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Transforming Preservice Teachers in Teaching Mathematics through Family Math Night: Community-Based Learning in an Urban Context

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This study investigates the impact of a Family Math Night event on preservice teachers' (PSTs) perceptions of mathematics within a mathematics methodology course at a Hispanic-serving university on the West Coast. Sixteen PSTs participated in designing and implementing activities for the Family Math Night event at an urban elementary school, aimed at fostering community-based field experiences in teaching mathematics. Through qualitative analysis of PSTs' reflections and discussions, the findings reveal a transformative impact of the Family Math Night event on PSTs' perceptions of mathematics and its teaching and learning. Moreover, PSTs highlighted the opportunity to teach mathematics at Family Math Night in relevant ways to accommodate individual students' mathematical levels and enhance student engagement. They also recognized the significance of parental involvement in mathematics education and expressed their intention to involve parents in their future careers. Overall, the findings highlight the potential of community-based learning initiatives like Family Math Night to expand PSTs' perceptions of mathematics education and bridge the gap between methodology courses and fieldwork. This study contributes to the understanding of community-based learning opportunities for PSTs in mathematics education within urban contexts.

KEYWORDS: *Family Math Night, Teacher preparation, Informal learning, Community engagement*

Engaging parents in urban settings presents significant challenges, including demanding work schedules, economic constraints, lack of communication, and unfamiliarity with formal education practices. These barriers can hinder effective collaboration between families and schools, ultimately impacting student success (Baker et al., 2016). Additionally, cultural and linguistic

differences may reduce trust in school interactions, limiting parental engagement (Araque et al., 2017; Eamon, 2002).

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Systemic issues within urban schools compound these challenges. Urban schools often operate in under-resourced environments, limiting students' access to high-quality mathematics education (Milner, 2012). Mathematics instruction in these settings is frequently disconnected from students' cultural and community contexts, which can reduce engagement and achievement (Leonard & Evans, 2008). Effective mathematics teaching in urban contexts requires a shift from traditional methods to equity-based approaches that connect math instruction to students' backgrounds and everyday experiences (Bartell et al., 2017). However, this shift is often underrepresented in traditional teacher preparation programs (Willey & Pinheiro, 2019). Many preservice teachers (PSTs) lack opportunities to engage directly with the communities they will serve, making it challenging to adopt culturally relevant practices effectively. Teacher education programs must prepare future teachers to navigate resource constraints and advocate for equity (Martin & Larnell, 2013).

Despite their evident passion for the profession, many PSTs express lower levels of confidence and employ less innovative approaches when teaching mathematics (e.g., Bursal & Paznokas, 2006). The mathematics methods courses aim to provide PSTs with opportunities to enhance their confidence and develop effective teaching skills through a combination of theoretical knowledge and practical experience. Research shows that guided field experiences in methods courses enhance PSTs' self-efficacy and support their professional development (e.g., McDonnough & Matkins, 2010; Zhou, 2024). However, in the traditional model of field experiences, PSTs are placed in classrooms to observe their cooperating teachers, which limits their chances to apply the strategies they learn in their methods courses. These teaching opportunities may be constrained by the practices of their cooperating teachers, leaving PSTs with fewer chances to directly engage with children and parents (Darling-Hammond et al., 2005).

Moreover, traditional field experiences often restrict PSTs to formal classroom settings, where they may encounter deficit-based teaching methods similar to their own mathematics learning experiences. This model can limit PSTs' exposure to valuable knowledge and perspectives derived from the community and families. In particular, the knowledge held by families from minority groups, including those from low socioeconomic backgrounds, immigrant families, and racial minorities, is often overlooked by educational institutions (Abreu et al., 2002; Civil et al., 2005; Gutstein, 2006). As a result, PSTs may miss opportunities to understand that mathematics, more than just a school subject, is embedded within diverse cultural contexts.

This study builds upon a project that aims to transform fieldwork within teacher preparation programs by integrating community knowledge and linking it

with methods courses. The project involves the incorporation of Family Math Night (FMN) into a mathematics methodology course as part of PSTs' field experiences. Sixteen PSTs enrolled in an elementary methods course participated in designing and implementing activities for the FMN event. Working in groups, PSTs designed their activities and developed detailed plans. A total of six activities were implemented during the FMN. The goal of this study is to investigate the impact of a community-based field model on PSTs' perceptions of mathematics and its teaching and learning. Specifically, the study inquiry is guided by the following three research questions:

- To what extent does the design and facilitation of activities in Family Math Night, as an informal learning setting, influence preservice teachers' perspectives on mathematics?
- What learning experiences do preservice teachers gain from participating in Family Math Night events regarding teaching mathematics?
- How do preservice teachers perceive parents' involvement in supporting children's mathematics learning through the Family Math Night event?

Literature Review

This literature review explores three key areas that inform the professional development of PSTs: informal learning environments, community-based learning experiences, and opportunities for collaboration with parents. This review establishes a foundation for the study, which investigates the informal nature of FMN as a community-based learning opportunity for PSTs. The following subsections delve into each area, highlighting their significance in shaping PSTs' perspectives on mathematics and its teaching and learning.

Informal Learning Environments on PSTs' Professional Development

Utilizing informal learning environments for preservice teachers' professional development is a relatively new area of research and practice. Some studies have examined the impact of informal learning experiences on preservice teachers' self-efficacy, teaching practices, and perceptions of teaching. The reviewed studies encompass a range of settings, including science and mathematics camps, field trips, museum-based learning, and robotics courses, using qualitative and mixed-methods approaches to explore their influence on preservice teachers' understanding of pedagogy, content knowledge, and teacher identity.

Research indicates that informal learning environments have a positive impact on PSTs' teacher identity and self-efficacy across subjects and grade levels. For instance, Arslan (2024) examined the reflections of preservice middle school mathematics teachers who served as assistant teachers in science and mathematics camps and found that these experiences enhanced their teacher identity development and confidence in teaching. Similarly, Evans et al. (2021) analyzed the effects of a Noyce Internship Program and STEM camp participation on preservice STEM teachers and found increased self-efficacy and enthusiasm for teaching

STEM subjects among these PSTs. Temel (2023) conducted a study with elementary mathematics teacher candidates ($n = 59$), examining their self-efficacy towards out-of-school learning activities and perceptions of out-of-school learning. The findings revealed a positive influence of these environments on both selfefficacy and perceptions of mathematics learning beyond the classroom.

Informal learning environments also enhance PSTs' teaching practices. Patrick et al. (2013) reported that PSTs who listened to elementary students' conversations during zoo visits shifted their conceptions about student learning and the importance of planning. Kayhan and Yetkin (2023) investigated the integration of museum resources into lesson plans by preservice middle school mathematics teachers, noting their ability to use museum resources as mathematical contexts. Mohr-Schroeder et al. (2018) used qualitative methods, including reflection analysis and interviews, to examine the impact of a field experience in a robotics course on preservice secondary mathematics teachers' understanding of STEM instruction and classroom management. Their findings indicated an improved understanding of STEM instruction, enhanced classroom management, and increased excitement for STEM content.

These studies highlight the diverse impact of informal learning environments on PSTs' professional development. Considering the limited attention given to informal learning environments in teacher education, this study seeks to contribute by investigating the impact of FMN. By exploring this area, the study aims to deepen our understanding of how FMN, as an informal learning environment, influences PSTs' perspectives on mathematics and its teaching and learning.

Community-based Learning for PSTs

Community-based learning emphasizes the establishment of connections within the community. Research has shown that engaging in community-based field experiences potentially broadens PSTs' understanding of pedagogical strategies and provides them with opportunities to facilitate learning. In Khan and Van Wynsberghe's (2020) systematic review of 25 articles on community service learning in science teacher education, they found that community-based learning has significant potential to enhance future science educators' abilities to understand their students, communities, and the multifaceted roles they embody as science teachers. Specifically, preservice science teachers showed improvement in their understanding of science content and pedagogy, demonstrated by their ability to integrate various resources into lesson planning and employ diverse assessment methods.

Community-based learning opportunities broaden PSTs' understanding of nontraditional educational models. In Hamilton and Margot's (2019) year-long pilot partnership with a public museum and a teacher education program, 35 secondary PSTs across various subjects explored methods for integrating community-based settings into their teaching approaches. The PSTs indicated that in their future teaching endeavors, they would consider the potential of "third spaces" to support and enhance learners' comprehension. Similarly, Khan and Van Wynsberghe (2020) reported that community-based learning facilitated PSTs' appreciation of diversity

and multicultural contexts, enabling them to reflect on teaching culturally diverse students and challenging deficit models of interaction and instruction.

In community-based learning, interactions between PSTs and parents provide valuable insights into culturally responsive instructional practices and communication skills (Guillen & Zeichner, 2018). Engaging with parents allows PSTs to gain insight into families' daily experiences, which subsequently informs their instructional practices in the classroom (Boit, 2020). Bofferding et al.'s (2016) study demonstrates that participating in FMNs increases PSTs' comfort levels when interacting with children and parents. Furthermore, engagement in communitybased settings, such as FMNs, enhances PSTs' abilities to develop skills in facilitating parent-child communication and understanding teaching methods through effective questioning (Mistretta, 2013). Thanheiser (2019) finds that FMNs support PSTs in reconceptualizing their perspectives on mathematics learning as a sense-making, engaging, and enjoyable process, thereby bolstering their confidence in teaching mathematics. Expanding upon this groundwork, the present study investigates FMNs as a community-based learning opportunity for PSTs to enrich their professional development in mathematics education.

Teacher Education Providing Opportunity for PSTs to Work with Parents

Substantial research confirms that students tend to be more successful when there is a strong connection and collaboration among educators, families, and communities to support their learning and development (e.g., Martinez & Ulanoff, 2013). When working with families, PSTs have opportunities to "conceptualize their learning and the learning of their students in new ways" (Hallman & Rodriguez, 2015, p. 100). Through interaction with parents, PSTs learn about families' daily experiences and gain insight into how to support parents in enhancing their children's understanding of mathematics (Boit, 2020). This interaction also benefits PSTs in implementing meaningful teaching in the classroom.

However, such opportunities are not commonly integrated into teacher education programs (Mistretta, 2013). Novice teachers often struggle with a lack of confidence in engaging effectively with parents (Boit, 2020). This challenge might stem from insufficient preparation programs, which often fail to equip PSTs with the necessary skills and strategies to work with parents (Mistretta, 2013). This challenge particularly persists in mathematics education, where children may struggle to recognize the mathematical knowledge embedded in their cultural contexts, hindering parental involvement in supporting mathematical learning (Civil et al., 2005; Mistretta, 2013).

Civil et al. (2005) emphasized the importance of understanding the social contexts in which students are situated, especially how parents perceive their children's mathematics education. Collaborations between schools and Latino families, for instance, involve recognizing language, individual variations, and parental concerns while positioning parents as active participants in the educational process (Leyva et al., 2018). Epstein (2018) advocated for integrating family and community engagement into college courses to help PSTs develop communication skills with parents and prepare for their roles as classroom teachers.

Strategic family and community involvement initiatives can promote inclusivity and equity (Epstein & Sheldon, 2006). For example, FMN initiatives not only celebrate mathematics but also foster a sense of unity among schools, families, and communities (Lopez & Donovan, 2009). By integrating family and community engagement into teacher education, institutions can empower PSTs to establish meaningful partnerships and create enriching learning experiences for all students (Epstein, 2018).

The reviewed literature provides valuable insights into the multifaceted impact of informal learning environments, community-based learning experiences, and opportunities for PSTs to collaborate with parents in their professional development. These findings inform the current study, which explores the utilization of FMN as a community-based learning opportunity for PSTs to engage with parents and children, further enriching their professional development in mathematics education.

Theoretical Framework

This study is grounded in sociocultural theory (Vygotsky, 1978) and situated learning theory (Lave & Wenger, 1991), which serve as lenses to understand the role of community-based learning in shaping PSTs' professional development. Sociocultural theory, as articulated by Vygotsky, emphasizes the importance of social interaction, cultural context, and collaborative learning in cognitive development. Situated learning theory views learning as participation in practices and emphasizes the relationship between learning and the social situations in which it occurs. In this study, FMN is conceptualized as a community-based learning experience where PSTs engage with students and parents in a sociocultural context through social interactions. This approach aligns with the literature that underscores the impact of informal learning environments, community-based fieldwork, and family engagement on PSTs' evolving perceptions of teaching and learning mathematics.

Sociocultural theory suggests that learning is embedded within social contexts and influenced by cultural values and practices (Cobb, 1994). Through FMN, PSTs participate in culturally relevant activities that reflect the diverse backgrounds of students and their families, thereby enriching their teaching practices. The literature review highlights how informal learning contexts, such as science camps and museum visits, positively affect PSTs' confidence and teaching skills (Arslan, 2024; Evans et al., 2021). Similarly, by engaging in FMN, PSTs encounter real-life cultural contexts, which enable them to see mathematics learning as a collaborative, community-oriented process rather than a solely academic endeavor. This mirrors Vygotsky's notion of activity—learning experiences structured around authentic, interactive tasks that connect psychological and sociocultural meaning.

Moreover, sociocultural theory emphasizes the role of social interaction in learning (Vygotsky, 1978). By engaging with parents during FMN, PSTs gain insight into families' daily experiences and develop skills for effective

communication and partnership with parents. As highlighted in the literature, collaboration with families supports PSTs in understanding how cultural contexts influence students' mathematical thinking and learning styles (Boit, 2020; Civil et al., 2005). This experience allows PSTs to view mathematics education as a shared endeavor between educators and families, enhancing their capacity to implement inclusive and equitable practices in their future classrooms.

Situated learning theory provides a robust foundation for analyzing the impact of FMN on PSTs' professional growth (Lave & Wenger, 1991). FMN serves as a bridge between PSTs' academic preparation and real-world application, encouraging them to move beyond deficit perspectives and appreciate the unique contributions of families. By situating FMN within a sociocultural framework, this study contributes to an understanding of how informal, community-based learning opportunities facilitate PSTs' development of culturally responsive teaching skills and foster their connections with students' families, bridging the gap between theoretical knowledge and practical application in urban mathematics education. Through the FMN experience, PSTs are better equipped to understand the social structures and cultural dynamics of urban education settings, aligning with the goals of sociocultural theory to foster meaningful, contextualized learning.

Methods

This study is based on a course project within a mathematics methodology course in a multiple-subject teacher education program at a Hispanic-serving university on the West Coast of the U.S. The project involves PSTs designing and implementing activities for an FMN event hosted at a local elementary school that predominantly serves a Hispanic/Latino population. Its objective is to provide PSTs with community-based field experiences in teaching mathematics, with the overarching aim of establishing sustainable connections among institutions, schools, and communities by creating informal learning spaces for PSTs, parents, and children.

Participants

Twenty PSTs were enrolled in the course. Aligning with the literature (e.g., Bursal & Paznokas, 2006), many PSTs do not feel confident in mathematics, and some even expressed their fear of teaching the subject. Designing and facilitating activities for FMN was a new experience for them.

Working in groups of 2-4, they collectively designed and planned activities for the FMN event. Due to scheduling constraints, only 16 of the PSTs were able to participate in the event. As these 16 PST teachers had full experience with the FMN, including planning, implementation, and reflection, they were therefore selected as participants for this study. In total, the PSTs organized six activities for the FMN. Refer to Table 1 for the activities and their brief descriptions.

Table 1.

Family Math Night Activity

Building a City	Students are given a paper with rows of numbers and a square above each number. For example, if the number is "8," they receive "8" Legos to stack up.
Subtraction Bowling	Students use a ball to knock down water bottles, keeping score on a whiteboard.
Money Equivalence	Students use fake money to demonstrate equivalent amounts using different combinations of coins.
UNO Multiplication	Students use UNO cards to practice multiplication facts. They draw two cards at a time, write the numbers on a sheet, multiply them, and continue until the stack is finished.
Multiplication Flower	Students create a flower with different number combinations that multiply to equal answers, providing a fun prop for practicing multiplication.
Jeopardy	Using a tablet, students answer questions ranging from addition to division, with paper provided to solve the questions.

Data Source

The main data sources consist of participants' contributions during class discussions and their written reflections, along with reflective insights shared during debrief sessions. Supplementary data were also collected from course assignments, such as autobiographical teacher stories submitted at the beginning of the semester, to examine the influence of these experiences on participants' perspectives regarding mathematics and its teaching and learning, and to capture the transformation of their viewpoints.

Data Analysis

The data analysis process involved three rounds. In the first round, open coding was employed to systematically review and categorize the data collected from individual participants. This process involved reading and re-reading the participants' reflections and discussions to identify initial codes (Saldaña, 2009). It enabled the emergence of diverse themes and patterns within the data.

In the second round of analysis, directed content analysis and thematic analysis were applied simultaneously. Directed content analysis, as described by Hsieh and Shannon (2005), focused on answering the three research questions. This approach facilitated a targeted examination of PSTs' perceptions of mathematics from informal learning, community-based learning, and parental involvement,

ensuring that the findings directly addressed the research questions. Thematic analysis (Braun & Clarke, 2006) was also conducted to identify recurring themes across the participants. This method allowed for the emergence of meaningful overarching themes and subthemes from the data.

The third round of analysis refined and further developed themes identified in the second round. This iterative process ensured that themes effectively addressed each research question and enabled a more nuanced exploration of the relationships between themes and subthemes, providing deeper insights into the experiences of PSTs in the FMN.

To enhance the validity and credibility of the data interpretation, member checking and peer review were conducted. A PST participant was invited to review the findings and offer feedback on the interpretation of the data. Additionally, during the data analysis process, a mathematics education researcher experienced in qualitative analysis methodologies was invited to provide feedback on the analytical approach. Their feedback contributed to a robust analytical framework and validated the data interpretation.

Findings

The findings are organized into three sections, each addressing a research question respectively. The first section explores the impact of FMN on PSTs' perceptions of mathematics. The following section presents learning opportunities for PSTs to teach mathematics during FMN. The last section delves into PSTs' perceptions of parental involvement in mathematics education.

Impact of Family Math Night on Preservice Teachers' Perceptions of Mathematics

This section addresses the research question: *To what extent does the design and facilitation of activities during Family Math Night, as an informal learning setting, impact preservice teachers' perspectives on mathematics?* The question is answered by delving into PSTs' transforming perceptions of mathematics and their recognition of meaningful mathematics learning.

Transforming Perceptions of Mathematics

The FMN event served as a catalyst for PSTs to transform their perceptions of mathematics and rethink their approach to teaching the subject. They highlighted the importance of presenting math in non-traditional ways to enhance student enjoyment and facilitate their growth as educators. One PST expressed this feeling, noting:

Math sometimes carries the stigma of being difficult and unenjoyable. However, presenting math in diverse, non-traditional ways can greatly enhance student engagement and enjoyment. I now recognize the versatility of integrating math into various contexts.

Reflecting on their own negative experiences with mathematics in school, PSTs acknowledged how engaging activities during the event reshaped their perceptions. For instance, one PST shared:

When I was in school learning anything with math was extremely difficult and I had a negative perception of math. FMN showed me various engaging activities for different age groups and different math content. This experience made me aware of how as teachers we might change students' negative perceptions of math.

PSTs emphasized the transformative role of hands-on activities during the FMN. One PST stated:

I usually don't enjoy math because it's difficult for me to understand, and I get confused and stressed out with all of the math symbols and vocabulary. In FMN, I realized Math can be fun, especially through hands-on activities.

Another PST shared a profound shift in perspective about the enjoyment potential of mathematics:

If you had asked me before FMN if math could be fun, I probably would have said no. But now I can confidently say that math can be fun if you make the effort to make it more fun and engaging for your students.

These reflections underscored the realization that mathematics extends beyond traditional learning, offering opportunities for enjoyment and applicability in everyday contexts. As one PST summarized:

This event taught me that math is not always problems solved on paper. Math can be fun, it can be used anywhere, and most importantly, math matters. This event showed me that students do love math and activities like the ones we did show them that math can be used outside of the classroom.

Additionally, PSTs who initially doubted students' engagement in math-related activities were surprised by the high level of enthusiasm they witnessed during the event. One PST admitted: "Although I consider myself a math person, I assumed students wouldn't be engaged because it was math. But it was amazing to see how engaged they all were."

These participants' reflections demonstrate the transformative impact of the FMN event on PSTs' perceptions of mathematics teaching and learning, inspiring them to adopt more innovative and engaging approaches in their future practice.

Recognition of Meaningful Mathematics Learning

Participating in FMN allowed PSTs to recognize their potential as future educators to make mathematics meaningful and provide engaging learning experiences for students. Reflecting on the event, one PST expressed their desire for students to find enjoyment in learning math: "As a future teacher, I want my students to have fun while learning math." Another PST highlighted the event's role in bridging the gap between mathematics learned in school and its real-world applications:

A lot of students have the same question about how math is useful outside of school. This event helped them to make that connection. I enjoyed FMN, and I think that it was a fun way to practice teaching math activities.

Across groups, PSTs reflected on how their activities effectively made mathematics visible and engaging. For instance, one PST shared: "My group's subtraction

bowling activity went really well. It showed me that math could be integrated into non-traditional ways like games." Similarly, another PST described how creating multiplication flowers provided an enjoyable way for students to practice multiplication: "The multiplication flowers served as a study tool for students to practice their multiplication memorization in a creative way."

Students' engagement during the activities further affirmed their effectiveness in making mathematics enjoyable and relevant. One PST noted: "The students and parents were excited to do our activity with UNO cards. Even those hesitant to practice multiplication were convinced to participate after seeing how fun it could be."

Visual aids and manipulatives enhanced the activities by making mathematics tangible. A PST from the Building a City group highlighted the use of Legos: "Using Legos made math visible; students had their own techniques when counting and building." A PST from the Money Equivalence group emphasized the importance of real-world relevance in the activity: "I hooked students by asking if they like to shop and use money. I reminded them that these skills are essential throughout their lives."

Overall, FMN inspired PSTs to adopt creative and engaging instruction in their future teaching endeavors. As one PST concluded,

I believe we all have the standards and testing that students must go through. Some teachers forget that they are still children and that playing is sometimes their priority. As teachers, we can follow the school curriculum but add a unique touch by providing children with activities that promote their math skills development through activities.

These reflections underscore FMNs' transformative role in shaping PSTs' perceptions of mathematics and its teaching and learning. FMN inspired PSTs to adopt innovative approaches and empowered them to make mathematics meaningful for their future students.

Learning Opportunities for Teaching Mathematics at Family Math Night

This section addresses the research question: *What learning experiences do preservice teachers gain from participating in FMN regarding teaching mathematics?* The informal nature of FMN offered PSTs a unique teaching experience, diverging from the structured macro-teaching with peers or traditional field teaching in classrooms. It served as a platform for PSTs to engage with students across different grade levels and adapt their instruction in real time.

Teaching Mathematics Across Grade Levels

PSTs organized stations for FMN, with each group responsible for managing a specific station. Initially, activities were labeled according to grade levels, such as Grades 2-3, to guide student participation. However, as the event progressed, students of all ages joined the activities, prompting PSTs to adapt their planned activities on the spot. This allowed them to engage in conversations with students and assess their readiness for the mathematical concepts involved. A PST from the Multiplication Flower group shared:

I thought our table would only bring in the grade group we focused on; however, students as young as Pre-K were able to successfully participate in the

activity. This was exciting for me to see because I didn't know if students that young could make multiplication connections. It made me realize that students have a bank of knowledge ready to be used at any time.

Teaching students across different grade levels also provided PSTs with an opportunity to tailor their instruction and approaches to suit the needs of diverse learners. For example, the Building a City group initially designed their activity for kindergarten to 1st-grade students. When older students joined, they adjusted their activity accordingly. One PST reflected on this experience:

We had 3rd and 4th graders approaching our table, even though we were originally targeting Kindergarten and 1st-grade students. We welcomed all students and seized the opportunity to improvise for the older kids. We decided to challenge them by incorporating multiplication problems into the activity, requiring them to solve equations before building with the Legos. It added a new dimension to our activity while still aligning with the overall concept.

Similarly, the Multiplication Flower group shared their experience in accommodating younger students:

Our activity was originally designed for 2nd and 3rd graders, so it was definitely not intended for kindergarten students. However, when kindergarteners and 1st graders approached our booth, we adjusted our approach to support them. Although the activity was challenging for them, we made efforts to help and include them in the activity.

Guiding Students' Learning rather than Imposing

At FMN, PSTs engaged in meaningful conversations with students, tapping into their interests and prior knowledge to facilitate mathematical learning. For instance, a PST reflected on the teaching: "You're guiding them through the activity without explicitly saying: 'Now it's time for math homework,' so they don't realize they're doing math."

The Money Equivalence group used their activity as a platform to explore students' spending habits and preferences, leading to insightful conversations about money management. One PST shared:

This activity allowed my group to hold conversations with students about things they like doing or buying with money. Some students like saving up money to buy interesting gifts, others like going to their local stores to buy candy, food, or chips, and some like sharing money with their siblings.

In the Building a City group, a PST connected the activity to students' observations of tall buildings in downtown, highlighting the real-life relevance of mathematics. She shared:

We introduced the activity to the students by asking if they had ever seen tall buildings or been to downtown. This helps students see mathematics in their lives outside of school, allowing them to observe and compare buildings. PSTs also practiced various instructional approaches to guide students' learning. A PST with prior classroom teaching experience as a substitute teacher reflected: "I scaffolded the problem they were stuck on and used easily understood language to facilitate self-learning without degrading or discouraging them."

Another PST described their approach to redirecting students' focus while encouraging engagement:

> Some of the kids were building structures where the numbers they counted didn't match the actual blocks used. Instead of correcting them, we encouraged their creativity by saying, 'That's a really tall building! Can you tell me how many blocks you have there?' This approach allowed us to gently redirect their focus without discouraging them and encouraged them to practice counting, which was our main goal.

Overall, FMN provided PSTs with valuable learning experiences in teaching mathematics. They learned to adapt instruction across grade levels, recognizing the importance of differentiation to meet diverse learner needs. Additionally, PSTs practiced guiding students' mathematical learning through meaningful conversations and real-life connections, and they recognized the value of student-centered approaches in mathematics education.

Understanding Parent Involvement in Mathematics Education

This section explores the research question: *How do preservice teachers perceive parents' involvement in supporting children's mathematics learning?* During the FMN event, PSTs had the opportunity to interact directly with parents and observe parent-child interactions. Unlike traditional classroom settings, where parents are rarely involved in real-time learning, FMN provided unique experiences for PSTs. These experiences offered insights into the role of parents in mathematics education and highlighted parents as valuable resources.

Involving in Parents in Mathematics Learning

FMN created a collaborative environment that encouraged parents to become co-learners and active supporters of their children's mathematics learning. PSTs observed and engaged with parents participating meaningfully in activities, demonstrating the potential for parental involvement to enhance mathematics education.

While planning the FMN event, PSTs focused primarily on designing engaging activities for children, such as crafting questions, tasks, and overall organization. They were surprised to see parents actively participating in the activities rather than acting as passive observers. One PST shared: "Seeing both parents and students engaged in activities was touching because it showed how much care and support parents have for their children." Another PST reflected:

> I initially expected parents to simply bring their children and let them do their own thing. However, it was so wonderful to see parents working alongside their kids. I also work at an elementary school, and in a recent event, parents mostly stayed together and allowed the kids to participate independently. There wasn't much interaction between parents and students or between parents and us. Therefore, I'm glad that parents were involved in helping their children and interacting with them, which made a big difference.

Some PSTs intentionally sought to involve parents in the activities. For example, a PST from Subtraction Bowling group explained: It was challenging to plan for parents' engagement, but we made an effort to encourage parents to participate with their children. We asked parents to assist their children, like helping them count how many bottles the children had knocked down. We also used academic language, which parents could then use with their children. For instance, I would ask, 'How many bottles they had knocked down?' and then say, 'So, 10 minus 4 is 6,' using mathematical language consistently. I noticed parents started using mathematical language themselves and asking their children questions like, 'How many fell down, and how many do you have left?'

PSTs noted that parental involvement occurred naturally during the FMN event. Parents provided assistance, offered suggestions, and celebrated their children's successes. As one PST observed: "Parents would watch what their child was doing and offered assistance or suggestions if their child made a mistake." Another PST added: "Some parents actively collaborated with their kids. It's wonderful to see how proud and excited parents become when they engage actively with their children."

These observations helped PSTs realize the value of parental involvement in supporting children's mathematics learning. This realization shaped PSTs' future intentions to foster parent involvement in their teaching.

Recognizing Parents as Resource for Mathematics Education

During FMN, parents played active and supportive roles in their children's mathematics learning. Beyond encouraging their children, parents acted as cofacilitators and co-learners, demonstrating the potential for parental involvement to enrich mathematics education. One PST noted: "During FMN, many parents emotionally and physically supported their children, encouraging them to try their best in completing the activities."

PSTs also witnessed moments where parental involvement directly influenced children's progress. For example, a PST from the Jeopardy group shared a particularly touching story: Two parents stood out to our group. Their child was not yet ready to solve multiplication and division problems, but the parents encouraged him to try. With their help, he was able to complete two of the harder categories. It was touching to see how aware the parents were of their child's progress and needs.

Some parents themselves became learners during FMN, gaining new strategies for supporting their children. As one PST shared: "Some parents admitted that they are learning the order of operations on the spot along with some kids." This mutual learning experience positioned parents as contributors to the mathematics learning process. For example, a PST from the Multiplication Flower group reflected:

I feel that the parents we worked with learned about a new activity that they could try at home with their children. They also saw that multiplication memorization could be fun and engaging.

Looking ahead, PSTs expressed growing confidence in working with the parents and emphasized the importance of fostering parental involvement in their future teaching. One PST reflected:

In my future classroom, I want to engage parents in helping their children and being involved in their learning. Having families volunteer in the classroom will help create a bond between the student's home life and learning environment. Another PST emphasized the potential for parental involvement to strengthen school-community connections, saying, I think having something like FMN regularly would be great. It is a great way to communicate and interact with parents while showing them what the students are learning in school.

Through the FMN event, PSTs recognized parents as critical resources for enhancing mathematics education. They observed that parental involvement not only supported children's learning but also enriched the overall educational experience. These insights reinforced the value of incorporating parent engagement strategies into future teaching practices, fostering meaningful collaboration between families and schools.

Overall, the findings suggest that FMN offered unique opportunities for PSTs to transform their perceptions of mathematics, gain valuable teaching experiences, and recognize the importance of parental involvement in supporting children's mathematics learning.

Discussion

The findings from this study offer valuable insights into the impact of FMN on PSTs' perceptions of mathematics and their understanding of parent involvement in mathematics education. These findings contribute significantly to the ongoing discourse on the importance of informal learning environments and community-based approaches in teacher education programs.

Consistent with existing literature, the informal setting of FMN served as a catalyst for transformative experiences among PSTs, challenging their conventional views of mathematics instruction and encouraging them to reconceptualize mathematics education (Arslan, 2024; Evans et al., 2021; Thanheiser, 2019). The observed shift in PSTs' perceptions underscores the potential of informal learning settings to enhance their confidence and enthusiasm for teaching mathematics while deepening their appreciation of the diverse representations of mathematics.

The informal structure of FMN facilitated meaningful interactions between PSTs and students with varying mathematical abilities. This aligns with findings from Khan and VanWynsberghe's (2020) literature review, which emphasizes how community-based field experiences challenge deficit-based teaching models and encourage PSTs to integrate contextual elements into their practices. The unique teaching opportunities provided by FMN equipped PSTs with the skills to adapt their instruction to meet the needs of diverse learners effectively.

The findings also emphasize the crucial role of parents as educational partners in mathematics education. The active engagement of parents during FMN highlights their potential to support student learning and underscores the importance of fostering family-school partnerships. In urban education, where parental

engagement is often hindered by challenges such as work schedules, cultural differences, and mistrust of educational institutions, FMN provides a model for bridging these gaps (Araque et al., 2017; Baker et al., 2016; Eamon, 2002). The findings align with calls from scholars like Civil et al. (2005) to design initiatives that actively involve parents and position them as valuable resources in their children's education.

The impact of FMN on PSTs' perceptions of mathematics and pedagogical approaches provides compelling evidence of the potential of informal learning environments that enrich teacher preparation and promote positive student outcomes. Echoing Epstein's (2018) call for further exploration of strategies for integrating informal learning experiences into teacher education curricula, this study advances the field of mathematics education and supports the success of both preservice teachers and their future students.

To fully leverage the benefits of FMN and similar community-based initiatives, teacher education programs should integrate such events into their curricula systematically and sustainably. Programs could incorporate FMN as part of fieldwork requirements, offering PSTs structured opportunities to interact with families and communities. Coursework could involve designing and implementing FMN activities to develop PSTs' cultural competence, instructional flexibility, and family engagement strategies.

Conclusion

This study highlights several key points. First, integrating informal learning experiences like FMN into teacher preparation curricula enhances PSTs' perceptions of mathematics, encouraging them to view math as engaging, meaningful, and connected to students' lived experiences. The findings also underscore the significance of exposing PSTs to learners with varying mathematical skills, motivating them to implement differentiated instruction to meet diverse learner needs. Additionally, the study emphasizes the importance of fostering partnerships between schools and families in teacher education programs. These partnerships are especially critical in urban education, where systemic challenges—such as limited resources and barriers to parental involvement—can hinder student success. By actively involving parents in initiatives like FMN, teacher education programs can help PSTs recognize the vital role of families in supporting students' mathematical development.

Moving forward, there is a clear need for teacher education programs to incorporate more experiential learning opportunities, particularly through exposure to informal settings like FMN events. This study offers several practical strategies for integrating such events into teacher preparation programs. First, collaborating with schools and communities to host regular events like FMN can ensure consistency and sustainability. Second, designing coursework that requires PSTs to plan, implement, and reflect on community-based learning activities provides valuable hands-on experience. Third, developing guidance to address common challenges, such as time constraints, funding limitations, and transportation barriers, helps engage families who may face these obstacles.

Finally, teacher preparation programs could include workshops or modules focused on culturally responsive communication with parents and leveraging community assets to overcome resource gaps. Future research endeavors could explore innovative approaches to promoting parental involvement in mathematics education and assess their impact on student learning outcomes and attitudes toward mathematics. Longitudinal studies could investigate the long-term effects of FMN on PSTs' beliefs about mathematics, classroom practices, and their ability to foster family-school connections. Additionally, future research could focus on the impact of FMN initiatives on families, examining changes in parents' attitudes toward mathematics and their involvement in their children's learning.

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