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ORIGINAL PAPER

Parents and teachers collaborating to disrupt asymmetrical power positions in mathematics education

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Abstract
This paper describes an innovative mathematics learning partnership that engages teachers and parents of multilingual children ages 7–10 from schools in underserved communities. At the center of this transformative work is the use of two complementary approaches to advancing equity in education– funds of knowledge and positioning theory. While both theories have been applied in mathematics education, they have not been integrated in a parent-teacher partnership program aimed at enhancing collaboration between multilingual families and teachers. We describe how the theories informed key features of our partnership model, including mathematical tasks and lesson planning activities for parents and teachers. Our research questions focused on how parents and teachers learned about each other's experiences and strengths, and disrupted traditional power differentials between them as they participated in these collaborative activities. Our findings are structured around two in-depth cases that illustrate patterns in our analysis, including features of activities that supported collaborative interactions and co-construction of knowledge. We end with implications for future mathematics education focused partnerships between multilingual families and schools.

Keywords Family school partnerships · Multilingual learners · Elementary mathematics education · Equity · Funds of knowledge · Positioning

1 Rationale

While there is widespread agreement that partnerships between families and schools are important (Averill et al., 2016), it is also well documented that in under-resourced communities, these partnerships are often marked by a deficit view of parents and narrow forms of parental participation (Baquedano-López et al., 2013; Barajas-López & Ishimaru, 2020; Hedges et al., 2016). As Ishimaru et al. (2015) note, research on family and school partnerships specific to mathematics is limited, but points to some additional tensions when working with marginalized / immigrant-origin communities. These tensions relate to parents' different forms of mathematical knowledge and practices that are often unrecognized by schools, as well as differences in language (Takeuchi, 2018; Wadham et al., 2022). This lack of recognition is related to valorization of knowledge (Abreu & Cline, 2007) and power differentials between home and school (Ishimaru et al., 2015). For example, a study on parents and teachers co-facilitating mathematics workshops for families documented asymmetrical power relations as teachers took on the role of content experts, relegating parents to workshop logistics (Civil & Bernier, 2006). While acknowledging these tensions, some efforts reflect an asset-based view of parents as partners in mathematics education (Civil & Andrade, 2003; Karsli-Calamak et al., 2022). However, these efforts have not focused on engaging parents and teachers in joint activities to learn from each other's experiences.

The design of our parent and teacher partnership model reflects an asset-based view of parents as authentic contributors to their children's mathematics education. Our model is guided by the premise that when parents and teachers build relationships by engaging in collaborative activities related

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to shared goals (i.e., supporting children's mathematics learning), they have opportunities to learn about one another's strengths and co-construct knowledge. While teacher professional development initiatives increasingly promote asset-based views of families, our model is guided by the understanding that abstract or theory-based discussions of these ideas often fall short (González et al., 2005). Teachers benefit from first-hand opportunities to collaborate with parents and learn about parents' experiences and strengths. For teachers, these interactions can support asset-based views of families and children, which could impact how teachers interact with children in instruction (Volman & 't Guilde, 2021; Williams et al., 2020). For parents, building collaborative relationships with teachers helps them to learn more about school spaces, and to express their perspectives and expectations as knowledgeable partners in their children's mathematics education (Civil et al., 2020). In other words, these interactions have the potential to support a shift in traditional power dynamics between teachers and parents in under-resourced schools. This is critical as parents' voices are important for challenging practices and inequities that limit children's mathematics learning opportunities. In this study, we investigate how parents and teachers learned about one another's experiences and strengths, and disrupted traditional power differentials during the collaborative activities in our partnership model.

2 Theoretical framework

We draw on two complementary theories—funds of knowledge (González et al., 2005) and positioning theory (Van Langenhove & Harré, 1994)—to inform our parent and teacher partnership model. While both theories have been applied in mathematics education, they have not been integrated in the design and study of a parent-teacher partnership program.

2.1 Funds of knowledge in mathematics education

Funds of knowledge refers to families' culturally and historically accumulated knowledge, resources and experiences that are embedded in daily practices and support family well-being (González et al., 2005; Vélez-Ibáñez & Greenberg, 1992). A funds of knowledge approach explicitly contests deficit perspectives of culturally and linguistically diverse students and families. Instead, this approach repositions marginalized students and families through the valorization of community and cultural resources that are often ignored or unrecognized in academic spaces. In the original research on funds of knowledge with Mexican-origin families in the southwestern United States, teachers were invited as researchers to visit students' homes. The goal was to bridge the gap between home and school through the validation of knowledge within households as well as building relationships of *confianza* (mutual trust) (Vélez-Ibáñez & Greenberg, 1992). The extension of this work to mathematics (Civil, 2007) was grounded on the premise that mathematics learning environments must build on students' and families' funds of knowledge and highlighted the need for reciprocal dialogues between parents and teachers. This work led to a model of working with parents and teachers that underscores parents' mathematical resources (Civil & Andrade, 2003). For example, Civil et al. (2020) describe how using contexts that draw on parents' experiences (e.g., adjusting recipes) leads to rich mathematical discussions and sense-making.

The concept of funds of knowledge has been used in studies across the world (Esteban-Guitart, 2024), particularly when working with nondominant communities. The most widespread application centers on teachers learning from their students' communities to then apply this learning to the classroom. For example, in a study with teachers working with ethnic minority HMông students in Vietnam, Tran and Le (2021) illustrated how learning about students' communities supported teachers to view their funds of knowledge as "potential resources that can be tapped and integrated into teaching" (p. 20). Hunter et al. (2020) studied the mathematical funds of knowledge in Pasifika communities, noting the challenge of recognizing mathematics in home practices (see also Civil, 2007) and the need to support teachers in this work. Ewing (2012) studied how the mathematical funds of knowledge of parents in the Torres Strait Islands related to sorting shells and sharing fish could support their children's learning. Overall, this work has emphasized the importance of teachers learning from students' families and communities, as well as the complexity of transforming household knowledge into mathematical knowledge for school practice (Civil, 2007).

A less discussed aspect of a funds of knowledge approach is its potential to challenge power issues that often characterize school-home partnerships. Moll (2005), a pioneer researcher in the Funds of Knowledge project, writes, "it is impossible to ignore, then, that schooling practices are related to issues of power and racism in U.S. society, especially as related to the working-class status of these families" (p. 276). Moll recommends contextualizing funds of knowledge research within the social class and power issues that shape schooling practices. Similarly, Jovés et al. (2015) wrote in their work in Catalonia (Spain), "the primary aim of the funds of knowledge approach is to transform the traditional power relationships between teachers, families and students" (p. 76). Our study supports this goal through the development of mathematical spaces aimed at challenging power differentials between parents and teachers.

2.2 Positioning theory in mathematics education

Positioning theory, which originated in social psychology, focuses on how individuals use discourse and actions to locate themselves, and others, in social interactions (Davies & Harré, 1990). Positioning theory has been applied across academic fields, including education, to understand how moment-to-moment social interactions influence opportunities to participate, which in turn impact the identities and shared understandings that participants develop (Kayi-Adar & Miller, 2018; Van Langenhove & Harré, 1994). Positioning theory often involves the analysis of three constructs: communication acts, positionings, and storylines (Herbel-Eisenmann et al., 2015). *Communication acts* refer to the language, gestures, facial expressions, and bodily stances that participants use to communicate meaning in social interactions. *Positionings* are a metaphor to refer to individuals' rights and responsibilities (what one is allowed or expected to say or do) that show how a person is located within conversations (Davies & Harré, 1990; Van Langenhove & Harré, 1994). This theory is based on the premise that not everyone involved in a social interaction has access to the same rights to speak or act in particular ways (Harré, 2012), which impacts how power is distributed. For example, participants who position themselves or are positioned by others as experts are afforded rights and responsibilities (i.e., to explain, to direct work) that differ from those who are positioned as learners (Pinnow & Chval, 2015). Harré and Moghaddam (2003) further explain that when individuals are positioned as lacking competence in a field, they will be denied the right to contribute to discussions. Specific to our focus, if multilingual parents are positioned as lacking knowledge related to mathematics education, they may not be invited to share their perspectives. *Storylines* are broad, cultural, and socio-historical narratives that provide context and meaning for social interactions. Storylines may be shared among participants, or multiple, and even competing storylines may be at play in an interaction. Related to our focus, storylines could include narratives about expected roles between teachers and parents, or about the potential skills and contributions of multilingual families and children. These three constructs interact with one another. Participants use *communication acts* to *position* themselves and one another in ways that may reinforce existing *storylines*, or challenge storylines and suggest new alternatives.

Research on positioning in mathematics education has primarily focused on classroom interactions, and less frequently on positioning between teachers and families. Classroom studies address the importance of positioning *every* student for mathematical success via equitable opportunities to contribute ideas (Herbel-Eisenmann et al., 2015; Wagner & Herbel-Eisenmann, 2009), and discourse practices that publicly affirm students' competencies (Martin-Beltrán, 2010). In New Zealand, Tait-McCutcheon and Loveridge (2016) used positioning theory to illustrate how the "ways that teachers positioned themselves and their students was more influential than the resources they were teaching with" (p. 327). Other research has described the use of positioning theory in mathematics teacher professional development to help teachers recognize the role of positioning in making identities and academic content accessible to learners (Chval et al., 2015). Civil and Quintos (2022) analyzed mothers and daughters positionings while engaged in open-ended mathematics tasks. They described how mothers and daughters drew on their cultural and linguistic funds of knowledge to share the position of knowledge holders which resulted in moments of co-learning. While the use of positioning theory to understand teacher and parent interactions is limited, Freeman (2010) analyzed white working-class parents' positioning efforts to counter deficit perspectives and stereotypes related to their involvement in schools. In our work, we draw on positioning theory to understand the potential of collaborative interactions between teachers and parents.

2.3 Connecting theories to guide our partnership model design

We see these two theories as complementary, as they focus on interrelated aspects of parent and teacher interactions. Both theories resist stereotypes and embrace a view of participants as intercultural, dynamic, diverse, and always learning (González et al., 2005). A funds of knowledge lens attends to how features of tasks and activities, including problem contexts or facilitator prompts, frame the expertise that participants bring to an activity as relevant, intellectual resources. From this perspective, opportunities for parents and teachers to share experiences, both to build relationships and to recognize one another's strengths, are particularly important. A positioning theory lens focuses on the moment-to-moment social interactions that unfold as parents and teachers collaborate on joint activities. From this perspective, the ways that communication acts afford positions to participants matters, as these positions impact what participants are able to say and do. We drew on both theoretical perspectives to guide the design of activities in our partnership model, such as mathematical tasks that drew on meaningful community contexts to support participants' (in particular parents') access to their funds of knowledge, and lesson planning cycles that distributed rights and responsibilities among parents and teachers. We elaborate on these activities in Sect. 3.2.

3 Methods

The goal of this study was to understand how the theory-informed activities in our partnership model shaped interactions between parents and teachers. Specifically, we addressed the following questions:

As parents and teachers engaged in collaborative activities, how did they: (a) learn about one another's experiences and strengths, and (b) disrupt traditional moment-to-moment power differentials between parents and teachers?

3.1 Context and participants

This research is part of a collaborative project between universities and schools in three diverse geographic regions of the United States. This paper focuses on sessions with parents and teachers at two sites, one in the Southwest and one in the Mid-Atlantic. At the Southwest site, participants included five teachers of second to fifth grade (ages 7–11), from a school that served a predominantly working-class, Mexican American, Mexican immigrant student population, many of whom had Spanish as their home language. Four of the teachers were Spanish/English bilinguals; two teachers identified as White/Latinx, one as Latinx, and two as White/non-Latinx. Seven bilingual (Spanish/English) mothers of elementary grade multilingual students also participated, invited by teachers. Five of the mothers had attended school in Mexico. At the Mid-Atlantic site, participants included six, third through fifth grade teachers, including an English-for-Speakers-of-Other-Languages teacher and a mathematics coach. One teacher identified as Black, 1 Biracial (Black and White), 4 as White. No teachers considered themselves fluent in a language other than English. Participants also included 6 multilingual parents (5 mothers and 1 father; 4 Latinx, 2 from Ghana/Sierra Leone). All parents were fluent in two or more languages, including Spanish, Yoruba, or Arabic, and all of them spoke English. The school community was economically diverse, with about half of the student population identified as low-income.

3.2 Parent and teacher partnership model

Our partnership model included six joint sessions (one 3-h session per month) when parents and teachers gathered after school or on a Saturday. These 'joint' sessions included activities such as discussing videos of classroom teaching, sharing mathematics learning experiences, learning about each other's funds of knowledge, solving mathematics tasks, and co-planning mathematics lessons. Sessions were facilitated by members of our research team, all of whom were fluent in English and Spanish. Given the participants' language backgrounds, both Spanish and English were used fluidly, both to present activities and in group discussion. In this analysis we highlight two specific activities—joint mathematics tasks and co-planning lessons.

3.2.1 Joint mathematics tasks

During joint sessions, parents and teachers collaborated in small groups to explore problem solving tasks. Each group included teachers and parents, to encourage building relationships. The tasks reflected mathematics content relevant to our target grade levels (e.g., fractions, multiplication, division, measurement), and were open-ended, with multiple solutions possible depending on decisions made by participants. We selected tasks that were more open than typical school math tasks to disrupt potential power differentials that might position teachers as experts (if tasks looked like the school curriculum). We also designed tasks to connect to familiar contexts in local communities. We aimed to position parents' knowledge and experiences as resources, and to encourage them to draw on mathematical ideas and practices from community settings. Task contexts included making sugar skulls for Day of the Dead celebrations, making tissue paper flowers, and designing skirts for traditional dances. Tasks were introduced in Spanish and English to counter the low status often awarded to Spanish in our local academic contexts. Tasks also included visuals and realia to support sense making.

3.2.2 Co-planning of mathematics lessons

During joint sessions at the end of the school year, parents and teachers co-planned two mathematics lessons for teachers' classrooms. The process was grounded on the premise that teachers and parents each have unique expertise to inform mathematics lessons. We began with conversations in which participants shared about their funds of knowledge to fracture unproductive hierarchies that ignore families' assets. Next, we discussed norms for collaboration, and parents and teachers collaboratively defined equity-oriented goals (Mathematical Agency Improvement Community, 2023) and instructional practices for the lessons. Parents and teachers first brainstormed goals separately so that we could learn about their unique perspectives and ensure that teachers did not dominate conversation. Parents and teachers then reviewed the curriculum materials, engaged in the mathematics tasks, and discussed suggestions from parents. Consistent with district curriculum guides, the third-grade (ages 8–9) lesson focused on making sense of metric units of measure for weight, while the fourth-grade (ages 9–10) lesson focused on linear functions through the metaphor of number machines. Next, two teachers taught the collaboratively planned lessons, while other teachers and parents

observed how the lesson aligned with the planned goals. Finally, parents and teachers met to share their learning and celebrate their collaboration.

3.3 Data sources

Data sources included video recordings of parents and teachers as they collaborated on the joint activities described above. We used multiple video recorders to capture several small groups at a time. Recordings were summarized, with a focus on parent and teacher interactions, and selected excerpts transcribed for further analysis. Additional data sources included artifacts created by parents and teachers during activities.

3.4 Data analysis

We analyzed small group parent-teacher interactions in joint mathematics tasks at our Southwest site. Additionally, we analyzed small and whole group interactions among parents and teachers at our MidAtlantic site across various stages of the lesson planning. We selected these activities because they reflected different types of activities in our partnership model and included participants from different sites.

Videos and associated transcripts of the selected activities were imported for analysis into Atlas-TI, a qualitative research program. Consistent with a funds of knowledge lens, codes attended to ideas and experiences shared by participants, particularly those involving mathematical concepts or practices. We also attended to moments when participants drew upon or valued funds of knowledge shared by others. We used a positioning theory lens (Kayi-Aydar, 2019; Wagner & Herbel-Eisenmann, 2009) to guide our analysis of how moment-to-moment interactions reinforced, resisted or shifted traditional power differentials and dominant storylines where teachers are experts who transmit knowledge and parents are receivers of ideas. We coded first order positionings (Van Langenhove & Harré, 1994), how participants locate themselves and others in moment-to-moment interactions through communicative acts (e.g., as contributors of ideas, as problem posers). Each instance of a code also noted whether the participant was a parent or teacher. See Table 1 for sample codes and definitions. Following this initial round of coding, we looked at each coded episode (e.g., one small group solving a collaborative mathematics task; one small group during the lesson planning activity), and then across episodes (e.g., across tasks and small groups in the mathematics activity, and across groups and sessions in the lesson planning activity) to analyze patterns in (a) participants' opportunities to learn about one another's' experiences and strengths, and (b) how power was distributed through participants' moment-to-moment interactions and positionings. These patterns included key features of collaborative activities that supported teachers' and parents' interactions. Differences in codes and interpretation were resolved through discussion, and emerging patterns triangulated across data sources.

4 Findings

Next, we present findings from our analysis of two specific activities (i.e., the folklórico skirt mathematics task, and determining goals for co-planned mathematics lessons) that reflected salient patterns in our data, and provided important insights related to our research questions. We first describe

Table 1 Sample codes and definitions

Coding category	Sample codes	Definition
Funds of knowledge Sharing knowledge and experiences Take of knowledge and experiences	Share experiences	Shares personal experiences related to the task context
	Share strength or expertise	Shares knowledge, expertise or strengths related to task context
	Share math knowledge	Shares mathematical idea or practice related to task context
	Share other knowledge or perspective	Shares other knowledge or idea (e.g., about equity, about teaching)
	Build on knowledge shared	Group builds on the knowledge or experiences shared by a participant
	Disregard knowledge shared	Group disregards the knowledge or experiences shared by a participant
First order positioning Position self as (via own words and/or actions) Position others as (via invitations, affirmation,, or validation of others' ideas)	Contributor of idea	Offers idea for group consideration
	Problem poser, creator	Suggests problem for group to solve
	Decision maker	Guides or suggests group decision
	Explainer or justifier	Explains or justifies idea
	Teacher or expert	Teaches others, serves as expert
	Learner or receiver	Seeks help, learns from others
	Challenge/evaluator of idea	Challenges idea, task, solution

the interactions in each activity, using discussion excerpts to illustrate how experiences and knowledge were shared (Research Question 1) and how teachers and parents positioned themselves and others in ways that, in the moment, restructured traditional power differentials and dominant storylines between teachers and parents (Research Question 2). Following these examples, we return to our research questions with a discussion of patterns across the cases and what supported parents' and teachers' opportunities to create a more equitable partnership.

4.1 Case 1: sharing knowledge and power in the designing a folklorico skirt task

We launched the folklórico skirt mathematics task with a video about a local seamstress who teaches folklórico dance and makes skirts for performances. After the video, teachers and mothers noted how the seamstress used mathematics as she measured fabrics. The facilitator, Maura, then invited them to share their experiences with sewing and traditional dances. The mathematics task focused on designing rows of ribbons to adorn ballet folklórico skirts, which are used for traditional dances in various regions of Mexico. Next, Maura launched the task (i.e., How much ribbon do you need for one skirt?) and offered several relevant details including that skirts often have one ribbon around the waist, one in the middle which is double the length of the waist ribbon, and another at the bottom of the skirt which is four times as long as the ribbon at the waist.

In one group, two mothers (Elena and Isabel, (M)) and one teacher (Melissa (T)) (all were Mexican American and spoke Spanish) began by sharing how they used their bodies to estimate the length of a meter when measuring tapes were not available. While the conversation was almost exclusively in Spanish, given space constraints, we only include English translations. Brackets indicate gestures, non-verbal communications, and context.

1. Isabel (M): What we did when we didn't have a measuring tape, we did this. This is the meter, right? [stretches out arms horizontally, one on each side of her body, to show how she estimated the length of one meter using distance from one shoulder to the end of her opposite outstretched hand].
2. Melissa (T): [nods in agreement, mimics gesture].
3. Elena (M): Right, this is a meter. [extends arms to show the meter measure, nods].
4. Isabel: Because they would ask, how much is a meter? Just stretch out your hand, but now I am thinking, my hand is really long, it doesn't compare with another's that is shorter. [*gestures to Elena, and both mothers laugh*].
5. Elena: Is this a meter? [picks up the measuring tape; holds one end at her chest and extends her opposite arm, comparing the length of her chest-hand distance to the length of the measuring tape].
6. Isabel: But it is from here. [indicates to Elena that she needs to start at her opposite shoulder, not her chest].
7. Melissa: Yes, from the other side. [gestures to position the measuring tape at her shoulder].
8. Elena: [repositions measuring tape, and extends along her arm; finds the 1 m mark on the measuring tape and compares the distance from her shoulder to the end of her finger; smiles when she sees that it measures 1 m.]

Next, Elena suggested using a sample skirt to think about how long the ribbons need to be. She held up the skirt, and all agreed that the first ribbon should be placed around the waist band. Melissa suggested that they figure out her waist measurement, and Elena used the measuring tape to measure the distance around her waist, which was approximately 1 m. Isabel then led the group to calculate the total length of ribbon needed, 100 cm for the waist, 200 cm (double) for the middle ribbon and 400 cm for the ribbon along the bottom of the skirt, or 700 cm (7 m) total. Next, Elena suggested that they also use Melissa's waist measurement, as it might result in different calculations. Melissa measured her waist as 98 cm, and Isabel doubled and quadrupled the new measurement to find the total length of ribbon needed, 686 cm. After sharing their solutions with facilitators, Isabel suggested a follow-up task.

9. Isabel (M): (to Facilitator) But if you ask us, how many ribbon spools will we need? That is something else.
10. Maura: Great extension. More complicated!
11. Isabel: Yes, like how many spools like this? [*points to spool*].
12. Maura: This one is 2.7 m. [*reads the label*].
13. Melissa (T): 2.7?
14. Elena (M): So how many of these spools are we going to need? We are going to need 3 …
15. Isabel: If they are 2.7, 3 and there will be extra …
16. Maura: I need to write down this extension.

Later, Melissa shared that while she did not know how to sew or do other creative projects, perhaps she could learn. Elena empathized with Melissa, noting that previously, she also lacked creative skills, but later learned how to make decorations and crochet, and could teach these skills to Melissa ("You know what, I can teach you."), to which Melissa agreed.

As Elena, Isabel, and Melissa worked collaboratively on the folklórico skirt task, their interactions were characterized by sharing knowledge across participants, and therein, an in-the-moment restructuring of traditional

teacher-parent power dynamics. For example, in Line 1 Isabel shared mathematical knowledge, explaining her method for estimating the length of a meter using lengths on her body. Elena and Melissa seemed familiar with this method, and Elena offered to test it out (Lines 3, 5, 8), building on the knowledge Isabel shared. Isabel continued to share her expertise, clarifying the correct start and endpoints of the measurement (Line 7). In these actions, Elena and Isabel (mothers) positioned themselves as knowledgeable contributors with ideas and experiences to share. Melissa (the teacher), was an active collaborator, affirming Isabel's method for estimating measurements (Lines 2, 7), while also positioning herself as learning from others. As participants shared their knowledge with one another, they disrupted, in this moment, traditional parent-teacher power differentials which position teachers as experts and parents as receivers of information. When Isabel suggested an extension task to the facilitator, positioning herself as a problem poser (Lines 9, 11), this also disrupted traditional power dynamics**.** The facilitator expressed excitement, positioning herself as learning from the mothers' ideas (Lines 10, 16). This again suggests that their interactions were characterized by an in-the-moment restructuring of traditional teacher-parent power dynamics.

In a second group, Liliana (mother) and Sabina (teacher), both Mexican American and Spanish speakers, began by sharing about their own mothers who were accomplished seamstresses. Sabina described that her mother made skirts with intricate triangular patterns along the waistline. Liliana listened with interest and shared about ruffled dresses and socks that her own mother sewed. As they shared additional stories about their mothers' sewing skills, they found points of connection in their histories.

Next, Liliana and Sabina read the task aloud as they held up a sample folklórico skirt. They measured the waist (80 cm) and reviewed the information provided about ribbon lengths (i.e., the bottom ribbon is four times as long as the waist ribbon). Both Liliana and Sabina seemed unconvinced by this relationship. Liliana lifted her arms to extend both sides of the skirt and mimic movements when dancing. Sabina suggested measuring the skirt to determine whether the information was valid.

17. Liliana (M): [after reviewing the information about the ribbon] Really?
18. Sabina (T): Let's see, let's see if it is true. Let's look at the bottom one.

Following Sabina's suggestion, they worked together to place the one-meter measuring tape along the bottom edge of the skirt, and then repeatedly moved the tape to measure the entire length. They concluded that the distance around the edge was approximately 6 m and 38 cm.

19. Liliana: The middle one, [middle ribbon], would be like 3 m [half of the distance they measured along the bottom].
20. Sabina: Yes, more or less. Let's see, they say it is 4 times longer, right, [*points to the statement provided by facilitators*], let's see, 80 [the waist] times 4. [*multiplies 80 by 4, gets 320 cm*]. It's more! [*the distance around the edge of the skirt is more than four times longer than the waist*].
21. Liliana: Yes, it's more. [points to Sabina's calculation] And maybe this one is the middle one? [Asking if the four times longer relationship could work for the middle ribbon].
22. Sabina: The middle one?
23. Liliana: Yes, this is the middle one.
24. Sabina: Ah, yes, because according to this theory it is supposedly [four times longer] at the bottom, but no.
25. Liliana: This one is four times longer, this one. [*pointing to where a "middle" ribbon might be placed*].

Liliana and Sabina continued to design their skirt and calculate the length of ribbon needed, using the relationships they determined (middle ribbons were four times as long as the waist, and edge ribbons were eight times as long). Later when they shared with the group, Liliana explained that the information in the task was incorrect, because the provided ratios would not allow the skirts to extend and move as they do in folkloric dance.

26. Liliana (M): What you [facilitators] said, it was not true, the skirt would not have had movement.

Similar to the first group, as Sabina (T) and Liliana (M) collaborated, they learned about one another's experiences relevant to the mathematics task. They shared stories about their mothers' sewing expertise, including the mathematical features of their work, which supported them to recognize strengths and connect their histories. The facilitator supported these connections by launching the task with an invitation to share prior experiences, thereby positioning both teachers and mothers as experts with relevant knowledge. Later, Liliana and Sabina drew on their understanding of folklórico skirt movement to question the task information (Line 17). When Sabina proposed testing the information by measuring the skirt (Line 18), they collaborated to conclude that the edge length was more than four times the waist (Lines 20, 22). Liliana further reasoned that the four times as long relationship must refer to the middle ribbon instead (Lines 21, 23, 25). As Liliana and Sabina drew on their experiences as intellectual resources to challenge the information in the task, they positioned themselves (and one another) as challengers and evaluators of ideas. In doing so, they disrupted, in the moment, traditional parent-teacher

power dynamics which position teachers (but not parents) as experts. By framing the information in the task as a "theory" (Lines 24, 26) versus a "given", and positioning themselves as problem posers who would "redefine" the task, they challenged traditional divisions between creators of mathematical problems and receivers.

Across both small groups, a storyline of collaboration was evident, one in which distinguishing participants' role as "teachers" and "parents" becomes challenging without prior knowledge. The invitation to share their experiences as resources to solve the task dismantled the entrenched historical asymmetries within these interactions (e.g., mothers posed extension tasks, mothers and teachers challenged provided information), and collaborative positions emerged.

4.2 Case 2: sharing expertise and goals during collaborative mathematics lesson planning

During the goal-setting stage of the collaborative lesson planning activity, parents and teachers separately brainstormed and identified goals that reflected what was most important to them to make mathematics lessons more equitable for multilingual students. These goals were posted on the wall, so that all participants could see and refer to parents' and teachers' ideas. Teachers' goals included encouraging risk taking and learning from mistakes, providing real-world application problems, and different ways of solving problems. Parents' goals included incorporating games, visual math, mixed-ability small groups, and mental math. In the following joint session, the initial phase involved mixed small groups where teachers and parents discussed how to prioritize a smaller list of goals. Later, in the whole-group discussion, they shared key ideas from their respective small groups, and collaboratively identified a couple of equity-oriented goals for the lessons.

In the excerpt below, three mothers (M) and five teachers (T) discussed the potential goals with two facilitators (F). Paige (T) started by suggesting that the lesson integrate real world applications (teachers' goal) and games (parents' goal), using an example shared by Clara (M), the mother of one of her students, Cecilia.

1. Paige (T): We talked about the real-world application compared to the games. It can be kind of intertwined, but we talked about [how] a real-world application makes it more meaningful for them than just games [that do not include a real-world connection]. Like [Clara said] Cecilia, she likes to play supermarkets and deal with money, so she feels like she's an adult, competent. She understands it that way, rather than a repetitive game that it's just like practicing, over and over again. So they can be kind of intertwined together, but specifically real world application games.
2. Bety (F): Okay. So let's stay with the same goal of real world application and games, someone has something different that you talked about at your table or if you see it differently, the games or the real world applications.
3. Wendy (T): I think we talked about, similar.
4. Alysa (M): Similar, yeah.
5. Saima (T): We added that the small groups would work well with the games so the students can be like helping each other and also in a smaller group have more opportunities to practice the skill of the game.
6. Wendy (T): Yeah.
7. Amira (T): I was just going to add on, we also said something about the small groups in the real-world application game, type of thing, because in real life, you are going to have to try to solve problems within groups of people. So, I was looking at that word, mixed [ability groups], being able to find a team to work with provides that practice of being able to interact with different people.
8. Carolina (F): So small groups work with everything. [laughter from group]
9. Clara (M): Sure, small groups always work.
10. Bety (F): Small groups always work? Yeah.
11. Paula (T): Yes, I was going to say that actually to encourage risk taking. I feel like my kids take more risks in small groups, rather than whole group, because it's not a lot of, you know, the whole class listening to their answer and learning from their mistakes.
12. Clara (M): They may feel more confident.
13. Bety (F): Does that apply for multilingual students too?
14. Alysa (M): Yeah.
15. Clara (M): Sí. (*Yes*)
16. Bety (F): Why do you say sí (*Yes*) so strongly?
17. Clara (M): Every time I'm studying with Cecilia or Ileana [daughters] I actually don't like when my husband does math or whatever with both of them because Cecilia answers right away. And Ileana doesn't have like, well, she's younger, but then she feels like she's shy. She's like, even though maybe she knows the answer. But I think that it's the same in a bigger group. In the whole class, maybe it's going to be your mistake, it's a mistake, but who wants to answer a wrong answer, you know? So when it's a small group or more like a private situation, there is less competition or they feel more confident.
18. Paula (T): Just going back on what she [Clara] said. In the whole group, I'll ask for a student to call a friend for help. And I try to see who they call on and they usually go to the person who gets the answers correct most of the time. But in a small group, they call on

their friend for help, who doesn't know, they haven't figured out [the answer yet, so they] don't give the answer.

19. Paige (T): Yeah, for example Cecilia, [in] whole group, [you] will never hear her talk. Small group, she's the one who is answering the entire time.
20. Saima (T): Ileana's the same way.
21. Carolina (F): What do you think about that? I am asking parents because this goal of risk taking was one that the teachers came up with.
22. Alysa (M): Yeah, I think it's good because sometimes the first thing that comes out of the kid's mouth when you ask the question, they don't really think through it. So when they make a mistake and you kind of encourage them, okay, okay, you said this, but let's look at it from this angle. It gives them a new perspective to like guess a different answer.

As the teachers and parents discussed potential equity-oriented goals, they had multiple opportunities to share experiences and contribute insights, and to learn about one another's knowledge. For example, when Paige (T) shared that the lesson should connect real-world applications (teachers' goal) and games (parents' goal) she built on knowledge shared by Clara (M) (Line 1). This positioned Clara (and the other parents in her group) as contributors of valuable ideas for their collaborative planning. Later, Saima (T), highlighted ideas from parents' proposed goals, specifically that games and small group work allow students to support each other as well as practice skills (Line 5), thereby creating another opportunity for the group to recognize parents' insights.

As the discussion continued, teachers and parents shared additional benefits of small group work for all students. Amira (T) highlighted that parents' goal of mixed-ability small groups reflected how people solve problems in everyday life and allowed students to practice this important skill (Line 7). Clara (M) and Paula (T) noted that small groups (parents' goal) encouraged more risk taking than whole group discussions, because children feel less pressure related to potential mistakes (Lines 11,12). It is worth noting that while the initial part of this discussion (Lines 1–11) primarily comprises ideas contributed by teachers, they incorporated insights from their small group discussion with parents and their goals. Furthermore, when the facilitator shifted the conversation to focus explicitly on multilingual learners (Line 13) and probed Clara's (M), and later other mothers' ideas (Lines 16, 22), positioning them as contributors and experts related to multilingual learners, the two mothers shared their insights. In Line 17, Clara drew on her experiences at home with her two multilingual daughters to emphasize the importance of small groups in the classroom (parents' goal), because students feel safer making mistakes (teachers' goal). Positioning herself as an expert on the importance of small groups, Clara connected the moments when her younger daughter seemed reluctant to answer questions in the presence of her older sister, "even though, maybe, she knows the answer" (Line 17) to how students might feel less confident and hesitant to make mistakes in whole group discussions. Next, several of the teachers (Paula, Paige, Saima) confirmed and built on Clara's ideas, sharing additional observations about how small group work helped collaborative problem solving (Line 18–20). Paige and Saima noted that Clara's daughters, who are multilingual learners, were active participants in small groups, but silent during whole group discussions (Lines 19, 20). The series of exchanges allowed Clara and her daughters' teachers to learn from one another about how the girls participate in different learning contexts (i.e., home and school), deepening their collective understanding (Line 17, 19, 20). Finally, Alysa shared that learning from mistakes (teachers' goal) was important for children to expand their perspectives (Line 22).

As teachers and parents shared their hopes for mathematics instruction and their insights related to the benefits of small groups for multilingual learners in particular, the discussion was characterized by a disposition of collaboration in which teachers and parents highlighted each other's ideas and extended them. Their moment-to-moment interactions disrupted traditional asymmetrical parent-teacher power dynamics that position teachers as experts and parents as receivers of information. Instead, parents and teachers learned from one anothers' perspectives and collaborated to create shared equity-oriented goals. The teachers shared their classroom experiences while the mothers shared experiences with children at home and children's accounts of their experiences at school. Parents contributed a critical perspective to counter practices, such as ability grouping, that affect the availability of equitable opportunities of learning. Both groups affirmed and built on the intellectual resources that each participant brought, strengths that reflected their unique roles and experiences.

After the conversation described above, the group continued to discuss connections among goals and in the end highlighted the importance of encouraging risk taking through mixed-ability small groups and real-world activities. These conversations were the foundation of the mathematics lessons they co-planned. In the fourth-grade lesson (students ages 9–10), students worked in small groups on a collaborative "number machine" poster to apply a given rule (i.e., function) to various input values to produce output values. Groups then removed the rule from their poster and rotated tables so that other groups of students could figure out the rule. The third-grade lesson (students ages 8–9) focused on estimating and measuring the weight of objects from their backpacks using metric units in small groups. Then, students

shared examples of how measuring weight was important in everyday life and determined which unit (kilogram or gram) was most appropriate. The central role that collaborative, mixed-ability groups played in the two co-planned lessons was a clear reflection of the insights shared in discussions, as teachers positioned themselves as learners, open to suggestions from parents. Teachers' typical instruction focused on activities from the designated curriculum. In the co-planned lessons, teachers went beyond their typical practice to design tasks that connected to everyday practices and meaningful objects in students' lives, drawing on the co-planning discussions.

The storyline unfolding during this co-planning was of collaboration with the goal of improving the mathematics learning opportunities for multilingual learners. The invitation to share their hopes as valuable resources to promote more equitable participation in the mathematics lesson disrupted the historical asymmetries within parent-teacher interactions, and both parties engaged in dialogue as experts.

5 Discussion

Our research employed two complementary theories, funds of knowledge and positioning theory, to design a parent-teacher partnership model aimed at creating collaborative interactions between parents and teachers that have the potential to disrupt traditional power differentials. The use of these theories was critical in the design, implementation, and analysis of our efforts. Central to our innovative approach was bringing parents and teachers together to build relationships, do mathematics together, and reimagine mathematics teaching and learning. Our findings point to several features of collaborative activities that supported teachers and parents of multilingual learners to learn about one another's experiences and strengths (Research Question 1), and to restructure, in the moment, typical asymmetrical power relationships (Research Question 2). We elaborate these activity features in the paragraphs below. While our findings focused on the sharing of knowledge and power in moment-to-moment interactions, we conjecture that these interactions can serve as catalysts for change in school structures and long-standing narratives about competence that often position multilingual families from marginalized communities through a deficit lens (Barajas-López & Ishimaru, 2020; Hedges et al., 2016), a point we return to later in the discussion.

First, we observed that open-ended activities connected to participants' funds of knowledge empowered participants to position themselves with agency to make decisions and promote more equitable participation, similar to what Civil et al. (2020) found in their work with open-ended problem solving tasks with mothers and teachers. For example, as shown in Case 1, open-ended mathematics tasks that connected to participant's funds of knowledge created opportunities for parents and teachers to share experiences and recognize intellectual resources. The fact that the task did not direct participants to use specific measurements or even a specific number of ribbons, but rather left these decisions open, encouraged participants to generate their own measurements and designs, which facilitated the knowledge sharing that occurred. Moreover, as both teachers and parents shared expertise related to sewing and measurement, this challenged traditional power differentials between parents and teachers, and facilitators (e.g., mothers posed extension tasks, mothers and teachers challenged information provided in the task). Similarly, in Case 2, the openness of the lesson planning activity (i.e., teachers and parents could make decisions about lesson goals, instructional strategies, and mathematics content connections) created opportunities for both parents and teachers to share knowledge and to learn from one another's experiences (e.g., ideas about the impact of small group work on children's learning in homes and at school). Additionally, the order of the activity in which parents and teachers first identified goals for mathematics lessons separately seemed productive, as it ensured a space for parents' insights about their children to inform classroom instruction. As in Barajas-López and Ishimaru (2020), if the activity had been more closed, such as asking parents and teachers to share suggestions for a pre-planned curriculum, we suspect that a different dynamic would have emerged given teachers' expected role and expertise with school mathematics curricula. In fact, several teachers noted the lack of openness within the curriculum to integrate families' funds of knowledge and the lack of support to engage in this complex endeavor as a challenge.

Second, we found that intentional explicit interventions on the part of workshop facilitators played a key role in supporting participants' opportunities to learn about one another's strengths and to position themselves as contributors with unique expertise as noted in Ishimaru (2020). For example, in Case 1, the facilitator launched the task with an invitation to share experiences related to sewing and folklórico dance, positioning the participants as experts. Across small groups, this prompted a rich exchange of stories and knowledge among parents and teachers. Later, the facilitator responded to mothers' ideas for a task extension with appreciation, positioning herself as learning from the mothers' and teachers' ideas. Similarly, in Case 2, teachers initially drove the conversation and positioned themselves as spokespeople for their small groups, which may have been exacerbated by the number of teachers in the activity (5 teachers and 3 mothers). Facilitators were aware of this potential pattern, and at multiple points decided to probe mothers' ideas and perspectives. These facilitator interventions seemed consequential, as they prompted contributions from mothers that

helped to shift the balance of participation and affirm the mothers' unique expertise. Additionally, as prior research on the impact of positioning practices on *students'* participation and learning has shown (Martin-Beltrán, 2010; Tait-McCutcheon & Loveridge, 2016), over time these sorts of practices may have the potential to restructure participation and power relationships among teachers and parents.

Third, our research revealed the importance of strategically validating and employing the languages spoken by community members as an essential component of their funds of knowledge. Affirming cultural and linguistic identities helped to counter oppressive raciolinguistic ideologies that suggest some languages are inferior (Rosa & Flores, 2017). Additionally, this supported establishing trust-based relationships, which facilitated the knowledge sharing that emerged from their collaboration. For instance, in Case 1, both teachers and parents shared Spanish as their native language, which allowed fluid interactions that supported learning about one another's experiences and recognizing strengths. Case 2 presented a significantly different linguistic context, where English (the language shared across participants) was often used when teachers and parents were all together. Even so, the facilitators strategically validated other languages by providing instructions in Spanish first and inviting parents to share phrases in their native language in the public space. Both facilitators were Spanish speakers and shared their identity as immigrants with parents. Although they could not speak all families' native languages, they frequently underscored the value of multilingualism.

Finally, we found that the collaborative interactions among parents and teachers not only allowed groups to learn about one another's strengths, but to co-construct *new* knowledge that reflected experiences across home and school, knowledge that neither group would be able to achieve without the other. Since children learn mathematics across these two contexts (Abreu & Cline, 2007; Takeuchi, 2018; Wadham, et al., 2022; Williams et al., 2020), this co-constructed knowledge has the potential to impact children's mathematics learning. For example, in Case 1, participants collaborated to verify embodied ways to measure length, based on suggestions from the mothers. These new understandings create the potential for teachers to draw on what they learned from the mothers as they teach mathematics in the classroom. For instance, teachers might ask students to describe how their families estimate measurements, positioning families' mathematical practices as intellectual resources to support learning. Similarly, in Case 2, teachers' and mothers' discussion of small group structures generated critical knowledge related to a key feature of mathematics classroom practice. These discussions could support both mothers and teachers to draw on their deepened understandings about small group work to support the learning of multilingual students across contexts. For example, teachers may decide to implement group work more frequently, based on their new understanding of how small groups support confidence and risk taking for their multilingual learners. While teachers' uptake of knowledge gained from interactions with parents was beyond the scope of our study, prior research suggests that while teachers need support in this work (Civil, 2007; Hunter et al., 2020; Tran & Le, 2021), when such connections are made, student learning benefits (Trinick, 2015).

These parent-teacher interactions occurred within a broader historical and sociopolitical context, including an educational system that further disempowers both teachers in minoritized Latinx communities and families. We acknowledge that our work alone cannot alter these systemic power inequities. Nevertheless, this shift in moment-to-moment interactions provided a glimpse into ways to create a fissure in their asymmetrical power relationships. Given that efforts to redefine power relationships between families and schools are often superficial at best (Baquedano-López et al., 2013), we view this potential disruption as promising.

6 Conclusion and implications

Our findings suggest several implications for the development of mathematics partnerships between parents and teachers that challenge power differentials that disregard multilingual families' experiences, perspectives, and knowledge. One such implication is to create opportunities for parents and teachers to explore mathematical tasks together. But, as our study shows, these tasks must be carefully designed to bring out the participants' (in particular the parents') expertise. With this type of tasks, participants become not only problem solvers but also problem posers; they take ownership and use sense-making to challenge tasks as needed. A second implication is that opportunities for parents and teachers to dialogue about mathematics education need to be structured carefully, as shown in the collaborative lesson planning. It is crucial that parents' ideas are brought to the forefront since teachers are likely to be seen as the sole experts in the classroom. This study offers some ways to do this such as separate time for parents and teachers to discuss goals and also underscores the importance of the facilitators in orchestrating the discussion. Further work on collaborative lesson planning with parents and teachers may suggest other supportive structures.

Our findings also suggest productive directions for future research. The use of positioning theory and funds of knowledge as complementary lenses supported our goal to create and understand ways to elevate the knowledge and expertise of multilingual families in under-resourced schools. The resistance to change of the school system and pervasive inequitable power relations based on race, ethnicity, gender, immigration status, socioeconomic status, and language

make these partnerships a complex effort (Ishimaru, 2020). Future research should continue to investigate ways to bridge school and home learning and heighten the voice of multilingual parents in the mathematics education of their children. The joint activities reported here were supported by other features of the partnership model, including sustained opportunities for participants to share stories and build trusting relationships (*confianza*). Future studies should explore how these types of activities work in less intensive learning partnerships, and the kinds of community-building structures needed to support their success. Future studies should also consider how to partner with caregivers that may be more reluctant or less available to participate in projects such as ours. The parents in our study all spoke at least English or Spanish (among other languages), which created common languages with teachers and facilitators, and therein supported the collaboration in joint activities. We need to better understand how to support partnerships in different settings involving multiple languages that are not shared among participants. Finally, future research should move beyond the parent-teacher study group context to also explore ways that teachers leverage understandings from interactions with families in classroom instruction. While our study suggests promising directions, further research is needed to deepen our understanding of how to build on community voices to enhance mathematics learning.

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