learn mathematics in Spanish, having successful outcomes for student math academic achievement. Zavala also noted that it was not about translating the content into Spanish but rather understanding how the Spanish language is an asset for students to develop a mathematics identity, countering deficit-thinking notions about those lacking English language skills that portrays them as not intelligent or smart enough to do mathematics.

The challenges identified here cannot be easily addressed by providing Latine parents more opportunities to learn English. The Latina mothers in this study clearly shared and described the complex ways in which they were raising and educating their children and how such experiences were shaped by sociocultural forces that educational institutions and family engagement programs continued to ignore. This study found that literacy and mathematics do not exist outside sociocultural structures, meaning that mathematics and literacy in Latine families’ practices uphold larger structures of racism and discrimination within an education system that punishes Latine families for not learning English or teaching their kids how to read and speak English.

### ***Ecological Environment***

To understand Latina mothers' family relations/socialization, their role of motherhood, and their concept of parent engagement and community engagement within family dynamics and ways of learning, it is important to consider their history and stressors.

*Daniela: En mi casa no, porque mis papás no eran mucho de ayudarnos.*

Not in my house because my parents didn't really help us.

*Erika: Ah, pues, tal vez...mi mamá nos [apoyo]...[pero] ella como no tuvo la oportunidad de estudiar...*

Oh, well, maybe... my mom didn't [support] us, she didn't have the opportunity to study...

Bronfenbrenner (1979a, 1979b) suggested that meaningful family engagement is based on the premise that caregivers, educators, and community members share responsibility for a child's development. I further argue that meaningful family engagement is also dependent on how family engagement programs can support parents within family learning contexts specific to their culture. One of the major stressors in immigrant and ethnic minority communities is the idea of acculturation (Ramos-Sánchez & Atkinson, 2009), which was evident in this study. All participants stated how much they wanted to hold on to their culture and speaking Spanish. Sharing Mexican and Nicaraguan traditions with their children contributed in a positive way to "the process of preserving the norms of the native group, whereby individuals retain identification with their ethnic cultures of origin" (Guarnaccia et al., 2007, p. 513).

This study's findings demonstrate family learning as a needed component in a child's development. In understanding Latina mothers' ecological environments, it helped the researcher center this study within the ecological system theory. The findings and analysis of this study further position ecological systems theory to reframe family engagement beyond just sit-and-watch experiences and rethink family learning as way to scaffold learning and equip families to support their children's early math development. This theme also helped provide a

lens to this study to, (a) support families to share their unique knowledge and skills to encourage active participation as adult learners, (b) enable caregivers and families to form connections with peers and mentors in formal or informal settings, and (c) allow families to create a home and learning environment that values learning. All of these contexts can help the child's development in a positive way.

Further studies in this area are needed to unearth family engagement research and practice more broadly to help address the achievement gap in the nation's largest growing population through family engagement. To do this, this study found that Latine families must be part of a co-design process to have a voice and to develop an identity as learners and doers of mathematics. Further, this study found that family engagement programs must tie learning ecosystems as systems of connection to Latine families' understanding of learning, sense-making, and construction of knowledge. It is crucial for a participatory design methodology, like this study, to include an ecological environments lens by understanding how the ecological environments came into being and how they have enabled and constrained the possibilities of learning, as well as how such understanding can inform future-oriented practices (Gutiérrez & Jurow, 2016).

Participatory design research seeks to design a process that strives to be part of a social transformation to connect learning experiences with cultural domains and practices, which can provide family engagement a culturally adapted approach. Just as Bronfenbrenner (1977) stated, relationships (family) and the indirect and direct interaction of personal factors with social environments (school/services) are critical in understanding a child's development. Internal and external relationships are interrelated, and "development occurs through the processes of progressively more complex reciprocal interaction between an active [individual] and the persons, objects, and symbols in its immediate external environment" (Bronfenbrenner, 2006, p. 797). Learning ecosystems are dynamic and shaped by the constraints and affordances that

Latine families encounter in their everyday lives and can influence a young child's learning development.

### ***Identity Formation Related to (Mathematics) Learning***

Much has been studied about children's mathematics cognition (Manolitsis et al., 2013), students' mathematical identities (Clements & Sarama, 2011), math anxiety in children and adults (Beilock et al., 2010; Justicia-Galiano et al., 2017), family math night programs (Chan et al., 2020), math classroom instruction (Spitler, 2011), and the role that funds of knowledge can play in helping families make a connection between in-school and out-of-school mathematics (González et al., 2001), but few studies have explored Latine families' histories and experiences with mathematics—not in the sense of understanding parents' educational level in relation to students' achievement scores in math or the funds of knowledge families have as assets and skills but in relation to sociocultural perspectives of their own learning. What do Latine families think about their own learning experiences? How can researchers and practitioners help unpack their learning histories to understand their relationship with mathematics? How can we scaffold home math environments in Latine families to shift beliefs, attitudes and identities so that in turn, these parents are confident in supporting their children's early math development?

Although math anxiety was not measured for this study, all participants' increased uneasiness and statements about their experience with mathematics can also be interpreted through the current research on parent-child math experiences. For all participants, their lack of confidence and negative experiences with mathematics instruction indicated strong math anxiety and negative attitudes toward mathematics, which could have consequences for her children's math learning experiences (Cannon & Ginsburg, 2008). This study found that Latina mothers expressed self-efficacy beliefs, attitudes, and behaviors about mathematics, talked about their lack of interest in developing math learning, shared powerful experiences of how teachers made them feel incapable of learning math, and grouped with all of these the idea that math is an inherent ability. This study found, based on all of the data from the interviews, that

the Latina mothers attributed their mathematics “shortcomings” to not being smart or capable of learning.

*Rosa: [Yo] no tuve el aprendizaje de poder razonar bien. Entonces, no aprendí a hacer [matemáticas], sino que todo era memorizado. Entonces, creo que por eso no me gustaba y no me gusta. [ríe]*

[I] did not have the intelligence to reason well. So, I didn't learn to do [mathematics], but everything was memorized. So, I think that's why I didn't like [math]. [laughs]

*Rosa. Creo que si hubiera tenido un maestro que-que hubiera explicado un poco mejor o hubiera dado algunos tips de cómo mejorar en lo que estaba fallando, creo que ami me hubieran gustado [las matemáticas].*

I think if I had had a teacher who had explained a little better or given some tips on how to improve on what I was failing at, I think I would have liked [the math].

This was an important analysis to uncover the complicated layers of Latina mothers' relationship with mathematics learning. Their primary beliefs and perceptions about their competence and self-efficacy weighed heavily on their perceptions of who could learn and do mathematics.

It is worth noting that although all participants stated their belief in a lack of mathematical self-proficiency, all participants shared conversations and interactions they had with their children that revealed the presence of home math environments. For example, many of the participants stated how they engaged in money practices like counting money, counting and sorting laundry and dishes, doing puzzles, identifying shapes and colors, and playing math games. For all participants, family life had a double meaning—their caregiving as mothers profoundly affected the lives of her children even without direct relationships and home learning environments as a major source of influence for their development (Ceka & Murati, 2016).

This is critical finding because research has shown how parents' home learning environments have implications for children's school readiness. Snow (2006) argued that

parents' home environments should be considered "an agent of change in promoting school readiness" (p. 20), linking parents and home context to support their children's academic success. This is highly crucial because families need to recognize how they can contextualize home math environments to understand how to support their children's early math development. The critical findings are two-fold: (a) families are creating home math environments, even if they do not see it in mathematics learning terms and view these interactions as part of their caregiving role; and (b) there is a need to help Latine families contextualize home math environments to help support children's math skills.

Although many of the participants stated how busy they were as homemakers, they said they always made time to engage with their children. However, they all cited their lack of confidence as a struggle to guide their children's early developmental skills that help promote math comprehension. This was a critical finding because often we think of parents as a separate entity in the process of learning. For example, when family programs design interventions for families to support their children's learning, parents are viewed as "clients" whose sole role is to receive information about how to support their children. Often, parents are treated as partners in family engagement interventions, but the operationalization of such partnerships is always left to the families to figure out. Therefore, I argue that to truly center families as math learners, create a sense of math identity, and build math self-efficacy, we must view family members as active adult learners. And to design programs for families as active adult learners, we should also understand their personal learning histories. How do Latine families remember math? What does it mean for families to learn math, based on their challenging histories and experiences?

Understanding Latine families' personal histories with mathematics can help practitioners support families in forming a learning identity, and this could be a powerful strategy for a real family engagement transformation. Reschly and Christenson (2012) noted that "the biggest challenges facing the [family engagement] field are no longer centered on *why* families

are essential but rather *how* do we create engaged relationships and partnerships (process), and *what works* (empirically based interventions)” (p. 66). Over the last few decades, a growing body of research has explored the benefits of family engagement in demonstrating improved children’s academic and developmental outcomes (Halgunseth et al., 2009; Moore et al., 2016).

We know that families are essential. We know that they have assets and skills. We also know that families from marginalized communities tend to feel uncomfortable doing mathematics themselves or directly participating in their children's math learning (Berkowitz et al., 2015). These negative beliefs about math are often because families feel unsure of what role they can play to support their children in developing early math skills (Jackson & King 2016), especially when they themselves had negative math experiences that shaped their beliefs about who can learn and do math. We now need to understand how we can create programs that will center families as learners and doers of math and how to support families’ awareness of mathematics concepts embedded in everyday contexts, their enthusiasm for doing and learning math, and their access to resources that support this engagement, such as co-design approaches to create family learning environments. Further, we must seek ways to evaluate whether a co-design approach works, which has implications for future research in this area.

### **Co-design Workshops Findings and Themes**

The following sections discusses the findings related to research question 2 “what perceptions do Latine families hold of math co-design approaches?” Two key findings emerged from the co-design workshops and in relation to research question 2, which are Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice. The data findings from the co-design workshops identified seven themes and one subtheme (Table 18) that emerged from parents’ perspectives



participation in the co-design workshops. Three key themes were repeated in the co-design workshops: interest-driven learning, familismo, and traditional virtues. These three themes are analyzed together from the co-design workshop perspective because they are similar to the interview themes.

**Table 18**

*Participants' Co-design Themes & Subthemes*

<b>Themes</b>	<b>Subthemes</b>	<b>findings</b>
Traditional education virtues Familismo Interest-driven learning Teamwork and collaboration Sense-making Interpersonal openness	Values and Traditions Funds of knowledge	Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves.  (5) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and
Conscientiousness		(6) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.

***Familismo, Traditional Virtues, and Interest-Driven Learning***

The second phase of data collection consisted of observing participants engaging in co-design approaches. One significant finding from the co-design workshops was that the same three themes from the semi-structured interviews—familismo, traditional virtues, and interest-driven learning—were yielded through the observations. This finding was not surprising because the creation of the generative design tools was based on the participants' interviews, but it served to reaffirm the idea that co-design instruments can facilitate an authentic experience in participants to “design from within” rather than “design by dictate” (Banathy, 1991).

This is crucial to understand because this study was framed within a sociocultural paradigm that used semi-structured interviews to reveal forms of cultural capital Latina mothers

implemented to make sense of their lived experiences to construct the co-design instruments. As a result, the researcher had the opportunity to center empathy in the design of all the generative design activities and co-design workshops to continue to connect with Latina mothers in a meaningful and authentic way. And while many of the participants were unsure about the co-design workshops, they were open to building relationships with strangers after learning from one another and building trust during the first co-design activities.

In fact, many of the participants stated that they had never been in a parent math workshop where they were asked to reflect on who they are and what they value. As Sol stated: *“Bueno no sabia si hacer el collage acerca de matematicas pero quise poner lo que yo quiero y valoro.”* / “Well, I didn't know if I needed to do the collage about math, but I wanted to put what I wanted and value.” It is significant to note how often, through the participants' co-design workshop artifacts, they valued their histories, language, families, beliefs, and traditions. This study revealed that for many of the participants, the most meaningful places, people, and activities in the co-design workshops weren't always specific but were always connected to feelings and emotions. Therefore, this means that family engagement events can happen anywhere and be about anything as long as they evoke the desired feelings in the space and people who are part of family engagement interventions. This also means, again, moving away from seeing families as engaged clients and toward seeing them as active learners. This requires prioritizing the design of family engagement interventions to evoke feelings of trust, safety, and non-judgment.

Additional findings revealed that setting a foundation of trust, safety, and non-judgment is essential in an ideal family engagement intervention. This aligns to participants valuing family, respect, and community before they even think about education as a priority. For programs to create a level of trust and relationship-building with families to encourage them to be enthusiastic about joining programs, we must equip families with a sense of ownership (Carr-Chellman & Savoy, 2001), and this was clearly evident in how Latina mothers felt seen with the

first generative co-design activities and created their own systems of human learning based on their funds of knowledge (Carr, 1997).

Among the Latina mothers, many concepts were interconnected with a collectivist perspective and based on personal interests or relevance to the participants' everyday life experiences. This is reflected in the finding that participants innately chose topics that were connected to their real lives (Table 19). Exploring participants' personal interests offers an opportunity to understand what they have experienced from a sociocultural learning paradigm along the timeline of where they have been to where they are now, to shift pedagogical practices (Moll & González, 1996). Because the connected learning framework has roots in funds of knowledge, interests are central to creating and leveraging learners' repertoires. According to Ito et al. (2013): The "primary driver of participation for interest-driven activity is a sense of personal affinity, passion, and engagement. Learning in this mode is generally knowledge and expertise-driven and evaluated by the metric internal to the specific interest group" (p. 64).

In the present study, Latina mothers brought real-life connections to the design of their *Mi Auto Retrato/Self-Portrait* and *Estética de Arte/Collage* artifacts. To achieve this, it was necessary to acknowledge different participant assets within families (knowledge, skills, emotional connections, values, rituals) to connect interest-driven learning opportunities with the co-design activities' goals. By honoring and centering the history, rituals, and examples from families' home cultures, the researcher allowed participants to set a foundation to design and prototype their math activities, even if this foundation was not related to mathematics at all.

This finding also highlights the importance of understanding what parents are interested in so they can design mathematics experiences around those topics. This approach can influence how families learn mathematics in enriching environments like co-design approaches, as this study revealed. In other words, without a strong sense of what families understand in

terms of their personal interests and learning, they are unable to scaffold mathematics and thus miss opportunities to learn mathematics in authentic and real-world settings.

**Table 19**

*Participants' Findings About their Personal Interests*

<b>Participant</b>	<b>Interest-Driven Learning Topics</b>	<b>English Translation</b>
<b>Rosa</b>	Le gusta y buena para leer a sus hijos. Le gusta y valora mucho los libros, la lectura, y la alfabetización. Siempre quiere leer y que sus hijos tomen la lectura tambien.	Rosa likes and is good at reading to her children. She likes and values books, reading, and literacy very much. She always wants to read and have her children read as well.
<b>Carla</b>	Le gusta y es buena para la cocina. Le gusta cocinar por que le recuerda cuando cocinaba con sus papas en su país natal.	Carla likes and is good at cooking. She likes to cook because it reminds her of when she used to cook with her parents in her home country.
<b>Sandra</b>	Le gusta convivir mucho con su hija haciendo rompecabezas. Es lo que mas le gusta a las dos y juegan mucho en familia.	Sandra likes to spend time with her daughter doing puzzles. It's what both like best and play a lot as a family.
<b>Sol</b>	Le gusta la naturaleza por que a sus papas les gustaba estar a fuera mucho. Le gusta mirar el arcoiris. Es buena para el acampar y estar a fuera.	Sol likes nature because her parents liked the outdoors a lot. She likes to look at rainbows. She is good at camping and exploring the outdoors.
<b>Erika</b>	Le gusta la naturaleza también. Le gusta estar afuera con sus hijos contando piedritas afuera. Le gusta y es buena para acampar y estar a fuera.	Erika likes nature too. She likes to be outside with her children, counting stones in the outdoors. She likes and is good at camping and exploring the outdoors.

A further analysis of these three themes demonstrated how differently each participant thought about her interests (Table 19), except for Sol and Erika, who are relatives—sisters-in-law. When participants were given a space to share what they liked and their interests, they approached it from “I like and I am good at this”/“*lo que me gusta y soy buena.*” This is a critical analysis because often we don’t approach families from an asset-based perspective. And

although there is vast research on funds of knowledge, there is still a need of specificity when it comes to the operationalization of the funds of knowledge framework seems to be missing.

Co-design approaches, then, give Latina mothers a choice and a voice to participate and learn. Drawing from the expertise found on Latina mothers' interest-driven topics within co-design approaches can help family engagement interventions touch on the concept of funds of knowledge and therefore contextualize and operationalize this knowledge it to help families move from the "engage client" concept to family learning and active adult learner concepts. Addressing interest-driven activities with families can provide an opportunity to design family experiences that center the adult as a learner along with their children.

It is worth noting that although participants were told that the co-design workshops were meant for them as parents, their children were curious and showed up in their Zooms. Throughout some of the activities, parents would mention how their children helped them with the activities because they believed their children to have more creativity than themselves. It also worth noting that although parents were okayed with their children helping, by the end of each co-design workshop, they reflected on the need to have workshops meant for them. Despite many of them stating they did not feel creative, their first thought was to involve their children, proving that families, in this case Latina mothers, want to learn alongside their children.

### ***Teamwork and Collaboration***

While the co-design workshop's goal was for participants to co-design and co-create an individual mathematics activity, there were co-design workshop structure iterations (e.g., the creation of breakout rooms for sessions 2 and 3) based on participants' feedback that enabled Latina mothers to engage in peer support and collaboration. The findings suggest that when participants were more engaged (deciding to participate in the co-design workshops), they were active learners in the process (engaging in inquiry and metacognition skills). An interesting finding of this study is how Latina mothers understood the co-design workshops activities in terms of problem-solving and overlapped this with scientific reasoning. This finding was evident

during the breakout room collaborations. The following conversation vignette illustrates how Latina mothers collaborated, engaged in sense-making, and navigated the possibilities and challenges in understanding how to storyboard their math activity. This finding raises questions about whether scientific knowledge could be an easier entry point for families to understand mathematics connections between formal early math concepts and home math environment.

*Rosa: Yo puse, título de actividad, "Contar los números en una mini casa de foami." ¿Les parece?*

*Carla: Hasta nos podemos quedar, "Contar los números en una mini casa," así puede usar contar en la actividad. Por ejemplo, Sandra, ¿usted ya pensó en el nombre de su actividad?*

*Carla: Las dos suenan bien ¿cómo lo va a llamar usted con su actividad? ¿Nada más es culebras y escaleras?*

*Daniela: Serpientes y escaleras de matemáticas.*

*Carla: Yo pienso que un nombre, no tiene que ser perfecto, no tiene que ser supergrande, pero pensemos en un nombre que nos gustaría dar a nuestra actividad para que guíe a nuestros hijos. Por ejemplo, Rosa, ¿qué es lo que le está enseñando a sus hijos con la casa? ¿Se acuerda de su tema que escogió? ¿Está muda o no la escucho?*

*Rosa: Mi beneficio sería, "Esta actividad le va a enseñar a mis niños a aprender números, contar, identificar números del uno al 10 usando una casa." ¿Sí me doy a entender? Rápido, así, ese es el beneficio. Sandra, ¿cuál es tu tema que usó?*

*Rosa: As the title, I wrote, "Count the numbers in a mini foam house." What do you all think?*

Carla: We can even say, "Count the numbers in a mini house." That way you can use counting in the activity. Sandra, have you already thought of the name of your activity?

Carla: Both sound good. What are you going to call your activity? Only snakes and stairs?

Daniela: Snakes and math ladders.

Carla: I don't think the title has to be perfect, but still we should think about a name for our activity that will guide our kids. For example, Rosa, what are you teaching your children with the house? Do you remember the subject you chose? Are you on mute or not listening?

Rosa: My math activity learning goal would be, "This activity is going to teach my kids how to learn numbers, count, identify numbers from one to 10 using a house." That's the learning goal. Sandra, what's your math topic?

All the participants positioned themselves as listeners and active learners, co-constructing knowledge collaboratively to achieve a shared goal—designing/storyboarding their math activity before prototyping it. Their peer support and collaboration allowed them to accomplish goals they set for themselves—especially their construction of their mathematics lesson plan. It is evident that their construction of their lesson plans was born of the collaborative experiences all participants were engaging in with one another. Further, engaging in peer support and collaboration increased participants' awareness of one another's qualities, transforming their relationships and increasing enthusiasm for their math activity project (Iversen et al., 2013).

It is worth noting that one of the hampering factors in the peer support and collaboration was the participants' desire to be in person with one another. Although it was clear that all of them were able to collaborate with one another in the breakout rooms, there was still a sense of wanting to discuss feelings and emotions. Some of them clearly wanted to be loud and create a

more bonding experience. After all, we learn socially. Despite this barrier, findings indicated communication among participants was crucial in their collaborative success. As illustrated in the prior conversation vignette, participants were willing to communicate by asking one another questions to make sense of their challenges and barriers. This is so important because, once again, in traditional parent workshops or family engagement interventions, families are seen as recipients of the information. But in the thoughtful and intentionally designed environment of family learning, these families had a vision for their math activity and engaged in communication and inquiry to help one another articulate their vision so that others could understand it. Here families were not just accessing information but actively engaging in co-design practices that resonate with theoretical understandings of funds of knowledge and connected learning from a sociocultural learning paradigm.

Again, this is important when we think about reframing family engagement interventions; we need to think about interventions that focus on understanding the needs of the person experiencing the problem, focusing on whether the proposed solution is effectively meeting their needs. And co-design approaches center users' voices—in this instance, families' voices (needs, wants, emotions, and values)—as experts to help co-create and co-design meaningful solutions to an issue (Fuad-Luke et al., 2015; Kang et al., 2015). The approach is most effective when the person experiencing the issue becomes a part of the co-design process, as in the case of the participants engaging in peer support and collaboration (as described in the conversation vignette).

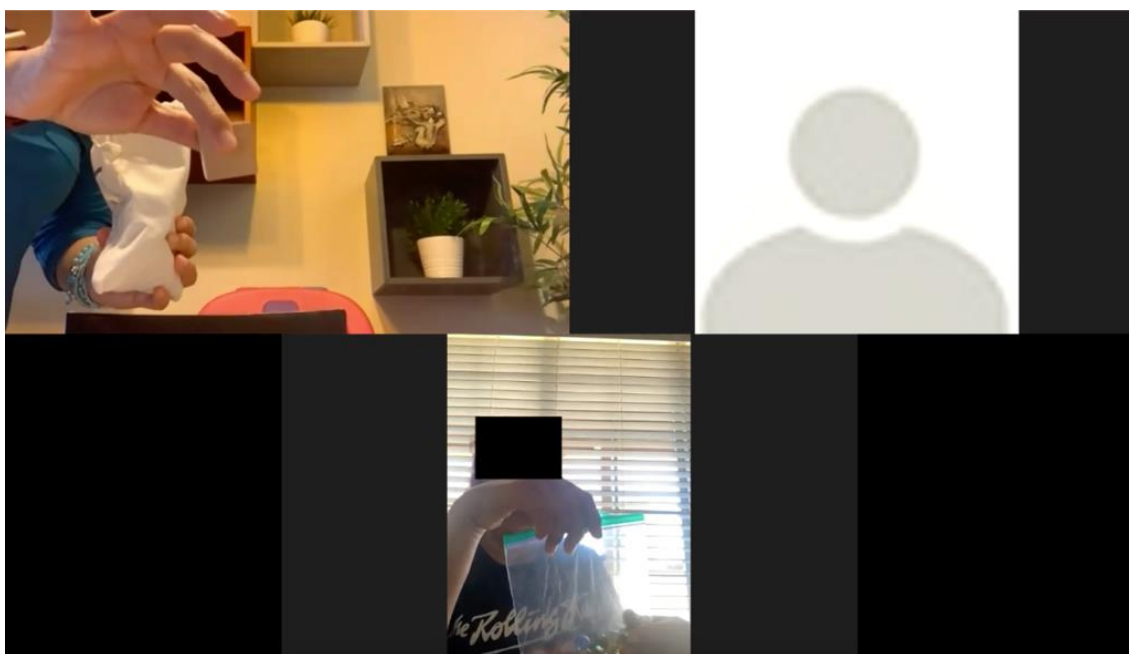
Another critical analysis interpretation is that through the participants' peer support and collaboration engagement, they also challenged the imbalance of power between the facilitator and the participants. Latina mothers had a space and opportunity “to voice their concerns, build relationships, and encourage creativity” (Khan & Beltran-Grimm, 2020, para. 8 ). Participants formed a collaborative creativity process that allowed them to wrestle with challenges and find solutions, in this case in creating a preliminary mathematics lesson plan to help them



understand how to storyboard their math activity (Figure 65). And although many of the participants stated they believed they were not creative, throughout the co-design workshops and specifically in the collaboration opportunities, participants contributed creatively based on their unique experiences—i.e., “creating something novel, valuable, useful and generative—in close collaboration with their peers” (van Mechelen et al., 2019, p. 5).

### Figure 65

*Participants Engaging in Peer Support and Collaboration to Brainstorm a Math Activity*



### **Sense-making**

Sense-making as a key theme was important for this study to continue to challenge deficit narratives of Latine communities, which have impacted family engagement interventions both in and out of school settings, especially in Spanish-speaking Latine families (Fránquiz et al., 2011). This study's epistemological leaning is constructivist because it sought to give a voice to Latine families as active participants seeking meaning in conjunction with the researcher to generate knowledge during the process of inquiry. Throughout the co-design workshops, all participants engaged in active creation of knowledge with one another and from the designed

learning environment (co-design workshops; Ponterotto, 2005; Vygotsky, 1978). Important to note is that the analysis and interpretation of this theme were also viewed through race-grounded phenomenology (Mackey, 2020), specifically through Anzaldúa's (1999) border and immigration identity lens. Anzaldúa argued that the state of being in between two worlds allows Chicana women to center their ways of knowing that emerge from their everyday experiences, cultural artifacts, and oppression.

This was evident in how all Latina mothers tried to make sense of what they were learning, designing, and creating. The codes under the theme of sense-making are problem-solving, construction of knowledge, views on expertise, self-beliefs about competence, and perceptions of creativity. All of these, analyzed and interpreted through Anzaldúa's (1999) ways of knowing, are similar to concepts such as *la facultad* (knowing through experience and intuition), *convivir* (praxis of living together), *valerse por si misma* (to be self-reliant), *sobrevivir* (survival and beyond), and *pensadora* (creative thinkers), respectively (Villenas et al., 2006, pp. 4–5). This was a very critical finding because it aligns to the theoretical framework from Chapter 2—funds of knowledge and the connected learning framework—but it also provides an illustration of what happens when parents are centered as the learners while valuing their ways of knowing (funds of knowledge).

Although all participants expressed their strong negative feelings about mathematics learning, all of them chose a math activity and problem-solved throughout the storyboarding and prototyping of the activity, engaging in inquiry practices with one another and engaging in levels of complexity to the task at hand.

*Rosa: Erika, te estaba dando la idea era de colocar las canicas en un recipiente para que el niño las pueda sacar y contar. Si son dos canicas, una, dos. Si uno le dice tres canicas, que cuente una, dos, tres.*

Erika, I was giving you the idea to put the marbles in a container so the child can take them out and count. If it's two marbles, one, two. If you tell him three marbles, let him count one, two, three.

*Carla: Cada quien tiene que escoger lo que a usted le guste más. ¿A Erika qué es lo que le gusta? A ella le gusta sumar, separar.*

Everyone has to choose what you like best. What does Erika like? She likes to add, to separate.

*Sandra: El que yo quería hacer es rompecabezas, que es el de razonamiento matemático. No sé cuál de los dos hacer, porque no sé hacer un rompecabezas.*

The one I wanted to do is puzzles, which is mathematical reasoning. I don't know which one to do, because I don't know how to do a puzzle.

By honoring their experiences and affirming their funds of knowledge, participants engaged in sense-making to design their own system of learning, without the facilitator telling them what to do but only guiding them through steps. The results were overwhelmingly positive. Many of their trials and errors role-modeled to one another how to problem-solve, while developing critical thinking. Participants exercised math self-efficacy and felt equipped to design their own mathematics activity and engage in discussions of what they would like to teach their children. Many of them stated they felt challenged because they had never been given an opportunity to feel like the content and resources were for them as adults and not for their children.

The following statement by one of the participants is a powerful illustration of how parents want to be centered as learners. They want to learn along with their children, but they want the content to be meant for them as parents.

*Sol: Sí, ojalá pudiéramos tener otra meeting así, nos dejan saber porque yo creo que todas estamos interesadas. A veces los meetings para los padres, dicen que son para no nosotros, pero es mas informacion para nuestros hijos. Nos gusta mucho estar en grupos donde podamos aprender y tambien mejorar la*

*educación de nuestros hijos. No solamente ellos aprenden, aprendemos nosotros también. Eso es lo más bonito, seguir aprendiendo lo que no sabemos hoy y aprender cosas nuevas, un día a la vez, yo creo.*

I wish we could have another meeting like this. They let us know because I think we are all interested. Sometimes people say that the meeting's for parents, they say that it is for us, but it is more information for our children. We like to be in groups where we can learn and also improve the education of our children. Not only [our kids] learn, but we learn too. That is the most beautiful thing, to learn what we do not know today and to learn new things, one day at a time.

This is important analysis because families are open to educational opportunities for their children and themselves. Yet, many of the family engagement interventions consist of information dissemination, viewing program and family relationships as transactional. To truly counter the deficit-thinking narratives that have characterized Latine families and children (Nieto & Bode, 2012) and to move from family engagement as a mandate and obligation, this study's findings show that co-design approaches can help reframe family engagement as participation and a possibility—where family learning can be an active, contextualized process to scaffold learning that is connected to an evolving ecosystem of educational contexts, home practices, and community settings.

Per Papert (1996, as cited in Roque, 2020), “What parents most need to know about computers is not really about computers but about learning” (p. 8). Although this quote is about parents' lives and perspectives on technology, it also rings true for this study's topic of mathematics. Latina mothers were interested in joining this study to support their children's math learning, but in the end, they stayed engaged in a full spectrum of social learning and inquiry to transform their own praxis (Moreno, 2014). Through the use of co-design approaches, the needs of Latina mothers as adult learners were met by changing how they learned (co-design workshops) and what they learned (interest-driven topics to guide their math learning

activities). Family learning, then, changed how parents learned and what they learned, to create an instructional space centered on their ways of knowing to foster social cognitive and math self-efficacy skills to design and create a math activity (Reschly & Christenson, 2012).

### ***Interpersonal Openness***

Phenomenology is a conduit for descriptive understanding of participants' perceptions, emotions, and thoughts (Reiners, 2012). According to Edmund Husserl, participants' consciousness of an object or event is embodied through lived experiences (Reiners, 2012). Social aspects and self-perception affect how Latina mothers experience learning and engagement, especially when viewed through a race-grounded phenomenological lens (Mackey, 2020). In the present study, interpersonal openness was a surprising finding because participants were new to co-design approaches. This finding aligns to validation theory (Rendón, 1994; Rendón-Linares & Muñoz, 2011). Many times, parents don't feel equipped to ask questions or engage in conversations in parent engagement programs. According to Rendón (1994), validation occurs when participants' personal development and social adjustment are recognized and reaffirmed through acknowledgment of participants as knowledgeable through an asset-based approach. For this study, Latina mothers engaged in emotional expressiveness and intelligence when collaborating with others. They had pride and agency when sharing their artifacts and engaged in intentional communication to describe their mathematics activities.

Pride and agency were a critical finding because Latina mothers were not told to feel this way; they discovered their pride and agency through the facilitation of the co-design workshops and through the decolonized design instruments. Because of this, Latina mothers were able to "trust their innate capacity to learn and to acquire confidence in being [an active learner]" (Rendón, 1994, p. 40).

*Sol: El mío, yo miré nature en las palabras que pusiste, este es el mío.*

Mine, I looked at nature in the words you put in, this is mine.

*Erika: Yo [comparto]. Me inspiré escribiendo.*

I want to share. I was inspired by writing.

*Carla: Yo puedo empezar.*

I can start.

*Rosa: ¿Quiere que le explique por qué lo de la luz y la pasta dental?*

Do you want me to explain why the light and toothpaste?

With the use of co-design approaches in a facilitated and supportive space, Latina mothers moved away from feelings of inadequacy:

*Sol: Tú me dices Susie, porque tú eres la experta, cómo se llama el que yo quiero, pintar, porque ahí ya uso los colores.*

You tell me, Susie, because you are the expert, what is called the one I want to paint, because there I already use the colors.

Furthermore, they moved toward having an enhanced critical experience of their mathematics learning experiences:

*Sol: Para mí todas las cosas que hay en mi casa son matemáticas...en la cocina, tengo unos medidores de cuchara, tengo la licuadora, tengo un termómetro de alimento, la estufa, el microondas, ¿por qué los menciono?*

*Porque son digitales, hay números y hay temperatura, está la tabla para cortar verduras, tengo contenedores porque tengo de diferente tamaño y de diferente forma...*

For me all the things in my house are math...in the kitchen, I have a few spoon meters, I have the blender, I have a food thermometer, the stove, the microwave.

Why do I mention them? Because they are digital. There are numbers and there is temperature. There is the table to cut vegetables. I have containers because I have different sizes and in different ways...

In developing these new perspectives and through their resilience, creativity, and unyielding commitment to their children and their education, Latina mothers moved from a system of

oppression to create new stories and counter-stories, to resist dominant narratives about who can learn and how to learn mathematics, to express pride, agency, emotional intelligence, and the embodied behaviors of confidence and self-esteem around mathematics learning experiences (Rodriguez, 2011). This is important because parents are users of family engagement programs, and thus, researchers should discover their intentions, motivations, and needs. This interaction has a psychological relation between the users (families) and the tools (co-design instruments) to develop emotions, social connections, and trust. This is important to note because one of the principles of a co-design approach is to center a participant's knowledge in relation to his or her history, culture, and values.

### ***Conscientiousness***

This theme highlights the importance of reflection in lived experiences. This finding resonates with co-design literature. Co-design is an open-ended and iterative process where participants' experiences are centered, and thus reflection is a critical component of co-design approaches.

*Sol: Lo que yo aprendí fue, como dijo Sandra ya una vez, creo que ella dijo la última vez que tiene creatividad o algo así, porque yo estaba dando vueltas y digo, "¿Qué voy a hacer?" Como tú dijiste, Susie [researcher], "Algo que te llame la atención, que tú quieras aprender o enseñarle a tus hijos," como yo dije, quiero que aprenda a contar de 1 al 100 y eso se me ocurrió hacer, nomás que lo voy a hacer un poquito mejor para mandarte la foto, porque ahorita lo hice así, muy rápido, y no se mira muy bien.*

Sol: What I learned was, as Sandra said once, I think last time she said that she has creativity or something like that, because I was going around and thinking, "What am I going to do?". As you said, Susie [researcher], "Something that catches your attention, that you want to learn or teach to your children," like I said, I want them to learn how to count from 1 to 100, and I had the idea to do so,

I'm just going to do it a little better to send you the picture, because I did it real quick right now and it doesn't look very good.

*Rosa: Sí. Lo que me gustó es que realmente descubrí que me gusta explorar las cosas. Cuando algo me gusta, lo hago y como que se me prende el foco, como dicen en mi país, y se me brotan las ideas. En esta actividad creo que lo descubrí. Lo que aprendí es lo mismo, que me gusta hacer las cosas, pensando en enseñarle a mi hija. Realmente, no solamente me enfoqué en esas actividades en mi hija, sino pensando que tal vez otras personas, otros niños, ya sean adultos o niños, puedan aprender. Lo que quisiera es que ojalá pueda compartir todo lo que hicimos todas las mamás, nuestras ideas, y puedan valorarlo también en ese programa. De verdad que quisiera algún día conocerlas a ustedes y a todas. Ojalá. Sí, me encantó ese taller, me fascinó. No me arrepiento. Estoy bien contenta.*

Rosa: Yes. What I liked is that I really discovered that I like to explore things. When I like something, I do it and I become aware, as they say in my country, and then the ideas start to flow. I think I discovered it with this activity. What I learned is the same, that I like to do things, thinking of teaching them to my daughter. I am actually not only focused on those activities to do with my daughter, but I think that maybe other people, whether they are adults or children, can learn. What I would like is that I hope I can share everything that we all moms did, our ideas, and they could also appreciate it in that program. I really would like to meet all of you one day, I hope so. Yes, I loved that workshop, it was fascinating. I do not regret it. I am very happy.

*Erika: Sí. A mí me gustó que entre todas nos damos ideas, pone una atención a lo que otra persona-- la imaginación que tiene y le ayuda también a que la imaginación de uno despierte. Aprendí cosas nuevas, como el de serpientes y*



*escaleras. Ese me gustó mucho para yo poderla enseñar a mi niña, también. Como el de Sol, que también contar y quitar números, los que faltan, y el de Sandra, el rompecabezas, también me gustó mucho. Yo nunca hubiera imaginado hacer con unos papeles chiquitos y cortarlos. También el de Rosa, me gustó mucho todo lo que hizo ella también, me sirve para yo tenerlo y enseñar a mis niños también con eso.*

Erika: Yes. I liked that we all shared our own ideas with the rest, you pay attention to the other person - the imagination they have, and it also helps to awaken your own imagination. I learned new things, like the snakes and ladders game. I liked that one a lot, I can teach it to my girl, too. Like Sol's, counting and subtracting numbers, the missing ones, and Sandra's, the puzzle, I also liked it a lot. I would have never imagined making it with small papers and cutting them. Rosa's too, I really liked everything she did too, now I am able to have it and teach it to my children too.

It is worth noting that although participants did not journal, through every moment of the co-design workshops, they engaged in reflective practices including forethought, performance, and perseverance. Participants inhabited the co-design process as they interacted with materials, in the breakout rooms with other participants, and with the researcher, allowing them to reflect on their everyday engagement as they designed and created their mathematics activity during the co-design workshops. As illustrated in the conversation vignette, these reflection practices are critical to build on lifelong habits and routines, again not just for engaging with the workshop content but for lifelong learning in the context of family learning.

This is crucial for family engagement interventions, where the “banking” of information is assumed to provide all content and resources to families, but where in reality, it becomes a transactional relationship. When families are given the opportunity to reflect, they are able to embody their capabilities to construct knowledge from social contexts, history, and exploration.

Reflection practices allowed Latina mothers to see mathematics in their everyday contexts, to understand them, and to connect them to early math concepts to support their children's early math development.

### **Analysis of Positionality in Theory and Praxis**

In Chapters 3 and 4, I wrote about the importance of acknowledging my positionality during the data collection phase and in the presentation of the data results. To ensure validity and reliability, I implemented several data triangulation steps and employed reflexivity, member checking, and peer examination. However, it was also important to integrate a critical race-grounded phenomenological lens to the analysis of this research study (Mackey, 2020). The following sections describes the researcher's positionality in reference to the study analysis.

Research scholars like Creswell and Creswell (2018), Maxwell (2013), Christensen et al. (2011), and Thomas and Magilvy (2011) have pointed out the importance of removing personal bias to ensure qualitative research remains credible and objective. However, throughout the research process, I was intrinsically linked to the active creation of knowledge in the social interactions with participants, both in the interviews and in the co-design sessions. It was as much a personal experience for me, as the researcher and Mexican woman, as it was for the Latina mothers who participated in this study. This mutual interaction influenced both the building of knowledge and the personal experience of analyzing the findings through a race-grounded phenomenology (Mackey, 2020).

As mentioned in Chapter 4, in centering my positionality as a Mexican woman, I discovered healthy tensions that acknowledge that inner subjectivities cannot be separated from active and participatory research like the study I conducted with Latina mothers. This does not mean a bias but a healthy tension to continue to understand how racial identity shapes a researcher who identifies as a person of color or a minority. Cross et al. (2017) and Mackey (2020) described the psychological negotiations that researchers of color experience throughout the research process. Cross et al. (2017) described these psychological negotiations as identity

enactments. I argue that the centering of my positionality was needed to create a collaboration with participants within their social–cultural context. I centered my positionality as a humanizing research strategy and ethical stance rather than a method (Cross et al., 2017; Mackey, 2020; Williams, 2016; Zavala, 2013). Therefore, as a researcher I believe that “subjectivities and discourses or individuals (agents) and their contexts can[not] be separated” (Scheurich & Young, 1997, p. 13) from this study’s research methods.

In fact, this was my study’s epistemology from the beginning. In this research project, I, along with the participants, engaged in meaningful learning that took place when we together co-constructed knowledge from our social contexts, history, and exploration of these identities. Within a constructivist paradigm, the participants and I shared the combined reality of the research process (Ponterotto, 2005) and therefore engaged in a remixing of research ideas and methods to create authentic learning spaces and environments. After all, learning is communal, relational, and cultural. My positionality added to the contextualization of this study and allowed participants and myself, as the researcher, “to think critically and address structural relations of power, to build upon cultural values and systems and contribute research back to communities that are transformative” (Smith, 2012, p. 214). This research study contributes to the argument that alternative ways of knowing and scientific knowledge can coexist along the same research paradigms.

Therefore, in theorizing Latina mothers’ lived experiences with co-design approaches, I decided to integrate a critical race-grounded phenomenological lens to the analysis of this research study (Mackey, 2020) to recognize that Latina women experience and navigate learning and oppression based on race, ethnicity, and social identities. This also includes me as the researcher. *In Borderlands/La Frontera: The New Mestiza*, Anzaldúa (1987) argued that Chicana women have been forgotten and devalued through the lens of U.S. history, calling for centering Chicana women’s lived experiences and knowledge as a way of knowing. In this study, Latina mothers’ way of knowing emerged from their retelling of their everyday

experiences. That is, their immigration history, language abilities and disabilities, culture, traditions, and mathematics experiences—these different ways of knowing informed a cycle of theory and action (praxis) throughout the analysis of this study (Villenas et al., 2006, p. 1).

My theory and praxis started in the creation of decolonized design instruments and continued with the coding and analysis of the research questions. For example, when implementing decolonized methodologies to design and modify the co-design activities and instruments, I employed Noel and Paiva's (2021) positionality worksheet (Figure 66) to understand and capture my liminal elements—knowledge, culture, language—as valid standpoints from which research can be developed, analyzed, and interpreted to “facilitate the expression of marginalized voices, and...attempt to re-present the experience of marginalization in genuine and authentic ways” (Smith, 2012, p. 205).

One of the most salient analyses of using Noel and Paiva's (2021) positionality worksheet was the discovery of liminality to capture my positionality as a researcher. Per Ladson-Billings (2001, as cited in Smith, 2012), “The work of the liminal perspective is to reveal the ways that dominant perspectives distort the realities of the other in an effort to maintain power relations that continue to disadvantage those who are locked out of the mainstream” (p. 204). Therefore, I argue that framing a researcher of color's positionality is less about the struggle for research methods and more about how positionality also affords new opportunities to understand Latina women's histories within/against learning and oppression discourses.

However, I want to make clear that I do not harbor epistemological perfection, but I argue that to truly move away from positional superiority in research, which is Eurocentric in nature (Smith, 2012), we must address the simultaneity and tensions associated with being within and against dominant structures of power. This study uses Anzaldúa's (1987) framing of Chicana women's ways of knowing, as a lens to position Latina mothers in this study beyond the either/or thinking discourse. For example, it is important to add a race-grounded phenomenology (Mackey, 2020) lens to understand why Latina mothers value reading and

literacy achievement in a country where they have been oppressed for speaking a different language.

**Figure 66**

*Researcher's Positionality & Reflexivity Worksheet*



*Note.* Description of how researchers' positionality and background frame how we conduct research. Adapted from "Learning to recognize exclusion," by Noel, L. A., & Paiva, M., 2021, *Journal of Usability Studies*, 16(2), p. 67. (<https://uxpajournal.org/learning-recognize-exclusion/>). Copyright 2020-2021. User Experience Professionals Association.

Therefore, this analysis speaks to how we create, interpret, and analyze knowledge as a subjective experience, interacting with our previous knowledge to construct new knowledge, indicating that "our present experience of the world is connected with the complex history of oppression...critical philosophy of race gives rise to a political phenomenology, which takes into account history" (Zeynep, 2017, p. 132). The following memo entry describes the questions about power relations, agency, ethics, and my participatory methodologies as a researcher and

my relation to the participants and the research itself. Memoing served as lingua franca to constantly expand knowledge for both the research analysis and the researcher.

There were many, many, many times when I wanted to also share my perspective and let the participants know that I understand them. I see them. I value them. I felt intimately related to their stories, histories, and the sharing of their immigrant challenges and how they came to this country. I know that this healthy tension has implications for my data analysis not as a bias but as a way to decenter power structures, even within my own power as an insider and outsider. A radical individuality that I have not thought about before I engage in this process. What is my role as the researcher? To discover, extract and reimagine new possibilities? Or to continue to emphasize scientific knowledge through a Western lens? (Researcher Memo Entry #27) .

### **Summary**

In Chapter 5, the researcher analyzed the findings presented in Chapter 4. Eleven themes, three subthemes and six major findings were highlighted in this chapter in relation to the research questions. Data analysis from the interviews revealed seven key themes: (a) traditional education virtues, (b) familismo, (c) role of language, (d) ecological environment, (e) views on knowledge, (f) interest-driven learning, and (g) identity formation related to (math) learning. The results of this study suggests: (a) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves, (b) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues, (c) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences and (d) Latina mothers engage in "direct numeracy " and "indirect numeracy" environments (Hart et al., 2016).

The findings suggest that Latina mothers in this study understood mathematical knowledge through a funds-of-knowledge approach. This approach was instrumental in helping

the researcher make meaning of participants' voices and experiences. These findings also suggest that Latino mothers engage in informal mathematical activities that they are not aware of but that can be contextualized to articulate math learning. This can ensure that family engagement curricula and future initiatives resonate with and meet the needs of families.

Additionally, in analyzing the co-design workshop observations, the researcher found themes such as (a) traditional education virtues, (b) familismo, (c) role of language, (d) ecological environment, (e) views on knowledge, (f) interest-driven learning, (g) identity formation related to (math) learning, (h) teamwork and collaboration, (i) sense-making, (j) intrapersonal openness, and (k) conscientiousness. Subthemes include values, traditions, and funds of knowledge. Key findings from the co-design workshops suggest, Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice. Additional findings included the working definition of family learning as an interactive, contextualized process that engages adults and scaffolds learning and is connected to an evolving ecosystem of generative social contexts, home practices, and community settings in the lived-in world.

Additionally, the researcher in this study found that it is crucial to view family engagement beyond the triangulation of home–community–schools and think about how educators, practitioners and researchers can consider parents' culturally specific needs to address how parents can learn instead of just engage. Abdi (2016) noted that school administrators and educators have placed children and families under the idea that families from “immigrant groups don't have the ‘right culture’ to succeed in school—and [this] further isolates a community from educators” (Abdi, 2016, para. 9). Instead of looking at the right way to engage families, we as educators should look at ways we can equip and empower families to understand their funds of knowledge to create equitable, social, and participatory family

engagement and family learning interventions. This idea—Latina mothers’ ways of knowing—was critical in implementing co-design practices. Auerbach (2006) noted how children’s and young adults’ lives are “shaped by parents’ social location, cultural models, and family dynamics” (p. 276).



## **Chapter 6: Conclusions and Recommendations**

The purposes of this study were to (a) explore how Spanish-speaking Latine families experience co-design workshops and (b) uncover Latine families' cultural repertoires and learning experiences to understand how Latine families participate in co-design learning experiences. This chapter begins with a brief restatement of this study's significance, it then provides a review of the findings related to the research questions, it discusses conclusions and recommendations within the larger context of family engagement and learning practice, and it revisits the study's theoretical underpinnings, it also examines the study's limitations; and finally, it discusses possible directions for future research.

### **Restatement of Significance**

Early positive life experiences for a child depend both on immediate (family) and external factors (ecosystems; Bronfenbrenner, 1979a, 1979b). Families are the first to provide adult-child interactions to children, which is critical in their early years for socioemotional development and for academic achievement in their later years (Cartmill et al., 2013). A great deal of research supports that statement: children who have rich early learning experiences are better prepared to thrive in school and beyond (Crosby et al., 2015; Manz et al., 2014; Mapp & Kuttner, 2013). Enhancing the opportunities for children to succeed in learning is critical for the future of the United States, and families play an important role in supporting young children's early learning development. This is especially true for Latine children.

Traditional frameworks have been used as a guide to implement family engagement interventions, from parent volunteerism in the classroom (Baker et al., 2016; Epstein et al., 2002) to school collaboration in programs like family math nights (Epstein et al., 2002; Lopez & Donovan, 2009). Additionally, researchers have explored the benefits of successful parent-teacher relationships (Hindin & Mueller, 2016; Jeynes, 2010), as well as the home learning environment (Crosby et al., 2015; Ozturk et al., 2016) and the community as an ecosystem of support (De La Garza & Kuri, 2014; Singh et al., 2013). However, many organizations,

institutions, and educators continue to struggle with the translation of these frameworks into sustainable family engagement practices (Bodenhausen & Birge, 2017), often ignoring how families learn and what cultural repertoires they bring to the table (Khan & Beltran-Grimm, 2020).

Despite robust findings from a vast ecology of research, family engagement continues to be a topic of mixed discussion as a means of helping to increase student achievement. This is especially true for topics like math because early math skills predict later school achievement. Similar to the manner in which early literacy skills and exposure to books at a young age positively impact the development of reading skills, early exposure to math concepts can be an important contributor to future success in school and in life for young children (Platas, 2012). However, families from marginalized communities tend to feel uncomfortable doing math themselves or directly participating in their children's learning (Berkowitz et al., 2015); these negative orientations toward math are often because families feel unsure of what role they can play to support their children in developing learning skills in school, in the community, or in digital settings (National PTA, 2016).

A prominent model and approach has emerged in the last few years, adapting participatory action research design, community psychology, design thinking, and human-centered design methods, to offer and establish itself as a transformative and service design approach (Manzini, 2015). Such co-design methods have been recognized and actively promoted within the medical field, for the most part (Holliday et al., 2015; Slattery et al., 2020); more recently, however, co-design approaches have been used to augment families' voices, experiences, and culture in education, centering them as experts in their own and their children's learning, and as people helping co-design and co-create meaningful learning experiences (Khan & Beltran-Grimm, 2020; Global Family Research Project, 2018; Westerlund et al., 2003). The approach is most effective when the person experiencing the learning becomes a part of the co-design process; indeed, co-design approaches give "individuals a

space to voice their concerns, build relationships, and encourage creativity” (Khan & Beltran-Grimm, 2020, para. 8).

However, there is very little research on co-design approaches for family engagement. The vast ecology of family engagement research is centered on the investigation of direct correlations between parent–child interactions and children’s academic and socioemotional development (Adamson et al., 2014; Guerrero et al., 2013); while this research is necessary, there is also a critical need to rethink family engagement practices and move them beyond traditional frameworks, such as Epstein et al.’s (2002) Six Types of Involvement, among others. Therefore, researchers must further investigate how co-design approaches can become a guiding framework for family engagement program improvement and systems change.

Most important, there is also a need to investigate how marginalized families—in this case, Latina mothers—engage in co-design approaches to understand how they learn and how to design environments to support their mathematics learning. No prior research or literature review has investigated this specific community in this arena (Latine families and co-design approaches for math learning), and while several research studies have investigated funds of knowledge in Latine families, no prior research has merged both funds of knowledge and co-design approaches for mathematics learning. Additionally, there are few research studies about parents’ mathematical identities and how they relate to the mathematical identities of their children through co-design approaches. For these reasons, this study is vital for the fields of learning sciences, family engagement, early childhood, and the emergent field of family math.

### **Review of Findings**

The study embarked on an inquiry about what happens when Latine families engage with co-design approaches to design and create a math activity for their young children. The intent of this study was to provide an in-depth analysis of how Latine families experienced three co-design sessions, engaged with generative design activities, and created a mathematics artifact. This study was guided by the following research questions:

1. How do Latine families create math learning experiences for their children?
2. What perceptions do Latine families hold of math co-design approaches?

Eleven themes were discovered in response to the two research questions (Table 20). Three of the themes appeared in the interview questions data and the co-design workshop data: traditional education virtues, familismo, and interest-driven learning.

**Table 20**

*Themes and Subthemes in Participating Latine Families' Interviews and Co-design Workshops*

No.	Themes	Subthemes
1	Traditional education virtues	Values
2	Familismo	Traditions
3	Role of language	Funds of knowledge
4	Ecological environment	
5	Views on knowledge	
6	Interest-driven learning	
7	Identity formation related to (math) learning	
8	Teamwork and collaboration	
9	Sense-making	
10	Intrapersonal openness	
11	Conscientiousness	

Six major findings from the study are: (1) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves, (2) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues, (3) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences, (4) Latina mothers engage in "direct numeracy" and "indirect numeracy" environments (Hart et al., 2016), (5) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and (6) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.

These findings suggest that co-design approaches to family engagement interventions are more dynamic and supportive of families. This study defines the concept of family learning as something that results from co-design approaches so that organizations, institutions, practitioners, and educators can achieve sustainable family engagement practices and thus create social action and change. However, in order for family engagement interventions to adopt co-design approaches, the creation of a participatory design culture, where co-design approaches are placed at the center and can bloom, is required.

Organizations, institutions, practitioners, and educators can cultivate, encourage, and foster co-design approaches by learning how to counter the dominant narratives about family learning affinity and ability. We need to move beyond just engaging families: we need to understand how families learn and help them to uncover that learning. This is possible through co-design approaches, where family learning can bloom and flourish. Ultimately, findings from this study highlight the importance co-design approaches as tools to help situate math more broadly for families within their contexts. Findings from this study confirm that a co-design approach could be an essential component for families to develop self-efficacy and distributed cognition, and thereby develop an adult learner identity.

### **Study Conclusions**

The following section delves further into the five major conclusions of this study to examine the relationship among Latine families' funds of knowledge, learning, and math experiences. Conclusions from this study are based on the perspectives revealed by participants during the semi-structured interviews and co-design workshops. Analysis of the data allowed the researcher to draw the following four conclusions:

- 1) Operationalization of funds of knowledge needs to be more concrete.
- 2) Latine families have very personal histories and experiences with mathematics.
- 3) Co-design is equitable, participatory, social, and promotes learning.
- 4) Parents want to learn as individuals alongside their children.

### ***Operationalization of Funds of Knowledge Needs to Be More Concrete***

Operationalization of funds of knowledge is in relation to the themes of traditional education virtues, familismo, and interest-driven learning (Table 21). The key finding in relation to this conclusion is Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves. Families, especially disenfranchised Latine families, are complex. Funds of knowledge offer an alternative to understanding family engagement practices that is in opposition to the prevalent deficit discourse. This study identified participants' funds of knowledge as a resource to design decolonized co-design tools and resources. This operationalization of funds of knowledge demonstrates how the principles of interest-driven learning functioned as resource for participants to recognize the funds of knowledge that they possessed (Ito et al., 2013). This is important to highlight because the literature tells us that families have significant funds of knowledge and that teachers should be integrating them via the curriculum or family–teacher events, but a key question is whether families are aware that they have funds of knowledge, and, if not, can family engagement interventions then be considered a process that can be used to help families discover their funds of knowledge?

**Table 21**

*Semi-structured interview Themes and Findings in Relation to Conclusion 1*

<b>Themes</b>	<b>Subthemes</b>	<b>Findings</b>	<b>Conclusion (1)</b>
Traditional education virtues	Values and Traditions	(1) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves.	Operationalization of funds of knowledge needs to be more concrete.
Familismo		(2) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues.	
Interest-driven learning	Funds of knowledge		
Role of Language			

Providing positive narratives of how funds of knowledge represent the accumulated cultural knowledge of Latine families and how they support skill and learning strategy acquisitions in child development is important (González, 1995; Moll & González, 1996). However, positive narratives alone are insufficient to bridge the distance between understanding and practice, something this study suggest. In fact, in their most recent study, Ramos and Kiyama (2021) provided a timeline of the last two decades' worth of literature on funds of knowledge, arguing for the expansion of our current theoretical understanding of it. More specifically, they alluded to the idea of operationalizing funds of knowledge by noting:

Nonetheless, this collection of work lacks specificity in collectively naming core components of [funds of knowledge] such as structural barriers, systems of inequality, community dynamics, relationships, and strategies that push communities to activate and mobilize their [funds of knowledge]. (Ramos & Kiyama, 2021, p. 438)

This study “activated” and “mobilized” funds of knowledge through a socially mediated process to help Latina mothers engage in practical mathematics learning experiences (co-design workshops) through direct connections within their ways of knowing (Anzaldúa, 1999; Villenas et al., 2006). The operationalization of funds of knowledge, through the researcher mediation of co-design tools and resources, required Latina mothers to navigate distributed contexts and relationships, which in turn allowed them to nurture dispositions as self-guided adult learners. This study “emphasize[d] community power to transform and recontextualize their [funds of knowledge] into empowering tools [co-design workshop generative activities] for successfully navigating inequitable contexts” (Ramos & Kiyama, 2021, p. 438) to design and prototype a mathematics activity for their young children.

### ***Latine Families Have Very Personal Histories and Experiences with Mathematics***

Latine families have very personal histories and experiences with mathematics is in relation to the themes of views on knowledge, ecological environment, and identity formation

related to (math) learning (Table 22). The key findings in relation to this conclusion (1) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences; and (2) Latina mothers engage in "direct numeracy" and "indirect numeracy" environments (Hart et al., 2016). The data gathered from this study clearly indicate that participants had strong negative math learning experiences—feelings that were deep-seated and that were formed over many years from assumptions, discrimination, oppression, and ecological challenges. The findings indicated that, because of their deep-seated beliefs about their own low levels of math competence and capability, participants chose to prioritize literacy and reading (which also has other implications for what it means to learn English for Latine families); however, it is worth noting that the families viewed their children with more of a mastery orientation toward learning math even if they themselves did not engage in mathematics experiences with their children.

**Table 22**

*Semi-structured interview Themes and Findings in Relation to Conclusion 2*

<b>Themes</b>	<b>Findings</b>	<b>Conclusion (2)</b>
Views on knowledge		
Ecological environment	(3) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences.	Latine Families Have Very Personal Histories and Experiences with Mathematics.
Identity formation related to (math) learning	(4) Latina mothers engage in "direct numeracy" and "indirect numeracy" environments (Hart et al., 2016).	

As mentioned in Chapter 5, this finding is critical because, although past and current research has studied math anxiety and math identities in children and adults (Beilock et al., 2010; Justicia-Galiano et al., 2017), this finding is different from the findings in previous literature, in the sense that it invites us to look more at how Latine people experience math from



a knowledge, skills, and attitudes perspective, and these represent learning domains. This means that Latine individuals clearly have strong negative experiences that have controlled their behavior for a sufficiently long time to develop a characteristic belief about being unable to learn/“Yo no tuve el aprendizaje de poder razonar bien.” Findings from this study suggest that there are benefits for looking at the ways in which Latina mothers feel they can develop learning and efficacy to do math. Much work needs to be done to unseat negative characterizations of math learning in families, especially in Latine families. While the co-design approach is not one-size-fits-all, this study has demonstrated that it helped Latina mothers to make sense of their own math learning to develop cognition and self-efficacy.

### ***Co-design Is Equitable, Participatory, Social, and Promotes Learning***

**Table 23**

*Co-design Workshop Themes and Findings in Relation to Conclusion 3*

<b>Theme</b>	<b>Findings</b>	<b>Conclusion 3</b>
Teamwork and collaboration	(5) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge.	Co-design Is Equitable, Participatory, Social, and Promotes Learning.
Sense-making		
Interpersonal openness		
Conscientiousness		

Co-design Is equitable, participatory, social, and promotes learning is in relation to the themes of teamwork and collaboration, sense-making, interpersonal openness, and conscientiousness (Table 23). The key finding in relation to this conclusion is participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge. A lot has been written about the need for family engagement programs to be holistic, supportive of families and children, and presented within a system that understands a family’s relationships, community,

and culture (Mapp & Bergman, 2019). This has always been a complicated task to execute for many organizations, institutions, practitioners, and educators. One obvious reason for the difficulty is that families are different and complex, but more than that, many family engagement programs are set up as banking models, providing mostly disseminations of information and not actually equipping families with the skills, knowledge, and tools they need to engage in formal and informal educational settings with their children.

This study found that the co-design approach is a possible alternative to standard family engagement interventions because it helps to extend families' and young children's interests and cultural practices, and thus transforms learning by building on families' strengths and assets. Indeed, this study built on existing evidence of co-design approaches as tools for centering participants' knowledge and experience in service design (Locock et al., 2014), something that has been documented in design methodologies and the medical field. This study's findings suggest that co-design approaches can create an equitable, social, and participatory learning experience that Latina mothers can use to develop an adult learning identity. Latina mothers developed a shared understanding of their cognition and self-efficacy to understand mathematics content and design and create a math activity.

Latina mothers never felt their role was limited by the scope of their math-specific knowledge. All participants reflected on how the co-design generative activities provided a space to hear and learn from one another's experiences, where their interest-driven knowledge was considered valuable to the decision-making of their own math activity. Co-design workshops allowed participants to learn through experience—their histories, culture, interests, and the co-design workshop experience itself. Co-design workshops facilitated learning by building on Latina mothers' ways of knowing, mediating interest-driven topics, and stimulating cognitive and self-efficacy autonomy. Although the researcher did not measure self-efficacy in this study, it was evident that Latina mothers translated their cultural self-efficacy into adult learning self-efficacy to design and create a math activity for their children. Co-design

approaches provided a space for families to believe they were able to design and create a math activity. We know that past/actual performance affects self-efficacy (Bandura, 1977, 1997), which was evident in the participants' interview data retelling their negative past experiences of and performance in math.

This study's co-design approaches provided Latina mothers with meaningful choices that they could use (based on their interests), materials they could use (e.g., papelería/cultural probes boxes), strategies they could implement (e.g., some of the participants wrote a lesson plan to help them brainstorm the creating of their math activity), and interactions with other participants, allowing them to collaborate. Counting all of these things, participants developed a self-efficacy belief that they could complete the task at hand: creating a math activity for their children. All Latina mothers demonstrated skills in the learning process, and the end result (creating and implementing the math activity with their children at home) proved that participants could construct their own skills and knowledge as adult learners. Because the construct of self-efficacy was not measured in this study, there is an opportunity to build on this research by conducting similar studies to measure how math self-efficacy develops through co-design approaches.

### **Parents Want to Learn as Individuals and Along with Their Children**

**Table 24**

*Co-design Workshop Themes and Findings in Relation to Conclusion 4*

<b>Theme</b>	<b>Findings</b>	<b>Conclusion 4</b>
Teamwork and collaboration		
Sense-making	(6) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.	Parents Want to Learn as Individuals and Along with Their Children
Interpersonal openness		
Conscientiousness		

Parents want to learn as individuals and along with their children is in relation to the themes of teamwork and collaboration, sense-making, interpersonal openness, and conscientiousness (Table 24). The key finding in relation to this conclusion is co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice. One of the most salient findings from this study was the reflections of Latina mothers about wanting to be part of workshops where they were meant to be the learner, so that they could learn along with their children. Co-design approaches open a new pathway for adult learning (andragogy). Andragogy theory focuses on how adults learn (Knowles et al., 2015) and the andragogy model views the learner as a co-developer in the various steps of the learning process. The present study suggests that co-design approaches facilitated the mediation of Latina mothers as adult learners, where the researcher (facilitator) created a learning environment that prioritized the participants' roles in identifying their own needs. In fact, the researcher (facilitator) and the learners (participants) formed a partnership that allowed them to assess the needs (i.e., interest-driven funds of knowledge), identify objectives in line with these needs (i.e., design of the co-design workshops), design the learning to accomplish these objectives (i.e., co-design generative activities), and assess the success of the learning (i.e., participants' co-creation and implementation of their math activity with their children).

In this study, co-design approaches centered families as adult learners, seizing power over their own learning. This was a critical finding because, as mentioned in Chapter 5, family program interventions tend to be banking models and thus a form of transactional partnership where organizations, institutions, practitioners, and educators transmit information and the recipient is expected to execute it. This co-design approach allowed both researcher (facilitator) and participants to form a relationship; the more active the learner's role, the more meaningful the learning would be, and the more families would remember how to replicate it at home with their children. This study's findings suggest that when co-design workshops build participants'

“previous experiences into the learning process, this process can [lead to] real-life applications in which adult learners acquire knowledge,” meta-learning skills, and strategies (Beltran-Grimm, 2019), and, thus, this constellation of knowledge, skills, and abilities can help parents to serve as role models to their children.

### **Reframing Family Engagement to Family Learning**

This study drew from sociocultural learning theories—it valued learning that is embedded within meaningful learning experiences and supportive relationships (Ito et al., 2013). This study recognized that there are diverse learning pathways and forms of knowledge and expertise, especially when it comes to Latine families. Family engagement interventions can be created and re-created in new ways to reconceptualize family engagement in family learning. This has the potential to build new communities and reframe family engagement interventions: family engagement cannot be prescriptive because families are ever-evolving and changing based on their contexts. Thus, family learning is an interactive, contextualized process that engages the adult, scaffolds learning for the child, and is connected to an evolving ecosystem of generative social contexts, home practices, and community settings in the lived-in world.

In a previous blog (Beltran-Grimm, 2019), I began to muse about the idea of family learning. Next are some of the key points that this study affirmed and re-emphasized. This study’s findings suggest that family learning could be a central focus of family engagement—after all, families are always learning, even if they do not fully engage with programs, interventions, sessions, meetings, etc., as this study proved.

- Families must have experiences that will allow the behavioral changes and outcomes they desire. How are the families experiencing math learning themselves? How do they see math in their respective cultures?
- Families must gain satisfaction (motivation) from the desired learning. PowerPoint presentations work for the dissemination of information, but workshops should be

designed around playful learning experiences, where math or science is fun and interactive.

- Reactions to the experience desired should be within the range of capability of the family/adult. No family should be made to feel incompetent. Science, technology, engineering and mathematics (STEM) subjects are complex and families already have funds of knowledge that can help them to understand science and math.
- Many experiences can be used to obtain the same objective. Families should not be given only one option. Let them play and explore like children.
- The same experience can bring out different outcomes. Families/adults might not share the same experience at the end of the workshop, but that doesn't mean they are not taking something with them; moreover, families might be learning through peripheral participation (Beltran-Grimm, 2019).

### **Limitations**

One of the major limitations of this study is the lack of a quantitative data for mathematics learning, specifically math self-efficacy measurement. Although the research found that participants developed math self-efficacy through the coding and analysis of the qualitative data, adding a math self-efficacy instrument would have augmented the validity and reliability of the study. Additionally, the field of early childhood mathematics education looks to studies to make significant changes in pedagogical practices relating to teaching, learning, and assessment, but it is important to note that this study contributes to the emerging field of "family math." In a family math review brief, Eason et al. (2020) suggested that researchers focus on a research agenda that recognizes sociocultural learning in how families engage with math and recommended that researchers focus on "particular communities or cultural contexts to develop asset-based models of family engagement and ensure that comparative studies do not frame differences a deficit" (p. 24), which is what this study sought to do.

Another limitation of this study is that the sample size is relatively small. This study cannot claim generalization of findings to other Latine families or another community outside its immediate context; however, the study's purpose was not to find generalizable results in mathematical thinking, but to discover the meaning of behavior or culture-sharing interactions among Latine families in co-design workshops to understand how learning works and how to design learning environments that support family math learning. Themes, conclusions, and recommendations revealed through this study might prove of interest and could be of use for the emerging field of family math and for organizations, institutions, practitioners, and educators looking at a similar change in how family engagement interventions are designed and implemented.

### **Recommendations for Future Research**

This research study serves as a starting point for the use of co-design approaches for family learning and engagement. All participants offered great feedback about their experience in the co-design workshops and would like to join similar workshops in the future. There is something powerful about providing a space for participants to own their learning process and offering bidirectional relationships between participants and the facilitator. The aim of centering participants as experts from their communities (i.e., using interest-driven funds of knowledge) is to leverage their knowledge to produce innovative ideas to address family engagement challenges. However, co-design workshops can be costly, time-consuming, and ineffective if the facilitator is not appropriately trained or does not understand the community the co-design workshops targets. Additionally, further research on how to evaluate the impact of co-design approaches is equally or even more important.

As this study suggests, families would benefit from learning about the rationale behind the approach to mathematics learning and to center them as adult learners, too. This study revealed several potential topics for further investigation, such as how can we better understand families' personal learning histories with math to uncover how to design and redesign family

engagement interventions in ways that improve their effectiveness. The participants' narratives helped the researcher to understand how families experience the co-design approach and develop a family learning identity to support math at home. Moving forward, there is a great need to uncover histories, cultures, and funds of knowledge and determine how to translate them from research into practice; this is a vital step for moving family engagement interventions forward and reframing family engagement as family learning, where the adult is centered as the learner, and equipping them with the information, resources, and skills they need to support their children at home.

The researcher recommends:

- Further study be done with families, communities, practitioners, and educators in different contexts within the field of family engagement and to measure the impact of co-design approaches on a larger sample of families.
- Co-design approaches should be simple but rigorous in practice. Co-design approaches seem to be ideal for developing a systems approach that might change how family engagement interventions are designed and implemented, but it requires rigor in the terms of the creation of co-design instruments and activities. Co-design approaches also support the concepts of learning, which should be considered when designing family engagement interventions. Families are not just *banking* systems of information; they are active learners, as this study suggests.
- A final recommendation for future research is to create a facilitator guide to train other family engagement practitioners interested in implementing co-design approaches.

Findings from this study suggest that co-design approaches (a) facilitate learning, (b) offer methods and tools that enable participants to understand how to design and create a math activity, and (c) challenge disempowering beliefs and assumptions. It would be interesting to research the relationship between co-design approaches and learning. How are participants able to frame and reframe experiential and transformational learning to design and create a



math activity for their children? The recognition of learning within co-design approaches and the significance of the process over the outcome is critical and needs further research to understand how families become adult learners to support their children's learning.

### **Summary**

This interpretive phenomenology research study was designed and explored the lived experiences of Latina mothers to uncover Latine families' cultural repertoires and learning experiences to understand their engagement in co-design workshops to create a math activity for their 3-5 years old children. Participants illuminated the ways in which Latina mothers understand their funds of knowledge to explore constructions of math learning.

This research study revealed key findings that serve as an important reminder for family engagement and practice: (1) Latina mothers have cultural forms of knowing that impact the educational experiences of their children and themselves, (2) Latina mothers emphasize the importance of socioemotional learning and literacy over mathematics because of sociocultural issues, (3) Latina mothers' mathematics experiences affect their mathematics beliefs and attitudes and their engagement with math experiences, (4) Latina mothers engage in "direct numeracy" and "indirect numeracy" environments (Hart et al., 2016), (5) Participatory research design (co-design workshops) prompts Latina mothers to engage in processes that stimulate their mathematics self-efficacy and social cognitive knowledge, and (6) Co-design methodologies have the potential to create new pathways for family learning in the 21st century to reframe family engagement practice.

Enhancing the opportunities for children to succeed in life will provide children with long-term benefits. This is especially true for Latino children. Young Latino children remained a disadvantaged group facing several educational disparities. Narratives of family engagement must include Latine families drawing connections from their historicity to their everyday experiences or funds of knowledge. This research counters the dominant narratives about learning affinity and ability—co-design approaches can be a relevant practice and pedagogy to

support children and families. And offers an alternative to understanding family engagement practices that is oppositional to the prevalent deficit discourse.

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## APPENDIX A

## Interview Protocol – English

Interviewer:

Interviewee(s):

My name is Susana Beltran, and I will be conducting this interview.

I am hoping to learn about the kinds of things families like yours do together at home so that we can try to design activities that reflect your family's interests and fit into your routines. Thank you for agreeing to speak with me. This interview should take approximately 30-45 minutes. If it is ok with you, I would like to tape-record us, so I don't have to worry about catching every detail in my notes.

I want to let you know that there are no right or wrong answers. I am trying to understand better how you and your child(ren) interact together at home. Before I start, did you bring your consent letter? If not, I have some here for you. (copies distributed). Do you have any questions? If there are no further questions, let's get started with some demographic questions.

Name:

What is your caregiver role:

Date of birth:

Place of birth:

Nationality/Country of origin:

Language you prefer to use at home?

What is your highest level of education?

How do you identified: Hispanic, Latine, Latina, Latinx or other?

### Warm-up Questions

1. Please tell me about your family background. How did you and your family come to live in Sea City/Metro City? How long have you lived here?
2. How is your family life in Sea City/Metro City regarding culture, values, and traditions; especially when raising your child(ren)? Please tell me more.
3. Please tell me about your community. How do you interact with others in your community?

### Parent Engagement Questions

1. What does a day in your life at home look like? Please tell me more.
2. What is most important when raising your child(ren)? Please tell me more.
3. How are you involved or engage in your child's learning at home?

### Funds of Knowledge and Math

1. Tell me about your experiences with math?

- a. Did you enjoy math in school?  
**PROMPT:** Why or why not?
  - b. How was it learning math at home?
  - c. How do your views on raising your child(ren) influence how you teach math at home to your child(ren)?
2. Was math something that you experienced at home or outside of school? For example, were there crafts, making, or fixing activities at home?
    - a. How is math shared through interactions in daily home routines?
  3. Did you or other family members have special or unique crafts or hobbies when you were growing up?
    - a. If yes, have you continued these with your child(ren)?
    - b. What materials in your home potential can help you teach math to your child(ren)?
  4. Do any of your cultural practices, traditions, or values influence how you teach your child(ren) at home, especially for math?
    - a. How do you incorporate your child's interest in home activities?

### Family Activities at Home

1. What kind of things do you and your child(ren) like to do together at home or in the community?  
**PROMPT:** For example, are there games? Chores?  
Regular activities like church Sundays
2. What kinds of things do you and your child(ren) do together that get your child(ren) talking a lot, asking questions, or excited?  
**PROMPT:** for example, is it playing or exploring outside, making things, chores, or?  
**PROMPT:** Tell me more ... How do you know? What do they do or say?
  - a. When you are doing these things, what are you doing and what are they doing? (Do you play a different role, or are you doing the same things as your child(ren)?)
3. Are there things you like to do individually at home that you would like to involve your child(ren) in more?  
**PROMPT:** Do you have a hobby or craft, or just really like to do something a lot?
4. Do you have anything you would like to add that we didn't get a chance to talk about?
5. Do you have any questions for me?

## APPENDIX B

## Mini Follow-Up Survey After Co-Design Workshops - English

I want to thank you for participating in the co-design workshop today. I hope you enjoyed your time on how to support your children's learning at home. After this workshop I would like you to reflect on what you experienced. Please answer the following questions with as best you can.

Question 1: What do you remember from the workshop?

Question 2: How did the workshop change your view of teaching math at home?

Question 3: What was most memorable about the workshop?

## APPENDIX C

## Informed Consent Form - English

**IRB Number #:** 21-02-1527

**Study Title:**

*LATINO FAMILY MATH ENGAGEMENT:  
A PHENOMENOLOGICAL STUDY OF CO-DESIGN APPROACHES*

**Invitation**

Dear [name],

My name is Susana Beltran. I am a doctoral student in the Graduate School of Education and Psychology at Pepperdine University, under the supervision of Dr. Reyna Garcia-Ramos at Pepperdine University. If you are between 18 and 60 years of age, and identify as Latino (Mexican, Mexican American, Mexican immigrants, and other South American communities), speak Spanish or bilingual speaker, and want to support your child(ren) 's early mathematics learning and live in Santa Ana, CA, you may participate in this research.

**What is the reason for doing this research study?**

The study's purpose is to share how your family's culture, history, and background influence how you share knowledge with your child(ren) and how that knowledge relates to math skills. You should read the information below and ask questions about anything you do not understand before deciding whether to participate. If you choose to participate, you will be asked to sign this form and given a copy for your records.

**What will be done during this research study?**

You will be asked to participate in interview sessions and time with the researcher in the form of workshops. Interview sessions will take place in April 2021. Workshops will take place in May 2021. Please note that the schedule is subject to change due to COVID19 circumstances. There will be one interview session for about 45 to 60 minutes per parent. The interview sessions and workshops will be audio recorded or recorded via remote technologies (Zoom) so that the researcher can review and reflect on the recorded activities. The researcher will also request self-recorded videos or photos. Participating in the interviews, workshops and spending time doing the activity at home with your child(ren) is projected to take about 10 – 14 hours.

**What are the possible risks of being in this research study?**

Participants may also experience boredom and fatigue. Participants may also experience harm if a breach of confidentiality occurs. To minimize the risk of a breach of confidentiality or identification, all data collected will be de-identified. Any identifiable information obtained in connection with this study will remain confidential. When the results of this project are presented, the names of the participants in the study will not be revealed. Participants will be assigned pseudonyms to maintain confidentiality.

**What are the possible benefits to you?**

Participants do not directly benefit from this study, though the findings may provide some societal benefits. For example, participants may understand more effective ways to engage at home with their children around math learning. Participants may share information with other

parents. They may gain knowledge or awareness of at-home early learning practices, receive educational materials and supplies.

Furthermore, the evidence gathered in this study adds to the body of knowledge regarding Latino family engagement, family math, and STEM family engagement research and practice approaches. The evidence gathered in this study may assist family engagement practitioners and family engagement program developers in understanding how Latino families engage in at-home early learning with their children.

Additionally, by distributing this study's findings with community members, academics, educators, and school districts, the researcher will communicate the potential of tapping into Latino families' specific and unique needs in diverse and low-income communities to support their child's education.

### **How will information about you be protected?**

I will keep your records for this study confidential as far as permitted by law. However, if I am required to do so by law, I may be required to disclose information collected about you. Pepperdine's University's Human Subjects Protection Program (HSPP) may also access the data collected. The data will be stored on a password-protected computer in the principal investigator's place of residence for a minimum of three years. Your responses will be coded with a pseudonym, and transcript data will be maintained separately.

### **What are your rights as a research subject?**

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study.

For study related questions, please contact the investigator(s):

Susana Beltran at [Susana.beltran@pepperdine.edu](mailto:Susana.beltran@pepperdine.edu)  
Dr. Reyna Garcia-Ramos at [reyna.g.ramos@pepperdine.edu](mailto:reyna.g.ramos@pepperdine.edu)

For questions concerning your rights or complaints about the research, contact the Institutional Review Board (IRB):

- Phone: 1(310)568-2305
- Email: [gpsirb@pepperdine.edu](mailto:gpsirb@pepperdine.edu)

### **What will happen if you decide not to be in this research study or decide to stop participating once you start?**

You can decide not to be in this research study, or you can stop being in this research study ("withdraw") at any time before, during, or after the research begins for any reason. Deciding not to be in this research study or choosing to withdraw will not affect your relationship with the investigator or Pepperdine University (list others as applicable). You will not lose any benefits to which you are entitled.

You are voluntarily making a decision whether or not to participate in this research study. I have read the information provided above. I have been given a chance to ask questions. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

### **Documentation of Informed Consent**

You are voluntarily making a decision whether or not to participate in this research study. By replying back to this email or signing the form and email it back to the researcher, your consent to participate is implied. You should print a copy of this page for your records.

---

Name of Person Obtaining Consent

---

Signature of Person Obtaining Consent

---

Date

**AUDIO/VIDEO/PHOTOGRAPHS**

- I agree to be audio/video-recorded /photographed*
- I do not want to be audio/video-recorded /photographed*

---

Name of Person Obtaining Consent

---

Signature of Person Obtaining Consent

---

Date



## APPENDIX D

## Informed Consent Form - Spanish

**Numero de IRB #:** 21-02-1527

**Estudio de investigación:**

*CO-CREACIÓN DE UNA ACTIVIDAD MATEMÁTICA CON SUS HIJOS: UN ESTUDIO DE CARÁCTER FENOMENOLÓGICO DE LAS FAMILIAS LATINAS*

Invitación

Estimado [nombre]

Mi nombre es Susana Beltran, estudiante de doctorado de la Facultad de Postgrados de Educación y Psicología de la Universidad Pepperdine, supervisada por la Dra. Reyna Garcia-Ramos de la Universidad Pepperdine. El propósito del estudio es compartir cómo la cultura, la historia y los antecedentes de su familia influyen en cómo usted comparte el conocimiento con su(s) hijo(s) y cómo ese conocimiento se relaciona con las habilidades matemáticas. Para poder participar debes tener entre 18 y 60 años de edad o más. Para poder participar debes tener entre 18 y 60 años de edad o más. Además usted se identificó como padre latino de la organización X con hijos en edades comprendidas entre los 2 y 5 años, es bilingüe o habla español, y su hijo se encuentra en preescolar, en el **programa** Head-Start, o de madurez para la escolaridad. Su participación es voluntaria. Lea la información a continuación y realice las preguntas que tenga antes de decidir si participar o no. Si decide participar, se le pedirá que firme este formulario y recibirá una copia para sus registros.

Se le pedirá que participe en entrevistas y que dedique tiempo con el investigador para participar en talleres. Las entrevistas se harán en marzo del 2021. Los talleres en abril y mayo del 2021. Por favor, comprenda que el programa está sujeto a cambios debido a las circunstancias por COVID-19. Se realizará una entrevista con el padre que durará entre 30 y 45 minutos. Las entrevistas y los talleres serán grabados en audio o mediante tecnologías remotas (Zoom o Skype) para que el investigador pueda evaluar posteriormente las actividades. El investigador también le solicitará videos o fotos tomado por usted mismo. La participación en las entrevistas, los talleres y las actividades que deba realizar en casa con su(s) hijo(s) tiene una duración aproximada de 10 a 12 horas.

**Posibles riesgos e incomodidades**

Los participantes también pueden experimentar aburrimiento y fatiga. Los participantes también pueden sufrir daños si se produce una violación de la confidencialidad o una violación de la identificación. Para minimizar el riesgo de una violación de la confidencialidad o la identificación, se desidentificarán todos los datos recopilados. Toda información identificable obtenida en relación con este estudio seguirá siendo confidencial. Cuando se presenten los resultados de este proyecto, no se revelarán los nombres de los participantes en el estudio.

**Posibles beneficios para los participantes y/o la sociedad**

Los participantes no se benefician directamente de este estudio, aunque los hallazgos pueden proporcionar algunos beneficios sociales. Por ejemplo, los participantes pueden entender maneras más efectivas de interactuar en casa con sus hijos en torno al aprendizaje de matemáticas. Los participantes pueden compartir información con otros padres. Pueden adquirir conocimientos o concienciar sobre experiencias de aprendizaje temprano en el hogar, recibir materiales y suministros educativos.

Además, la evidencia reunida en este estudio se suma al cuerpo de conocimiento sobre el compromiso familiar latino, las matemáticas familiares y los enfoques de investigación y práctica de compromiso familiar STEM. La evidencia reunida en este estudio puede ayudar a los profesionales de la participación familiar y a los desarrolladores de programas de compromiso familiar a entender cómo las familias latinas se involucran en el aprendizaje temprano en casa con sus hijos.

Además, al distribuir los hallazgos de este estudio con miembros de la comunidad, académicos, educadores y distritos escolares, el investigador comunicará el potencial de aprovechar las necesidades específicas y únicas de las familias latinas en comunidades diversas y de bajos ingresos para apoyar la educación de sus hijos.

### **¿Cómo se protegerá la información sobre usted?**

Conservaré los registros de los participantes de forma confidencial y hasta donde lo permita la ley. Sin embargo, si por ley me lo exigen, podría tener que divulgar la información recogida. El Programa de Protección del Individuo (HSPP por sus siglas en inglés) de la Universidad Pepperdine también podría acceder a los datos recogidos. La información será almacenada en una computadora protegida con contraseña en la residencia del investigador principal durante al menos tres años. Sus respuestas será codificadas con un pseudónimo y se conservarán los datos de transcripción en un lugar aparte.

### **¿Cuáles son sus derechos como sujeto de investigación?**

puede hacer cualquier pregunta relacionada con esta investigación y responder a esas preguntas antes de aceptar participar en el estudio o durante el mismo. Para preguntas relacionadas con el estudio, póngase en contacto con el investigador(es):

Susana Beltran en [Susana.beltran-pepperdine.edu](mailto:Susana.beltran-pepperdine.edu)  
la Dra. Reyna Garcia-Ramos en [reyna.g.ramos-pepperdine.edu](mailto:reyna.g.ramos-pepperdine.edu)

Para preguntas sobre sus derechos o quejas sobre la investigación, comuníquese con la Junta de Revisión Institucional (IRB):

- Teléfono: 1(310)568-2305
- Correo electrónico: [gpsirb-pepperdine.edu](mailto:gpsirb-pepperdine.edu)

### **¿Qué pasará si decide no participar en este estudio de investigación o dejar de participar una vez que empiece?**

puede decidir no estar en este estudio de investigación, o puede dejar de estar en este estudio de investigación ("retirar") en cualquier momento antes, durante o después de que la investigación comience por cualquier razón. Decidir no estar en este estudio de investigación o decidir retirarse no afectará su relación con el investigador o con la Universidad de Pepperdine (enumerar otros como corresponda). Usted no perderá ningún beneficio al que tenga derecho.

Este está tomando voluntariamente la decisión de participar o no en este estudio de investigación.

He leído la información proporcionada anteriormente. Me han dado la oportunidad de hacer preguntas. Mis preguntas han sido respondidas a mi satisfacción, y acepto participar en este estudio. Me han dado una copia de este formulario.

**Documentación de consentimiento informado**

Este está tomando voluntariamente una decisión de participar o no en este estudio de investigación. Al responder a este correo electrónico o firmar el formulario y enviarlo por correo electrónico al investigador, su consentimiento para participar está implícito. Debe imprimir una copia de esta página para sus registros.

---

Nombre de la Persona que recibe el Consentimiento

---

Firma de la Persona que recibe el Consentimiento

---

Fecha

## APPENDIX E

## Invitation Letter to Organization

Dear [Name],

My name is Susana Beltran and I am a doctoral student at Pepperdine University in the Doctor of Education in Learning Technologies in the graduate school of education and psychology, under the supervision of Dr. Reyna Ramos-Garcia, faculty at the graduate school of education and psychology at Pepperdine University.

I am conducting a research study examining how Latino families share early math skills and knowledge by engaging in co-design workshops and you are invited to participate in the study. If you agree, you are invited to participate in I would like to meet and interview you for about 30 to 45 minutes. During the interview, I would like to learn more about the kinds of things families like yours do together at home so that we can try to design activities that reflect your family's interests and fit into your routines.

After the interviews, I would like you to participate in three workshops. This part of the study is called participatory research and involves implementing knowledge from your home into an activity you would like to create for your child(ren)'s math learning. During this time, you will be asked to engage in designing and prototyping at-home activities that you can take home and implement with your child(ren). You will receive a \$100 visa gift card for your time plus the opportunity to keep all the materials to continue to engage at home with your child(ren).

The interview, workshops and mini follow up survey is anticipated to take no more than 1- to 12 hours. Participation in this study is voluntary. Your identity as a participant will remain confidential during and after the study. I will keep participant records for this study confidential as far as permitted by law. However, if I am required to do so by law, I may be required to disclose the information collected. Pepperdine's University's Human Subjects Protection Program (HSPP) may also access the data collected. The data will be stored on a password-protected computer in the principal investigator's place of residence for a minimum of three years. This study will also be shared with my dissertation committee and other appropriate members of Pepperdine University. In addition, it may be published in a university document or professional journal. Any identifying information or description will be removed from the document.

If you have questions or would like to participate, please contact me at [Susana.Beltran@pepperdine.edu](mailto:Susana.Beltran@pepperdine.edu) and at.

Thank you for your participation,

Susana Beltran  
Pepperdine University  
Graduate School of Education and Psychology  
Doctoral Candidate

## APPENDIX F

Recruitment Flyer - English



## Recruitment Flyer

**Seeking Parents (biological, adoptive, step, or foster) with child(ren) between the ages 2 to 5 and who identify as Latino (Mexican, Mexican American, Mexican immigrants, and other South American communities), are Spanish/bilingual speakers and would like to support their children's early mathematics learning to participate in a Interview sessions, time with the researcher in the form of workshops, and take a brief survey. The interview sessions and workshops will take place via remote technologies (Zoom or (Skype). The study is conducted by Susana Beltran, doctoral student at Pepperdine University and Dr. Reyna Garcia-Ramos, Faculty at Pepperdine University.**

**Participating in the study is projected to take 10 to 12 hour  
You will receive a \$100 visa gift card for your time plus the opportunity to keep all the materials to continue to engage at home with your children.**

## Contact Information:

Please contact Susana Beltran, doctoral student at Pepperdine University at [susana.beltran@pepperdine.edu](mailto:susana.beltran@pepperdine.edu). All correspondence will be kept confidential. Please tear-off the following and return to the X organization or email me at [susana.beltran@pepperdine.edu](mailto:susana.beltran@pepperdine.edu)

***Principal Investigator: Susana Beltran***

I am interested in learning more about participation in this study on Latino family engagement for math learning.

Parent Name: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Child's Name: \_\_\_\_\_

\_\_\_\_\_

Please return this to:

## APPENDIX G

## Recruitment Flyer - Spanish



## Plantilla de volante

Buscamos padres (biológicos, adoptivos, padrastros/madrastras o temporales) que tengan hijos de 2 a 5 años de edad y que se identifiquen como latinos (mexicanos, mexicoamericanos, inmigrantes mexicanos y de otras comunidades de América del Sur), que hablen español o que sean bilingües, y que les gustaría ayudar a sus hijos con el aprendizaje temprano de matemáticas para que participen en entrevistas, talleres y realicen una encuesta breve. Las entrevistas y los talleres se harán de forma remota, a través de Zoom o Skype. Este estudio lo están realizando Susana Beltrán, estudiante de doctorado de Pepperdine University, y la Dra. Reyna García-Ramos, profesora de Pepperdine University.

Se estima que la participación en el estudio tomará de 10 a 12 horas.

Recibirá una tarjeta de regalo de Visa de \$100 y la oportunidad de quedarse con todos los materiales para que los siga utilizando en casa con sus hijos.

## Información de contacto:

Por favor, contacte a Susana Beltrán, estudiante de doctorado de Pepperdine University a través de [susana.beltran@pepperdine.edu](mailto:susana.beltran@pepperdine.edu). Toda la correspondencia será confidencial. Por favor, desprenda esto y devuélvalo a la organización X o envíeme un correo electrónico a [susana.beltran@pepperdine.edu](mailto:susana.beltran@pepperdine.edu)

**Investigadora principal:** Susana Beltrán

Quiero saber más sobre cómo participar en este estudio de participación de familias latinas en el aprendizaje de las matemáticas.

Nombre del padre:

\_\_\_\_\_ Teléfono: \_\_\_\_\_

Nombre del niño:

\_\_\_\_\_

Regrese este panfleto a:

## APPENDIX H

## Follow-up Letter – English

Dear (name of participant),

Thank you for volunteering to participate in this study. Before we proceed to the interview, I would like you to sign the informed consent form so that my school is aware that you are volunteering and not being forced to participate. You can print it, sign it, take a photo, and email it to me for my records. Once you sign it, I will then schedule a date for our interview. In the meantime, please send me your physical address so I can ship the materials that you will need in the workshops.

Please remember that the box will include all materials and a \$25 visa gift card to buy either lunch or dinner for the workshops. At the end of the workshops, you will keep the materials, and you will have another \$75 visa gift card.

Please let me know if you have any questions.

I am incredibly grateful to count on you as a participant.

Susana

## APPENDIX I

## Follow-up Letter – Spanish

Estimado (nombre del participante),

Gracias por ofrecerse como voluntario para participar en este estudio. Antes de proceder a la entrevista, me gustaría que firmara el formulario de consentimiento informado para que mi escuela sepa que usted es voluntario y no se ve obligado a participar. Puede imprimirla, firmarla, tomar una foto y enviarla por correo electrónico para que la registre. Una vez que lo firme, programaré una fecha para nuestra entrevista. Mientras tanto, por favor envíeme su dirección física para poder enviar los materiales que necesitará en los talleres.

Recuerde que la caja incluirá todos los materiales y una tarjeta de regalo de visa de \$25 para comprar el almuerzo o la cena para los talleres. Al final de los talleres, usted se quedará con los materiales y tendrá otra tarjeta de regalo de visa \$75. Por favor, hágame saber si tiene alguna pregunta.

Estoy increíblemente agradecido de contar con usted como participante.

Susana



## APPENDIX J

## Interview Protocol – Spanish

## Protocolo de Entrevista para Padres

Entrevistador:

Entrevistado(s):

Yo soy Susan Beltran y estaré realizando esta entrevista.

Mi objetivo es el de conocer las cosas que las familias como la suya hacen en casa para así poder diseñar actividades a favor de los intereses de su familia y que encajen en sus rutinas. Gracias por aceptar hablar conmigo. Esta entrevista tomará aproximadamente de 30 a 45 minutos. Si usted está de acuerdo, me gustaría grabarnos en cinta para poder capturar todos los detalles y no perderme de algunos al hacer mis anotaciones.

Quiero que sepa que aquí no hay respuestas correctas o incorrectas. Mi objetivo es el de entender mejor **cómo usted y sus hijos interactúan en casa**. Antes de comenzar, ¿trajo con usted su carta de consentimiento? Si no la trajo, aquí tengo una para usted. (Se distribuyen las copias). ¿Tiene alguna pregunta? Si no tiene preguntas, empecemos con algunas preguntas demográficas.

Nombre:

¿Cuál es su función como cuidador?:

Fecha de nacimiento:

Lugar de nacimiento:

Nacionalidad/País de procedencia:

Idioma que prefiere utilizar en casa:

¿Cuál es su nivel de educación?

Usted se identifica como: hispano, latino, latina, latinx u otro:

**Preguntas de preparación**

4. Cuénteme sobre su historia familiar. ¿Cómo usted y su familia vinieron a vivir en Sea City/Metro City? ¿Desde hace cuánto viven aquí?
5. ¿Cómo es su vida familiar en Sea City/Metro City en cuanto a cultura, valores y tradiciones, sobre todo al criar a sus hijos? Cuénteme al respecto.
6. Cuénteme sobre su comunidad. ¿Cómo es su interacción con los demás miembros de su comunidad?

**Preguntas de participación de los padres**

4. ¿Cómo es un día normal en su casa? Cuénteme al respecto.
5. ¿Qué es lo más importante al educar a su(s) hijo(s)? Cuénteme al respecto.
6. ¿Cómo participa o se involucra en el aprendizaje en casa de sus hijos?

## Bases de conocimiento y matemáticas

5. Cuénteme sobre su experiencia con las matemáticas
  - a. ¿Le gustaban las matemáticas en la escuela?  
**PREGUNTA GUÍA:** ¿Por qué o por qué no?
  - b. ¿Cómo fue el aprendizaje de las matemáticas en casa?
  - c. ¿Cómo sus opiniones sobre la crianza de su(s) hijo(s) influyen la manera en la que les enseña las matemáticas en casa?
6. ¿Las matemáticas fueron algo que usted aprendió en casa o fuera de la escuela? Por ejemplo, ¿realizaba oficios, creaciones o actividades de reparación en casa?
  - a. ¿Cómo se transmiten las matemáticas a través de las interacciones diarias en casa?
7. ¿Usted o algún otro miembro de su familia realizaba oficios o pasatiempos particulares cuando era pequeño?
  - a. Si la respuesta es sí, ¿comparte hoy en día dichos oficios o pasatiempos con sus hijos?
  - b. ¿Qué materiales en casa le ayudan a enseñar las matemáticas a su(s) hijo(s)?
8. ¿Sus prácticas, tradiciones o valores culturales influyen la manera en la que enseña a sus hijos en casa, en especial las matemáticas?
  - a. ¿Cómo involucra los intereses de sus hijos en actividades en casa?

## Actividades familiares en casa

6. ¿Qué clase de cosas les gusta realizar a usted y a su(s) hijo(s) juntos en casa o en su comunidad?  
**PREGUNTA GUÍA:** Por ejemplo, ¿juegos, quehaceres? Actividades regulares como ir a la iglesia los domingos.
7. ¿Qué clase de cosas realiza usted con su(s) hijo(s) que haga que hablen bastante, hagan preguntas o se emocionen?  
**PREGUNTA GUÍA:** Por ejemplo, ¿salir a jugar o a explorar, realizar cosas, quehaceres, o...?  
**PREGUNTA GUÍA:** Cuénteme más... ¿Cómo se da cuenta? ¿Qué hacen o qué dicen?
  - a. Cuando se encuentra en esta situación, ¿qué hace usted y qué hacen ellos? (¿usted adopta un papel diferente, o hace lo mismo que su(s) hijo(s)?)
8. ¿Hay cosas que usted disfruta hacer solo en casa y en las que quisiera involucrar más a su(s) hijo(s)?  
**PREGUNTA GUÍA:** ¿tiene algún pasatiempo u oficio, o hay algo que disfrute bastante hacer?
9. ¿Quisiera agregar algo de lo que no hayamos podido hablar?
10. ¿Tiene alguna pregunta?

## APPENDIX K

## Mini Follow-Up Survey After Co-Design Workshops – Spanish

## Mini-encuesta de seguimiento después de los talleres co-diseño

Quiero agradecerle por su participación en el taller co-diseño de hoy. Espero que haya disfrutado su experiencia sobre cómo ayudar en el aprendizaje de su(s) hijo(s) en casa. Después de que finalice este taller, quisiera que me contara su experiencia. Por favor, responda las siguientes preguntas con la mayor claridad posible.

Pregunta 1: ¿Qué recuerda del taller?

Pregunta 2: ¿Cómo cambió este taller su punto de vista sobre la enseñanza de las matemáticas en casa?

Pregunta 3: ¿Qué fue lo más memorable del taller?

APPENDIX L

Approved Letter from Organization A



03/11/21

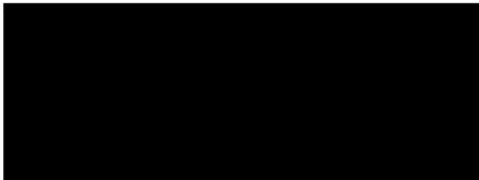
Pepperdine University  
Graduate and Professional Schools Institutional Review Board (GPS IRB)  
6100 Center Drive – 5<sup>th</sup> Floor  
Los Angeles, CA 90045

RE: Susana Beltran. Dr. Reyna Garcia-Ramos.  
LATINO FAMILY MATH ENGAGEMENT:  
A PHENOMENOLOGICAL STUDY OF CO-DESIGN  
APPROACHES

To GPS IRB:

This letter is to convey that I/we have reviewed the proposed research study being conducted by Susana Beltran, doctoral student and her advisors, Dr. Reyna Garcia-Ramos, [REDACTED] [REDACTED] for her research study LATINO FAMILY MATH ENGAGEMENT: A PHENOMENOLOGICAL STUDY OF CO-DESIGN APPROACHES. I found her research study acceptable. I/we give permission for the above investigators to conduct research at this site. [REDACTED]

Sincerely,



APPENDIX M

Approved Letter from Organization B




March 11, 2021

Pepperdine University  
Graduate and Professional Schools Institutional Review Board (GPS  
IRB) 6100 Center Drive – 5<sup>th</sup> Floor  
Los Angeles, CA 90045

RE: Susana Beltran. Dr. Reyna Garcia-Ramos.  
LATINO FAMILY MATH ENGAGEMENT:  
A PHENOMENOLOGICAL STUDY OF CO-DESIGN  
APPROACHES

To GPS IRB:

This letter is to convey that I/we have reviewed the proposed research study being conducted by Susana Beltran, doctoral student and her advisors, Dr. Reyna Garcia-Ramos, intended to recruit subjects at KidWorks in Santa Ana, CA for her research study LATINO FAMILY MATH ENGAGEMENT: A PHENOMENOLOGICAL STUDY OF CO-DESIGN APPROACHES. I found her research study acceptable. I/we give permission for the above investigators to conduct research at this site. If you have any questions regarding site permission, 



Sincerely,



APPENDIX N  
IRB Approval Notice



Pepperdine University  
24255 Pacific Coast Highway  
Malibu, CA 90263  
TEL: 310-506-4000

**NOTICE OF APPROVAL FOR HUMAN RESEARCH**

Date: April 12, 2021

Protocol Investigator Name: Susie Beltran

Protocol #: 21-02-1527

Project Title: LATINO FAMILY MATH ENGAGEMENT: A PHENOMENOLOGICAL STUDY OF CO-DESIGN APPROACHES

School: Graduate School of Education and Psychology

Dear Susie Beltran:

Thank you for submitting your application for exempt review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations 45 CFR 46.101 that govern the protections of human subjects.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Since your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware that changes to your protocol may prevent the research from qualifying for exemption from 45 CFR 46.101 and require submission of a new IRB application or other materials to the IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at [community.pepperdine.edu/irb](http://community.pepperdine.edu/irb).

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

Sincerely,

Judy Ho, Ph.D., IRB Chair

cc: Mrs. Katy Carr, Assistant Provost for Research