Developing Professionals: Preservice Teachers' Knowledge, Comfort, and Beliefs in Elementary Mathematics Education Family Engagement

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Abstract

This article reports on the development of preservice teachers' knowledge, comfort, and beliefs about family engagement in elementary mathematics. Nine traditional undergraduate female participants, who were involved in the delivery of 21st century mathematics learning workshops for families, completed both a pre- and post-assessment consisting of an open-ended questionnaire and a Likert scale survey. Use of mixed methods analysis illumined areas of nuanced transformation that may be unique to direct interaction with families around 21st century mathematics learning and key for bolstering early career teachers who feel well prepared for this specific work. The typological analysis of qualitative data revealed the emergence of six themes of professional growth. Results of the Wilcoxon Signed Rank Test for survey data also indicated growth with a significant increase in overall knowledge levels ($p \leq 0.01$) and comfort levels ($p \leq 0.05$). Findings are considered in relation to the ongoing challenge of the mathematics education field to fully include families as shared stakeholders in reform instruction and the potentiality of subject-specific family engagement learning in teacher preparation programs.

Key Words: subject-specific family engagement, elementary mathematics education reform, 21st century mathematics learning, teacher education, preservice teachers, professional development, knowledge, comfort, beliefs

Introduction

At its outset in 2010, the Common Core State Standards Initiative (CCSS) was both uncontroversial and bipartisan, with 45 states adopting and initiating implementation by 2013 (NGA Center & CCSSO, 2010). Yet, by 2015, the Common Core State Standards were largely under attack, and less than a decade after the rollout, many states had "retreated from" or "rebranded" the Common Core (Goldstein, 2019). Despite much confusion, misunderstanding, and misinformation surrounding the initiative, Larson and Kanold (2016) have posited that what does not receive opposition is the K–12 mathematics *content* of the standards. That is, there is very little argument against the actual mathematics that the standards state that students should know and be able to do. Simply put, today's learners need to not only know the *how* of mathematics taught in previous generations, but also the *why* and *when* (Briars, 2014). As such, "the mathematics classroom children experience today operates very differently from the one their parents remember" (Whitenack et al., 2015, p. 4). Students, for example, engage in collaborative problem solving, explain solution methods, and defend and critique their own and other's reasoning. They also make connections between multiple representations, moving from concrete manipulatives to math drawings to abstract notation. It is important to recognize, however, that these approaches to teaching and learning mathematics in the Common Core era are proving quite challenging for many parents who mostly learned mathematics in an algorithmic way (Heitan, 2014; Rich, 2014; Ryan, 2015).

That parents struggle with and the public resists mathematics that they perceive as radically different from the mathematics they learned is not new. The Common Core State Standards Initiative can trace its lineage back to the National Council of Teachers of Mathematics 1989 release of *Curriculum and Evaluation Standards for School Mathematics*, the first voluntary national content standards of any subject. The active enactment in classrooms across the country of these seminal standards, which stressed reasoning and understanding, sparked the now infamous math wars of the 1990s (National Council of Teachers of Mathematics, 2020). In a review of the mathematics education reform literature from the 1980s–90s, Peressini (1998) identified that tension results from the incongruity between the discourse employed by professionals using the language of the reform documents and the discourse of those less familiar, such as parents and public.

Research that is more recent demonstrates this tension or power imbalance. Remillard and Jackson (2006), for example, provided an illustration of lost opportunity when the discourse of mathematics reform is not made accessible to

parents. A cohort of African American parents from a low-income neighborhood consistently placed importance on the role of learning mathematics, were "heavily involved in their children's mathematical learning beyond homework assistance" (p. 254), and saw strong connections between school mathematics and daily life. Moreover, the parents wanted their children to develop "confidence, independence, and the ability to use math in their daily lives" as well as "a deep understanding of math" (p. 255). Yet, although the goals of the reform curriculum implemented at the school and the aspirations of the parents were well aligned, parents failed to see a relationship between the two. The work of Bratton, Civil, and Quintos (2006) in low-income, ethnic and language minoritized communities additionally explored mathematics education as an area of power contestation. Parents' mathematics knowledge often stands in contrast to the school's mathematics knowledge. Hence, the school experiences of both children and parents are fraught with the valorization of knowledge, that is, the valuing of one knowledge over another.

The *AMTE Standards for Preparing Teachers of Mathematics* (Association of Mathematics Teacher Educators, 2017) identify collaboration with families as one indicator entailed for professional attainment, specifically, "Well-prepared beginners must be clear and confident in their visions for teaching mathematics. They must be able to effectively communicate their visions while building relationships and trust with families to support mathematics learning throughout the school year" (p. 18). Moreover, the document asserts that well-prepared beginners are "ready with strategies that will ensure that parents understand the rationale for innovations in the teaching and learning of mathematics (e.g., new standards or new teaching approaches) and minimize potential fears and concerns that parents might have about these unfamiliar approaches" (p. 18). Undoubtedly, with a public often skeptical about changes in mathematics education, accomplishing these aims is no small task for teacher education.

Literature Review

The Role of Teachers and Schools in Engaging Parents in Mathematics Education

Research is beginning to emerge on strategies specific to fostering family math engagement in the era of Common Core. Mangram and Metz (2018), for example, examined a five-month mathematics intervention program for parents that overviewed the Common Core State Standards for Mathematical Practices. At the conclusion of the intervention, parent–child dyads were engaging in increased and more varied use of the mathematical practices when jointly solving rich mathematical tasks than at the start. Moreover, there was a

reported change in parent assistance practices that allowed for a shift to deeper mathematics engagement for the child. These findings are promising given the previous work of Sheldon and Epstein (2005), who found a consistent and positive relationship between mathematics-focused learning-at-home activities and improvement in the percentage of students proficient on mathematics achievement tests. Contributing to this achievement were the actions of providing mathematics materials and resources for at-home use as well as assigning mathematics homework that necessitated parent and child interaction and dialogue.

In contrast, the work of Jay et al. (2017) suggested affordances of a parent-led approach, as opposed to a school-centered approach to mathematics workshops:

> By focusing on finding and engaging with the mathematics in everyday family life, parents could avoid some of the high-stakes issues, including needing to know the "right answer" and needing to take on the role of expert mathematician or teacher. Parents instead focused on open-ended questioning, allowing time for children to think, and supporting children in reflecting on an activity. (p. 226)

Jay et al. have submitted that, to improve the outcome of parental engagement, schools and teachers should be aware of and attend to the mathematical conceptions of parents. Parents' notions of mathematics as a subject of "right and wrong answers" or as a subject separate and distinct from other subjects are potential obstacles to productive involvement.

Preparing Preservice Teachers to Work with Parents in Mathematics Education

Epstein's (2009, 2011) theoretical model of the overlapping spheres of influence of family, school, and community on children's learning provides a basis for preparing preservice teachers to work with parents in mathematics education. With the child figuratively situated in the overlap of three spheres representing family, school, and community, the model highlights a range of variables that have the potential to affect the strength of the overlap and hence the child's educational experience. At an external structural level, the model accounts for the forces of developmental and historical time as well as the experiences, philosophies, and practices of the respective family, school, and community. Additionally, the model includes an internal structure which focuses on the interpersonal relationships between individuals situated within the family and school spheres. Clearly, preservice teachers are on the cusp of taking a position within the school sphere and may have great agency in the interpersonal relationships they value building.

A review of the extant literature by Evans (2013) indicated the positive impact of efforts in teacher education to address family, school, and community engagement practices on preservice teachers. Yet, Evans additionally reported findings indicating that, even with recent increased coverage of the topic in teacher education programs, teachers continued to feel unprepared for working with parents. Epstein (2018) has similarly concluded that inadequate preparation for conducting effective partnership programs with all students' families is a problem inherent across many countries. An important direction that has emerged in Epstein's research is the need to prepare teachers to design and conduct goal-linked engagement activities for student learning in specific subjects. She has drawn on research indicating not only that parents' most frequent request of teachers is how to help their child at home, but also that family engagement activities in specific subjects have a positive influence on student learning in the subject. Whether it be through full partnership courses or subject-specific methods courses, teacher education programs should "[enable] future teachers to see the connections between teachers' classroom lessons and ways to inform and engage parents with students on subject-specific learning activities" (Epstein, 2018, p. 402).

Studies in the field of mathematics teacher education that contribute to a research base for preparing teachers to design and conduct goal-linked engagement are nascent. Lachance (2007) reported that involving preservice teachers in family math nights can help them appreciate the important role that parents play in children's learning. Also pertinent is the work of Jacobbe et al. (2012), who examined the effects of a family math night on preservice teachers' perceptions of the parental involvement of African American parents from a high poverty community. Specifically, the survey study focused on the perceptions of preservice teachers, enrolled in multiple sections of a mathematics methods course, in relation to communication and to methods of supporting families to help their children learn at home. Preservice teachers in the treatment group assisted in preparations for the family math night and additionally coordinated the math games during the event. Pre-survey scores generally revealed deficit thinking about low income parents. However, there were notably more positive perceptions of parental involvement by the treatment than the control group in the post-test. It is worth noting that a follow-up survey one year later indicated lasting, albeit diminishing, effects.

The breadth of work of Mistretta (2013, 2017) also has significant import. Mistretta (2013) detailed the effects of integrated coursework and fieldwork on preservice teachers' understandings of parent–child collaborations in mathematics. With mentorship and support, the preservice teacher participants engaged families in solving hands-on mathematics tasks over the span of four

sessions, all the while completing complementary and reflective coursework. Mistretta attributed the practical inquiry experiences as the conduit for preservice teachers becoming "in the know" about parent–child collaborations and ultimately the success of influencing parents' participation in their child's education. More recently, Mistretta (2017) reported on the nature of conversations about math between families and teachers. She demonstrated how purposeful conversations between family members and teachers enrolled in a math methods course served, as in the previous study, as a form of practitioner inquiry. Specifically, these conversations revealed to teachers: families' interest in strengthening their own mathematical content and pedagogical knowledge, families' desire for varied communication about their children's math learning, reasons for classroom behaviors, and mathematical behaviors and interactions occurring in the home. Ultimately, these revelations informed the teachers' practices related to family interactions. It is worth noting, although it does not detract from the contribution of the research, that participants in both studies conducted by Mistretta were enrolled in graduate level methods courses.

There exists a quandary in the persistent reporting of underprepared teachers in the area of family engagement as well as in the historical challenges of the educational community to convey the value in mathematics reform. Clearly, the research reviewed above is critical in tackling the challenge, but much work remains in the area of preparing preservice teachers to confidently communicate a vision of the highest quality mathematics education for the 21st century to families. As such, the study reported in this article aimed to investigate, using both quantitative and qualitative methods, preservice teachers' knowledge, comfort, and beliefs in relation to enacting family engagement[1] in mathematics. It was hypothesized that there would be an increase in each of these three areas after training for and assisting in the delivery of family math workshops. Moreover, the study investigated the nature of the change by posing a three-part research question. Namely, how does training for and assisting in the delivery of family mathematics education workshops influence preservice teachers':

- knowledge in engaging families in children's mathematics learning?
- comfort in engaging families in children's mathematics learning?
- beliefs about family engagement in children's mathematics learning?

Methods

Participants

Participants in this research study included nine traditional undergraduate preservice teachers (ages 18–22 years), from a small private university in

the rural northeastern United States. The total numbers of education majors (early childhood and middle level) enrolled at the university for each of the three years of the study were 22, 17, and 11 respectively. Of all education majors across the relevant three years, the majority were predominantly White (91%–95%) and female (71%–82%). The study's participants were White females and had, prior to their involvement in the study, successfully completed two required courses on mathematics content knowledge for teaching with the first author. With the exception of one, all participants were pursuing degrees in early childhood education. The ninth participant was working towards a degree in middle childhood education with a concentration in mathematics. Participation to assist in the delivery of mathematics learning workshops for families was by invitation but largely based on evening and weekend availability. This precluded student athletes and those with work commitments. Moreover, participation was not part and parcel of a credit bearing course. Rather, it was suggested that the experience would be excellent for building the resume.

Role of Researcher

The project germinated when the first author began receiving inquiries from school leaders and community members asking for support in helping families to understand 21st century mathematics teaching and learning. From the outset, it was important for the first author, a mathematics teacher educator, to include preservice teachers in the work. The nexus of the work in mathematics education outreach and preservice teacher involvement provided a rich opportunity for an investigation drawing from the tradition of action research, a type of applied research centered on the investigation and improvement of problems in practice (Hatch, 2002). Here, preparing preservice teachers for mathematics education family engagement was of interest and, as recognized in action research, the first author and her values had a prominent place in the inquiry. Spanning three academic years, the project and, consequently, the level and type of preservice teacher involvement, evolved in response to local needs.

Establishing trustworthiness was paramount given the first author's multiple and overlapping roles in the project: researcher, workshop leader, and mathematics teacher educator. To that end, several steps were taken. First, detailed description of the project context is provided in the next section to aid readers in transferability. Moreover, to ensure that the findings could be trusted, two additional investigators (the second author and her research assistant, who were both external to the three-year project) were brought in for the data analysis phase. In particular, they contributed to the aspect of confirmability—making sure that findings were clearly derived from the data. Finally, the

findings include numerous examples of raw data in the form of direct quotes from participants. For brevity, the first author will heretofore be referred to as "the author" in the remainder of the article.

Project Overview

The author designed three workshops for family members wishing to support their elementary-age children in learning mathematics. The first workshop had as its content focus addition and subtraction, the second multiplication and division, and the third fractions. Each workshop followed the same format built for 120 minutes (see Appendix A). All workshops included an introduction to central tenets guiding the 21st century's best mathematics teaching and learning, including: the importance of reasoning and sense making, building conceptual understanding to support procedural fluency (National Council of Teachers of Mathematics, 2014), and practicing a growth mindset (Boaler, 2016; Dweck, 2007). The second segment of each workshop explored the conceptual underpinnings of the mathematical operations under focus. An important and final component of all three workshops was the inclusion of specific activities that could easily be implemented in the home setting to reinforce learning in the respected content focus of the workshop. For example, in the Multiplication and Division workshop, parents loved learning the game "How Close to 100?" (see https://www.youcubed.org/tasks/how-close-to-100/), which makes use of dice, a grid, and colored writing utensils to strengthen children's understanding of the rectangular array interpretation of multiplication, while simultaneously building fact fluency.

The project commenced early in the fall semester, with the author meeting with the first cohort of four participants for a total of six hours of training. The training began by introducing the importance of school, family, and community partnerships, using as a basis for discussion Epstein's (2011) theoretical model of overlapping spheres of influence (as described above), and then detailed the elements of the author-designed family workshops. Significantly, training time was dedicated to engaging in each of the family-friendly math activities with follow-up opportunities to practice introducing and leading the activity. Accordingly, the preservice teacher participants and author worked as a team in workshop delivery, with the author leading the introduction and main content discussion and the preservice teachers leading activities and assisting workshop attendees in concrete representations (e.g., using Base 10 blocks to model regrouping in the Addition and Subtraction workshop; see Appendix A). The initial year included the delivery of (1) the Addition/Subtraction workshop and the Multiplication/Division workshop at a small school district on two separate evenings in early fall, and (2) a three-hour Saturday

morning workshop which was open to the public on the university campus in mid-Autumn which combined the addition/subtraction and multiplication/division content.

During spring semester of the initial project year, the author met with the local education agency to discuss need of the workshops for the following academic year. Interest levels by administrators were high as it was common for them to have parents request help in understanding their students' math homework. Accordingly, invitations to participate in workshop delivery were extended to a second cohort of four new preservice teachers, and they received training at the outset of the next fall semester. In total, the author and second cohort of preservice teachers delivered 14 workshops to eight different school districts across a three-county geographical area from September through January. According to the revised definitions of school locale types of the National Center for Education Statistics (see https://nces.ed.gov/surveys/ruraled/definitions.asp), three of the eight school districts from Year 2 classified as rural–distant; two classified as town–distant; two classified as town–fringe; and one classified as rural–fringe. The school district from Year 1, located in a fourth county, classified as rural–distant. Additional demographic information for the school districts visited during Year 1 and Year 2 can be found in Table 1. Workshops were open to adult family members of all students, although it was recommended that the Addition/Subtraction workshop would be of specific interest to those with children in Grades K–2 and that the Multiplication/Division and Fraction workshops would be of specific interest to those with children in Grades 3–5. Each school district respectively handled their own advertising for the workshops, resulting in a range of 1 to 20 workshop attendees. The workshop focus breakdown included five Addition/Subtraction workshops, three Multiplication/Division workshops, three Fraction Workshops, and three workshops combining addition/subtraction and multiplication/division.

Table 1. School District Demographics

Demographic	Low	High	Mean
% White Students	90.7	98.8	96.3
% Economically Disadvantaged	37.7	51.9	45.5
% ELL	0.00	0.70	0.20
Total District Enrollment (PK–12)	473	2,037	1,140
Geographic Size of District (Square Miles)	33.5	146.4	95.8
Distance from University (Miles)	7.9	59.7	27.1

In partnership with the local education agency servicing the four-county geographic region, the author aimed to build sustainability for family mathematics engagement in the region. In the summer preceding the third academic year of the project, the author offered a two-day training, coordinated through the local education agency, for in-service teachers who wanted to lead family mathematics workshops at their own schools. Through training, the teachers gained access to the author-developed materials and agreed to involve preservice teachers in the delivery of workshops. The teachers were welcome to use the materials in the "as is" form or customize them for their local context. One preservice teacher participant from Year 2 voluntarily attended and took part in discussions during the summer teacher training. She and one other preservice teacher participant from Year 2 returned for the Year 3 project. The author trained one additional preservice teacher during the same summer and therefore connected, at the commencement of Year 3, a total of three preservice teacher participants (two returning and one new) with the trained in-service teachers in the area. Unlike the previous two phases, the author was not involved in the delivery of workshops during Year 3. Rather, the three preservice teachers took part in the teacher-led workshops. The extent of the preservice teacher participation varied with this format. In some cases, they were very involved and, in other cases, they mostly observed. This final implementation saw the delivery of eight workshops. An overview of the three-year project is provided in Appendix B.

Data Collection

Preservice teacher participants completed a pre-assessment immediately prior to receiving training and a post-assessment at the conclusion of delivery of all workshops for the academic year. In constructing the assessment, the author built on instrumentation developed by other researchers in the field looking broadly at the question of preparing teachers to partner with families. The assessment for this research, composed of both a Likert scale survey and an open-ended questionnaire, more specifically uncovers preservice teacher understandings as they relate to collaborating with families in *mathematics* learning. The Likert scale survey portion of the assessment included 14 items distributed across three domains: knowledge (4 items), comfort (4 items), and beliefs (6 items). Knowledge and comfort items were rated on a six-point Likert scale with 1 as low (knowledge or comfort) and 6 as high (knowledge or comfort). These items were modeled, with permission, from a similar survey administered to preservice teachers by Morris et al. (1996). The six items comprising the third domain were adapted from the work of Hoover-Dempsey et al. (2005) and explored teacher beliefs about parental involvement and teacher

perceptions of parental efficacy. A six-point Likert scale was also utilized, with 1 as disagree strongly and 6 as agree strongly. Despite the author modifying items from adopted surveys, pre-assessment internal consistency remained adequate for items of knowledge ($\alpha = 0.75$), comfort ($\alpha = 0.80$), and beliefs ($\alpha = 0.78$). The author modeled, with permission, the open-ended questionnaire component of the assessment on the work of Patte (2011). The questionnaire covered the domains of positive outcomes associated with establishing family–school partnerships, barriers impeding family–school partnerships, content knowledge and teaching competencies in establishing family–school partnerships gained in recent coursework, and practical strategies to employ as new teachers in creating partnerships (see Appendix C).

The author conducted debriefing sessions with each group of participants at the conclusion of each of the first two years of the project when the author was also the lead workshop presenter. These debriefing sessions were recorded and transcribed to provide additional qualitative data. See Appendix C for the Debriefing Protocol utilized.

Mixed Methods Analysis

Given a sample size of nine, nonparametric statistics were employed to analyze the Likert survey portion of the assessment. To address the quantitative research objectives, aside from combatting family-wise error, a mean score was computed for each of the three domains (knowledge, comfort, beliefs) of each respondent's pre- and post-assessment surveys. The respective pre- and post-means were then compared using the Wilcoxon Signed Ranks Test in SPSS software to determine whether participants' knowledge, comfort, and beliefs about family engagement changed as a result of participating in the family mathematics workshop experience. For each of the two participants who were involved for two years of the project, just one survey, completed after their first year of participation, was analyzed.

The focused aim of the research, to describe the nature of change in participants' knowledge, comfort, and beliefs around family mathematics engagement, lent itself to using typological analysis (Hatch, 2002; LeCompte & Preissle, 1993) for the qualitative data set. "Typological analysis involves dividing everything observed into groups or categories on the basis of some canon for disaggregating the whole phenomenon under study" (LeCompte & Preissle, 1993, p. 257). The identification of three initial typologies for analysis derived directly from the research objectives: knowledge of family mathematics engagement, comfort in relation to family mathematics engagement, and beliefs about family mathematics engagement.

The author transcribed all data collected from the questionnaires and debriefings. Each entry, which was assigned a code, was carefully read and examined in relation to the three typologies. Relevant data entries were then collated by typology. Next, the author reread the data entries within each of the respective typologies, detecting and outlining possible themes for each typology. Data entries were read multiple times and organized around developing themes of change and growth influenced by mathematics workshop participation. Ultimately, each theme was supported by data that spanned multiple participants and failed to be contradicted by nonexamples (Hatch, 2002). The data that fell into to the knowledge typology did not coalesce around any clear themes of change. However, a total of six tentative themes of growth emerged with three related to comfort and three related to beliefs.

Table 2. Six Themes of Professional Growth

Typology	Theme
Knowledge	No themes revealing growth emerged from the qualitative data set in relation to knowledge. Data from the post-assessment was reflective of data from the pre-assessment.
Comfort	*Participants gained comfort in their ability to work with parents and families with confidence as opposed to intimidation.*
	Participants gained comfort specific to explaining mathematics and mathematics education.
	Participants gained comfort in handling mathematics education discussions potentially fraught with tension.
Beliefs	*Participants came to regard parents as allies.*
	Participants acknowledged potential parental frustration and resistance, while simultaneously claiming a professional responsibility to engage these very same parents.
	Participants articulated an emerging understanding that their professional responsibility as a mathematics educator extends to families as well as students.

To further secure trustworthiness and ensure that the focus of investigation was on the characteristics of the data (Lincoln & Guba, 1985), the data was next shared with the research assistant. The assistant, who was external to the implementation of the project, conducted an independent analysis, also focused on knowledge, comfort, and beliefs. Once the assistant had been grounded in the data through this independent analysis, the first author then shared with her the six tentative themes. The assistant independently reviewed each of these themes to confirm whether they were clearly derived from the

data. Each review included an explanation of confirmability, questions for consideration, and additional observations for each theme. The first author studied the assistant's analysis and reviews and then both researchers then came together for discussion on confirmability. Through justification, comparing, and contrasting of analyses, consensus was established that the six themes were well supported by the data. An outline of the typologies and related themes is provided in Table 2, with further description provided in the Findings and Discussion section. The qualitative analysis on the basis of three initial typologies (knowledge, comfort, beliefs) revealed six themes of professional growth.

Findings

Knowledge, Comfort, and Beliefs Prior to Participation

In questionnaire data collected prior to participation in training and workshop delivery, the preservice teachers communicated that they had acquired a fundamental knowledge around building family engagement from previous coursework and experiences. They identified the importance of keeping parents informed using strong communication (e.g., through newsletters and parent–teacher conferences). They additionally valued building strong and positive relationships with parents and creating welcoming classroom communities that encouraged parent involvement. The preservice teacher participants also anticipated positive outcomes associated with establishing family–school partnerships in relation to mathematics learning. Specifically, they expected increased support at home, improved attitudes and outlooks toward mathematics, and higher student achievement. In respect to potential barriers that might impede family–school partnerships in relation to mathematics, the participants recognized demands on families' time and scheduling conflicts. As well, they noted that adult family members may generally have a negative posture toward mathematics due to bad experiences in school, poor comprehension or confidence, or a mistrust or misunderstanding of current instruction and curricula that emphasize conceptual learning.

Knowledge and Comfort After Participation

Quantitative Results

Findings from analysis of the Likert scale survey suggest that training for and delivering math learning workshops increased the participants' total knowledge related to family engagement in mathematics. The total pre- and post-average comparisons on survey items related to total knowledge using Wilcoxon Signed-Ranks test were significant, $Z = -2.67$, $p \leq 0.01$. Descriptive statistics resulted in a pre-assessment median for total knowledge of 3.50 and

post-assessment median for total knowledge of 5.00. Across the knowledge section items, the nine participants reported total mean improvement differences ranging from 0.25 to 2.75.

Summary statistics for the individual knowledge survey items are shown in Table 3. Of note were survey items K2 and K3, which improved on average two points from pre-assessment to post-assessment. In both items, participants moved from a slightly negative to somewhat positive rating of their knowledge of components of effective mathematics workshops for families and of strategies for involving adults in the mathematical activity of children.

Preservice teachers' comfort levels in engaging families in mathematics learning additionally increased with participation in the workshop project as indicated by Likert scale survey results. The total pre- and post-average comparisons on survey items related to total comfort using Wilcoxon Signed-Ranks test were significant, $Z = -2.41$, $p \leq 0.05$. Here, descriptive statistics resulted in a pre-assessment median for total comfort of 3.88 and post-assessment median for total comfort of 5.25. Across the comfort section items, eight of nine participants (i.e., missing data for one) reported total mean improvement differences ranging from 0.00 to 2.00.

Table 3. Preservice Teacher Participants' Pre- and Post-Knowledge in Engaging Families in Mathematics

Knowledge Survey Item (on a 6-point scale)	Pre		Post		*p*-value[a]
	Median	IQR[b]	Median	IQR	
K1: Concepts needed for effective school, family, and community partnerships?	4.00	1.50	5.00	2.00	0.026
K2: Elements of effective mathematics workshops for parents?	3.00	1.50	5.00	1.00	0.007
K3: Successful strategies for involving parents in mathematics activities of their children?	3.00	1.50	5.00	0.00	0.011
K4: Advantages and disadvantages of parental involvement in school mathematics activities of their children?	4.00	1.00	5.00	1.50	0.084

[a]The authors acknowledge the potential increase of Type 1 error with multiple *p*-value items. Rather than adjusting for family-wise error, *p*-values are presented for individual item comparisons to highlight where the greatest benefit of participation occurred, relatively speaking.
[b]IQR = Interquartile range.

Summary statistics for the individual comfort survey items are shown in Table 4. Levels of comfort on three of the four items (Items C1, C2, C4) improved on average by two points. Item C2, related to comfort in planning and implementing effective mathematics learning workshops, is notable. Whereas all other comfort pre-assessment item averages were somewhat positive, the average response for Item C2 moved from slightly negative comfort to somewhat positive comfort.

Table 4. Preservice Teacher Participants' Pre- and Post-Comfort in Engaging Families in Mathematics

Comfort Survey Item (on a 6-point scale)	Pre		Post		*p*-value[a]
	Median	IQR[b]	Median	IQR	
C1: Ability to explain and discuss mathematics learning with parents (for example in a teacher conference)?	4.00	1.50	6.00	1.00	0.010
C2: Ability to plan and implement effective mathematics learning workshops for parents?	3.00	1.75	5.00	0.50	0.017
C3: The process of developing positive relations with parents of children that will be enrolled in your classes?	4.00	2.00	5.00	1.00	0.084
C4: About your ability to encourage parents to increase their involvement in the school mathematics activities of their children?	4.00	1.00	6.00	1.00	0.014

[a]The authors acknowledge the potential increase of Type 1 error with multiple *p*-value items. Rather than adjusting for family-wise error, *p*-values are presented for individual item comparisons to highlight where the greatest benefit of participation occurred, relatively speaking.
[b] IQR = Interquartile range.

While both levels of total knowledge and total comfort increased significantly over time, there was a stronger positive change overall for total knowledge ($p \leq 0.01$) than for total comfort ($p \leq 0.05$). Of the knowledge scale items, the two items with the greatest average gains (Items K2 and K3) relate to knowledge *specific* to family mathematics engagement: *elements* of a math workshop for parents and *strategies* for involving parents in children's math activities. Both of these items began with slightly negative averages. This is in contrast to Items K1 and K4 which point to a more general knowledge base and began with somewhat positive averages: *concepts* for effective school, family and community partnerships and *advantages/disadvantages* of parental involvement. Just

one comfort scale item (C2) began with a slightly negative average and also increased on average by two points. This item referred to comfort of a functional nature, planning and implementing a math workshop, as opposed to items that might be characterized as more affective, such as encouraging parents and developing positive relations. These findings seem consistent with those reported by Morris et al. (1996) on the original (but more general) family engagement scale; they indicated,

> Items receiving relatively high mean ratings on the pre-assessment tended to be related to general knowledge, efficacy, and comfort level in facilitating parental involvement. In contrast, items receiving low mean pre-assessment ratings tended to refer to more specific, operational aspects of facilitating parental involvement (p. 15).

Although the majority of all individual knowledge and comfort items significantly increased from pre-assessment to post-assessment, there were only near-significant trends ($p \leq 0.084$) for Items K4 and C3. Thus, with training and workshop delivery, the weakest improvement occurred for preservice teachers in knowledge of advantages and disadvantages of parental involvement in school math activities and in feelings of being comfortable with their own ability to develop positive relationships with parents. The project model was such that preservice teachers interacted with many adult family units across multiple school districts, but not the same adult family unit over time. It seems plausible that preservice teachers may need additional opportunities to work with family units over the long term to significantly increase their knowledge and comfort in some areas of family math engagement.

Qualitative Findings

The typological analysis of the open-ended questionnaire and debriefing session (see Appendix C) in relation to knowledge did yield a theme in which participants expressed *knowledge of the primacy of sharing mathematics class information and resources with adult family members*. However, this same theme was also evident in pre-assessment data, and, therefore, did not describe a discernible change of knowledge influenced by workshop participation.

Three important facets of participants' emerging preparedness for engaging families in mathematics learning in relation to comfort, however, were revealed in the typological analysis. First, participants connected their participation with a *comfort level in their ability to work with parents and families with confidence as opposed to intimidation*. Comments such as the following were common: "This boosted my confidence greatly. By the end I felt very comfortable speaking in front of and to parents," "These workshops most definitely helped expand my comfort level as a prospective classroom teacher who will be working with

parents," and "I am glad I had this opportunity to work with students' parents. This is not something a lot of preservice teachers have experience with. So, helping to deliver the workshops helped me to feel more comfortable talking to parents." Importantly, not only was this level of comfort acknowledged, it replaced previously held fears and anxieties about interacting with parents. There was a distinct delineation between the before and after. Participants described the thought of working with parents prior to participation as intimidating, scary, and nerve racking. But participation "eased the nerves," as one participant described. "Now," another wrote, "I am confident in myself and my knowledge." Finally, and significantly, there were examples of participants projecting this newfound and present comfort into their future work. Responses such as, "I am now ready to take the role and help the parents as well as the students" and "I look forward to working with parents and feel confident in my abilities to answer their questions" indicate the potentiality of the preservice teacher experience on the work of the eventual early career teacher.

In addition to an increase in participants' confidence in interacting with parents, the typological analysis revealed participants' improved *comfort specific to explaining mathematics and mathematics education.* The following responses capture the increased comfort level in discussing mathematics that came from participation in delivering the mathematics workshops: "I feel a lot more comfortable discussing and explaining math in front of people, especially parents. You have to think on your feet, and the workshops gave me a chance to do that"; "Helping with the parent workshops helped to develop my competence and comfort level. I now feel more comfortable talking about math and using proper math language"; and "This experience has boosted my confidence in talking about math in general, not just to parents." Emerging, too, in this facet was a growing confidence in speaking to the shifts in mathematics instruction as illustrated by a participant who shared: "My confidence level with the material has skyrocketed, and I have immense confidence in discussing the change in how mathematics is taught."

The third theme that appeared was in relation to participants' growing *comfort in handling mathematics education discussions potentially fraught with tension*. Participants expressed that they were ready to engage parents in conversation even around a "touchy subject like 21st century math," "even if they have different views," and especially those "who may not agree with the new way things are being taught." Data analysis indicated that participants do not intend to shy away from challenging conversations. "I have learned how to communicate with parents, and I have learned how to have calm discussions with parents who are upset with their child's learning," shared one participant. In fact, participation may have emboldened participants to tackle challenging conversations

head-on in the future as illustrated by this final statement: "Math seemed to have been a touchy subject with most parents, but this math workshop has really encouraged me to have meaningful math conversations with parents."

Beliefs After Participation

Quantitative Results

The preservice teacher participants were also surveyed to determine their beliefs about family engagement and perceptions of parental efficacy in children's mathematics learning. Unlike the areas of knowledge and comfort related to family mathematics engagement, the total pre- and post-average comparisons on survey items related to total parent beliefs using Wilcoxon Signed-Ranks test was not significant, $Z = 0.00$, $p = 1.00$. Descriptive statistics resulted in a pre-assessment median for total beliefs of 5.17 and post-assessment median for total beliefs of 5.33; since four participants improved over time, four declined, and one did not change, the pre- and post-assessment parent belief distributions cancelled each other out. Across the parental belief items, the nine participants reported total mean difference scores ranging from -0.50 to +1.33. The four instances of consistent decline were distributed across all three years, with two instances in the first year and one in each subsequent year. This suggests it is unlikely that an occurrence or feature that was specific to a project year could account for the cases of decline.

Summary statistics for the individual belief survey items are shown in Table 5. Interestingly, they suggest that the preservice teacher participants brought with them to the experience strong positive dispositions about the importance and potential of parental involvement in a child's mathematics learning. In fact, in five of the six pre-assessment items, the median response was a 5 or 6. However, one item, B1, in this part of the survey was exceptional to all others: *Most parents know how to help their children with mathematics schoolwork at home*. Here, the descriptive statistics indicate the preservice teachers held negative beliefs, which, although not statistically significant, became more negative over time. The initial responses seem consistent with the project's aim. Preservice teachers were invited to participate to help parents increase their knowledge of 21st century mathematics teaching and learning topics. Hence, preservice teachers likely began with the impression that helping with mathematics homework was an area of needed support for parents. It additionally seems plausible that working with parents and seeing specific needs and knowledge gaps reinforced this notion. It is worth noting that the worst decline over time for individual belief items was on Item B6, where the participant who trained in Year 3 dropped from a pre-assessment rating of 5.00 to a post-assessment rating of 1.00. Given that this was both the last item on the survey

and reverse-coded, it seems most plausible, although unfortunate, that the participant may have rushed through or misinterpreted the question. A less likely interpretation, but one that cannot be ignored, is that never having delivered workshops directly with the author, the participant may have been negatively influenced in her beliefs about parents by the project's partnering in-service teachers. This trend was noted by Hindin (2010) who found that "teacher candidates' beliefs…closely mirrored beliefs of the practicing teachers they observed" (p. 86).

Qualitative Findings

Typological analysis uncovered the preservice teachers' new ways of regarding and understanding parents and the relationship that parents have to their child's mathematics education. The data revealed, too, an emerging interpretation by the preservice teachers of their own future roles and responsibilities in family engagement. In all, three distinct themes were present within the typology for beliefs.

First, the experience seemed to serve as tangible evidence for the preservice teachers that *parents are allies*—that they just want what is best for their child. This confirmation that "they (the parents) had the same goal as we (the educators) did—success for their children" was linked to a growing comfort in working with parents. It also served as a future motivator:

> I cannot wait to work with my students' parents because I know that most parents want to work with their children and want what is best for them, and as a teacher I am able to do that. Also, as a teacher, I am supposed to help my students in any way, and sometimes helping parents is the best way to help the students.

The data also pointed to a significant respect that parents earned from the preservice teachers for going "out of their way to learn how to do math" and for being open to new ideas. "I really thought they were going to be more reluctant to transform their ways of thinking. But a lot of them were truly curious and were there because they really did want to change their way of thinking."

The data additionally pointed to a growing realistic and empathetic regard for parent frustration with newer ways of teaching and learning math by the preservice teacher participants:

> This experience has helped me with my attitude towards working with parents in general because it allowed you to see how some parents feel about math and just how easily frustrated they can get when they don't understand what is going on. It helped me to be able to feel some sympathy for them as they are physically struggling to understand what is

going on and how these workshops helped them with their attitude towards math and helping their child.

Table 5. Preservice Teacher Participants' Pre- and Post-Beliefs About Parental Involvement in Mathematics

Beliefs of Parental Involvement Survey Item (on a 6-point scale)	Pre		Post		*p*-value[a]
	Median	IQR[b]	Median	IQR	
B1: Most parents know how to help their children with mathematics schoolwork at home.	3.00	2.00	2.00	2.50	0.783
B2: Every family has some strengths that can be tapped to increase student success in mathematics class.	5.00	1.00	6.00	1.00	0.257
B3: All parents could learn ways to help their children with mathematics schoolwork at home, if shown.	6.00	0.50	6.00	0.50	1.000
B4: Parent involvement can help teachers be more effective with more students in mathematics learning.	6.00	0.50	6.00	0.00	0.414
B5: Parent involvement is important for student success in mathematics learning.	6.00	1.00	6.00	1.00	0.655
B6: Students' parents have little influence on their children's motivation to do well in mathematics.[c]	5.00	1.00	6.00	1.50	0.680

[a]The authors acknowledge the potential increase of Type 1 error with multiple *p*-value items. Rather than adjusting for family-wise error, *p*-values are presented for individual item comparisons to highlight where the greatest benefit of participation occurred, relatively speaking. [b]IQR = Interquartile range. [c]Reverse coded.

Participants were able to acknowledge potential parental frustration and resistance, while simultaneously claiming a professional responsibility to engage these very same parents. Appreciating that parents do not always agree with the mathematics learning made one participant realize that "It is essential to have a positive attitude and reach out to parents." Another pointed out that all parents are different, so it is necessary to get to know them and understand their situation in order to help them. This same participant went on to say, "As for mathematics, parents are rather reluctant toward math. This can be frustrating, but I have to deal with that and do the best I can to help their child." Impor-

tantly, there was evidence in the data in the participants' expected efficacy in being able to make new ways of teaching and learning mathematics understandable to parents: "As for math, I saw that while parents tend to cling to the old ways of doing things, they can be open to new ideas when someone takes the time to explain the concepts to them and give them the proper tools."

Finally, analysis revealed an emerging perception of the preservice teachers that their *professional responsibility as a mathematics educator extends to families as well as students*. First, the experience exposed the participants to the knowledge gaps of parents. For example, the participants confronted the reality that math tools common to teachers and students, such as Base 10 Blocks, can be initially confounding to adults with no prior experience with them. Consequently, adults benefit from instruction in their use. Another participant noted what might have been a strictly procedural understanding of addition and subtraction by a parent or perhaps a lack of understanding of the wide variety of contexts that addition and subtraction encompass. "They (parents) just didn't understand why you have to teach addition and subtraction. (To them) it was trivial. You have to teach them that. So, for me, I broke down addition and subtraction and how you would teach that, how it actually works." Participants made important connections between parent mathematics education, the "importance of making sure the parents know what is going on in the classroom," and modes to do so. Epstein (2018) calls for amplified efforts to bring family and community engagement within the professional canon of teaching. The findings of this study suggest that through training for and delivery of math workshops, preservice teachers may organically begin to adopt a professional responsibility towards the mathematics education of not just children, but also their families. These final two quotes are illustrative:

> As preservice teachers, this is a learning for us to make sure that you can provide materials for the parents to help them to be able to understand: whether it's a website [or] a sheet of paper or more in detail instructions that the parents see when they are doing the homework.…You don't realize just how big an impact it is until you're the one trying to teach the parents. You're going to be teaching kids one day, too.…You've got to be able to realize that they [parents] need help as well.

> Aside from talking to parents, I learned the parents need the teaching, too. You can't just teach the kids. You need to also teach the parents because they might not learn something or remember something from when they were in school. I think our math workshop was bridging that gap.

Discussion

Synthesis

Decades of research point to the invaluable educational outcomes related to family engagement. Yet, family engagement implementation is too often "random" and disconnected from instructional practices: "Educators tend to treat parents and families as bystanders rather than as partners, and often overlook their strengths and their capacity to transform public education" (Weiss et al., 2010, p. 2). Specifically, the field of mathematics education has not been especially successful at translating its reform discourse in a way that is readily adopted by parents and families (Bratton et al., 2006; Peressini, 1998; Remillard & Jackson, 2006). That family engagement might truly prove an effective strategy to promote student success, it must be reframed as a shared responsibility of families and schools, and it must occur across multiple settings where children learn (Weiss et al., 2010), such as the mathematics classroom and home.

The internal structure of Epstein's (2011) theoretical model of overlapping family and school spheres details "interpersonal relationships and influence patterns of primary importance" (p. 34). These relationships account for the experiences of parents, teachers, and students. At the level of praxis, the Association of Mathematics Teacher Educators (2017) asserts that beginning teachers must be well prepared to build "relationships and trust with families to support mathematics learning throughout the school year" (p. 18). The aim of our research entertained this personal dimension of subject-specific engagement between teacher and family members around elementary mathematics. That is, the three-part research question attended to the development of preservice teachers' knowledge and comfort in engaging families in mathematics learning and also to the beliefs they held about family mathematics engagement. Taken as a whole, the quantitative results and qualitative findings of this mixed methods study pointed to the potentiality of optimal conditions for healthy germination of between-organization connections (specific teacher-to-parent interactions and general school-to-family communications), delineated in the internal structure of Epstein's (2011) theoretical model, when preservice teachers were given an opportunity to deliver math workshops and engage with families.

Knowledge

The statistical analysis of pre- and post-average comparisons of Likert survey items showed a strong significant positive overall change ($p \leq 0.01$) related to participants' knowledge around engaging families in math. There were notable gains in relation to knowledge of important elements to include in math workshops for families as well as strategies for involving parents in children's

math activities. While the analysis of the qualitative data set did not yield any knowledge themes (of growth) that could be attributed to participation in delivering math workshops, it could tentatively be suggested that participants gained a firsthand knowledge of the imperative of sharing mathematics learning information and resources with parents. This firsthand knowledge might be thought of as complementing or reinforcing knowledge reportedly gained in previous coursework.

Comfort

The quantitative results specifically suggest that the opportunity to directly engage with families around 21st century mathematics teaching and learning topics is significant ($p \leq 0.05$) for developing much needed comfort to facilitate mathematics family engagement. Notable gains were found in participants' comfort in explaining and discussing mathematics learning with parents, planning for mathematics family workshops, and encouraging increased parental involvement in math. The qualitative findings both confirm and extend these results. They point to participants connecting their involvement in workshop delivery to increases in *comfort in their ability to work with parents and families with confidence as opposed to intimidation, comfort specific to explaining mathematics and mathematics education,* and *comfort in handling mathematics education discussions potentially fraught with tension.* The benefits of increased comfort are certainly important given Evans' (2013) review of the extant literature on educating preservice teachers for family engagement. The review indicated that while curricular exposure to family engagement topics contributes to increased levels of confidence for preservice candidates, teachers remain feeling unprepared for working with parents. The results here, however, lend optimistic evidence on the value of utilizing fieldwork in family math engagement as a critical bridge between preservice teachers' coursework and their first classrooms.

Beliefs

Pre-assessment data revealed strong initial beliefs about parent engagement, but pre- and post-comparisons of survey data were not significant. Qualitative data, however, was revealing. It seems that, given the opportunity to engage with families around mathematics learning, preservice teacher participants tended to refine their already-positive beliefs of family engagement and derive a firsthand *understanding of families as allies*, while simultaneously and realistically acknowledging that parents are not necessarily well prepared to support their students in 21st century math learning and will need significant support from the school system. This resulted in *expressions of realistic and empathetic regard for parent frustration* and also led participants to *articulate that a mathematics educator's professional responsibility extends to families as well as students.*

Epstein (2018) has argued that much more is needed to prepare teachers to understand family engagement as part of their professional work. The qualitative themes from this study depict how preservice teachers can begin to conceive their professional work with families, specifically in math, when they are given the experiences to engage with families directly. Uncovering these nuances could be an important step in building a teaching force skilled in overcoming the pervasive tension that emerges between those versed in reform mathematics discourse and those who are not.

Limitations

While promising, the work reported here has obvious limitations of generalizability. As previously described, the entirety of participants were White and female, and the field experiences occurred exclusively in rural and town locales. There is a clear opportunity to extend the research to include a more diverse pool of preservice teachers and to engage families in suburban and urban settings. In terms of methodology, it is also critical to highlight that the changes in knowledge, comfort, and perceptions in preservice teachers reported in this study were a result of preservice teachers interacting with a wide swath of adults in singular episodes. It is suspected that a research design which had preservice teacher participants engage the same family units over extended periods of time could yield varied findings. Finally, it cannot be ignored that this study's participants were shaped by working with adult family members who had both the interest in and ability to attend the family math workshops. The results, therefore, do not reflect how working with the population that was *not in attendance* would influence the formation of preservice teachers' knowledge, comfort, and beliefs.

Conclusion

The findings of this mixed methods study might inform the fine-tuning in teacher education programs of preparing future teachers for goal-linked family engagement (Epstein, 2018). Given overloaded coursework and time constraints common for education degrees, it is worth considering, for example, the appropriate balance between hours spent in coursework versus fieldwork for not just meeting, but optimizing, preservice teacher family engagement competencies. Furthermore, what affordances might preservice teacher family engagement models that relate directly to teaching and learning of content, such as mathematics, hold beyond more generic approaches? A favorable byproduct reported in this study was increased confidence in mathematics content knowledge and pedagogy by the preservice teachers. Although voluntary,

this field experience was most closely aligned with a required content course, not a family engagement or methods course. Given that, in practice, family engagement should ideally span the multiple settings in which children learn, it seems promising for teacher education programs to similarly diversify preservice teacher experiences.

Although the project reported on in this article proved encouraging for preparing teachers with the comfort, knowledge, and beliefs needed to communicate a 21st century vision of learning and teaching mathematics to parents and families, more research is needed to understand how participants translate their preservice family engagement learning and experiences into practice as early career teachers. Ideally, future studies could be longitudinal in nature with beginning teacher participants providing feedback and informing revisions to preservice teacher programming. Additionally, given that family, school, and community engagement is a much needed and underused lever for building college and career readiness (Weiss et al., 2010) and given that high school mathematics continues to be a gatekeeper to college and careers, the need for researching best practices in preparing preservice secondary mathematics teachers for family engagement is great. Those practices may differ in emphasis from those at the elementary level. Clearly, research that provides teacher education programs with guidance on how to prepare preservice teachers in the area of family engagement and mathematics education must continue to be a priority.

Endnote

[1]See Ferlazzo (2011) for a discussion on terminology. The authors of this article adopt the contemporary perspectives of family engagement and family partnership, but value and draw from the larger research base which historically focused on parent involvement.

References

Association of Mathematics Teacher Educators. (2017). *Standards for preparing teachers of mathematics*. http://www.amte.net/standards

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages, and innovative teaching.* Jossey-Bass.

Bratton, J., Civil, M., & Quintos, B. (2006). Engaging with parents on a critical dialogue about mathematics education. In M. Bosch (Ed.), *European research in mathematics education IV: Proceedings of the fourth congress of the European Society for Research in Mathematics Education* (pp. 1182–1192). http://erme.site/cerme-conferences/cerme-4/

Briars, D. (2014, August). *Back to school: Time to engage parents and families*. https://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/Diane-Briars/Back-to-School_-The-Time-to-Engage-Parents-and-Families/

Dweck, C. S. (2007). *Mindset: The new psychology of success*. Ballantine Books.

Epstein, J. L. (2009). School, family, and community partnerships: Caring for the children we share. In J. L. Epstein & Associates (Eds.), *School, family, and community partnerships: Your handbook for action* (pp. 9–30). Corwin Press.

Epstein, J. L. (2011). Toward a theory of family–school connections: Teacher practices and parent involvement. In J. L. Epstein (Ed.), *School, family, and community partnership: Preparing educators and improving schools* (pp. 26–41). Westview Press.

Epstein, J. L. (2018). School, family, and community partnerships in teachers' professional work. *Journal of Education for Teaching, 44*(3), 397–406. https://doi.org/10.1080/02607476.2018.1465669

Evans, M. P. (2013). Educating preservice teachers for family, school, and community engagement. *Teaching Education, 24*(2), 123–133. https://doi.org/10.1080/10476210.2013.786897

Ferlazzo, L. (2011). Involvement or engagement? *Educational Leadership, 68*(8), 10–14. https://www.ascd.org/el/articles/involvement-or-engagement

Goldstein, D. (2019, December 6). After 10 years of hopes and setbacks, what happened to the Common Core? *New York Times*. https://www.nytimes.com/2019/12/06/us/common-core.html

Hatch, J. A. (2002). *Doing qualitative research in education settings.* State University of New York Press.

Heitan, L. (2014, December 2). Schools teach common core math to two generations. *Education Week.* https://www.edweek.org/teaching-learning/schools-teach-common-core-math-to-two-generations/2014/12

Hindin, A. (2010). Linking home and school: Teacher candidates' beliefs and experiences. *School Community Journal,20* (2), 73–90. https://www.adi.org/journal/fw10/HindinFall2010.pdf

Hoover-Dempsey, K. V., Walker, J. M. T., & Sandler, H. M. (2005). Parents' motivations for involvement in their children's education. In E. N. Patrikakou, R. P. Weissberg, S. Redding, & H. J. Walberg (Eds.), *School–family partnerships for children's success* (pp. 40–56). Teachers College Press.

Jacobbe, T., Ross, D. D., & Hensberry, K. K. R. (2012). The effects of a family math night on preservice teachers' perceptions of parental involvement. *Urban Education, 47*(6), 1160–1182. https://doi.org/10.1177%2F0042085912447805

Jay, T., Rose, J., & Simmons, B. (2017). Finding "mathematics": Parents questioning school-centered approaches to involvement in children's mathematics learning. *School Community Journal, 27*(1), 210–230. https://www.adi.org/journal/2017ss/JayRoseSimmonsSpring2017.pdf

Lachance, A. (2007). Family math nights: Collaborative celebrations of mathematical learning. *Teaching Children Mathematics, 13*(8), 404–408. http://www.jstor.org/stable/41198982

Larson, M. R., & Kanold, T. D. (2016). *Balancing the equation: A guide to school mathematics for educators & parents.* Solution Tree Press.

LeCompte, M. D., & Preissle, J. (1993). *Ethnography and qualitative design in educational research* (2nd ed.). Emerald.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry.* Sage.

Mangram, C., & Metz, M. T. S. (2018). Partnering for improved parent mathematics engagement. *School Community Journal, 28*(1), 273–294. https://www.adi.org/journal/2018ss/MangramMetzSpring2018.pdf

Mistretta, R. (2013). Becoming "in the know" about parent–child collaborations in mathematics. *Mathematics Teacher Educator, 1*(2), 108–136. https://doi.org/10.5951/mathteaceduc.1.2.0108

Mistretta, R. M. (2017). Conversations with family members about math. *School Community Journal, 27*(1), 181–200. https://www.adi.org/journal/2017ss/MistrettaSpring2017.pdf

Morris, V., Taylor, S., Knight, J., & Wasson, R. (1996). Preparing teachers to reach out to families and communities. *Action in Teacher Education, 28*(1), 10–22. https://doi.org/10.1080/01626620.1996.10462818

National Council of Teachers of Mathematics (NCTM). (2014). *Principles to actions: Ensuring mathematical success for all*.

National Council of Teachers of Mathematics (NCTM). (2020). *Looking back, moving forward* [Interactive timeline]. https://www.nctm.org/100timeline/

National Governors Association Center for Best Practices and Council of Chief State School Officers. (2010). *Common Core state standards for mathematics*. http://www.corestandards.org/wp-content/uploads/Math_Standards1.pdf

Patte, M. M. (2011). Examining preservice teacher knowledge and competencies in establishing family–school partnerships. *School Community Journal, 21*(2), 143–159. https://www.adi.org/journal/2011fw/PatteFall2011.pdf

Peressini, D. D. (1998). The portrayal of parents in the school mathematics reform literature: Locating the context for parental involvement. *Journal for Research in Mathematics Education, 29*(5), 555–582. https://doi.org/10.2307/749733

Remillard, J. T., & Jackson, K. (2006). Old math, new math: Parents' experiences with standards-based reform. *Mathematical Thinking and Learning, 8, 231–259.* https://doi.org/10.1207/s15327833mtl0803_3

Rich, M. (2014, June 29). Math under Common Core has even parents stumbling. *New York Times*. https://www.nytimes.com/2014/06/30/us/math-under-common-core-has-even-parents-stumbling.html

Ryan, M. (2015, February 15). New effort teaches mathematical thinking, but homework confuses parents. *Florida Today.* https://www.floridatoday.com/story/news/local/2015/02/13/new-effort-teaches-mathematical-thinking-homework-confuses-parents/23368287/

Sheldon, S. B., & Epstein, J. L. (2005). Involvement counts: Family and community partnerships and mathematics achievement. *The Journal of Education Research, 98*(4), 196–206. https://doi.org/10.3200/JOER.98.4.196-207

Weiss, H. B., Lopez, M. E., & Rosenberg, H. (2010). *Beyond random acts: Family, school, and community engagement as an integral part of education reform.* National Policy Forum for Family, School, & Community Engagement. https://sedl.org/connections/engagement_forum/beyond_random_acts.pdf

Whitenack, J. W., Cavey, L. O., & Henney, C. (2015). *It's elementary: A parent's guide to K–5 mathematics.* National Council of Teachers of Mathematics.

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Appendix A. Workshop Format

Workshop Format (Year 1 and Year 2)		
Introduction to 21st Century Mathematics Teaching and Learning	This 30-minute segment provided participants with an overview of the latest research for how the brain learns mathematics best and described the 21st century skills needed for college and career readiness. This segment was the same regardless of mathematical content focus of the workshop.	Led by author
Mathematical Content	This 60-minute segment provided participants with a conceptual overview of elementary mathematics content. Participants engaged in hands-on math learning. There were three workshops based on different mathematical content: • Addition/Subtraction • Multiplication/Division • Fractions	Led by author with preservice teachers assisting family members in hands-on math learning
At-Home Mathematics Activities and Resources	This 30-minute segment introduced math activities to do at home and provided participants with a compilation of resources that families could easily access to increase their own conceptual understanding of elementary mathematics and to assist in their child's learning.	Led by preservice teachers

Appendix B. Project Overview

	Year 1	Year 2	Year 3
Evolution of Project	Multiple inquiries for support lead author to develop workshops for families of elementary age children on 21st century mathematics teaching and learning.	Author partnered with local education agency for delivery of workshops across a three-county geographical region.	Author partnered with local education and conducted a two-day summer "train-the-trainer" with in-service teachers on delivering the workshops.
Cohort Training	First cohort of four preservice teacher participants received 6 hours of training.	Second cohort of 4 preservice teacher participants received 6 hours of training.	One additional preservice teacher participant received 6 hours of training.
Delivery of Project	Author and first cohort delivered one Addition/Subtraction and one Multiplication/Division workshop over the course of two evenings at a local school district and a combined Addition/Subtraction and Multiplication/Division workshop which was open to the public and offered on the university campus on a Saturday morning.	Author and second cohort delivered 14 workshops to eight different school districts. The workshop focus breakdown included: 5 Addition/Subtraction workshops, 3 Multiplication/Division workshops, 3 Fraction Workshops, and 3 workshops combining Addition/Subtraction and Multiplication/Division.	Two preservice teacher participants returning from the second cohort and the newly trained participant assisted with eight workshops delivered by the in-service teachers who received summer training. The author was not involved in the delivery of the workshops, and the formats varied.

Appendix C. Questionnaires and Debriefing Protocol

Pre-Program Questionnaire

1. What specific content and competencies have you learned in your undergraduate coursework for establishing family–school partnerships in general? For mathematics learning in particular?

2. What are the most positive outcomes associated with establishing family–school partnerships in relation to mathematics learning?

3. What are some barriers impeding family–school partnerships in relation to mathematics learning?

4. As a new teacher, what could you do to promote meaningful family–school partnerships in general? For mathematics learning in particular?

Post-Program Questionnaire

1. What are the most positive outcomes associated with establishing family–school partnerships in relation to mathematics learning?

2. What are some barriers impeding family–school partnerships in relation to mathematics learning?

3. As a new teacher, what could you do to promote meaningful family–school partnerships related to mathematics learning?

4. Discuss the effect that training for and helping to deliver the parent workshops had on developing your competence and comfort level as a prospective classroom teacher who will be working with parents.

5. How has this experience affected your attitudes about working with parents in general? And in relation to mathematic learning in particular?

Debriefing Protocol

1. Did any of the mathematical content of the workshops help you think about elementary mathematics in new ways? If so, which content and explain.

2. Were you surprised by anything or find anything interesting in working with or listening to the parents?

3. Were there any particular workshops or interactions with parents that were significant to you? If so, why?

4. What is your biggest "takeaway" from this experience?