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Preservice Mathematics Teacher Professional Learning through Informal Field Experiences

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Abstract: *The authors describe a study investigating the role that involvement in a program-wide informal field experience had on the professional learning of preservice mathematics teachers at a Midwestern university. Participants completed a survey as well as a semi-structured interview which was transcribed. The qualitative coding and analysis was structured in accordance with a previously developed theoretical framework involving a reflexive inquiry model for preservice teacher education. The framework was adapted to fit the specific context of the informal field experience and focused on the following three lenses; inquiry into self in relation to prior experience, inquiry into contexts and personnel roles, and inquiry into relationships. Analysis revealed thirteen categories which demonstrated connections preservice teachers made between their programmatic informal field experience involvement and their professional learning as teachers. Preservice teachers described positive aspects of impact from the informal field experience in areas including classroom management, rapport, planning, and collaboration. Implications for teacher educators are discussed.*

Keywords: *Teacher preparation, field experience*

1 Introduction

Preservice teachers often have a variety of pre-teaching field experiences such as tutoring, peer teaching, observations, or small group teaching. Research studies seeking to find the benefits of each experience are important for informing teacher educators about the development of the programs that prepare preservice teachers (PSTs). The study shared here focused on one kind of programmatic informal field experience for PSTs incorporated at a university in the Midwestern United States. In this program, the PSTs work as a professional team to design and enact mathematics camps that engage K–12 students in mathematical problem solving in an exciting camp-like atmosphere. PSTs plan mathematics and problem-solving tasks as well as orchestrate the flow of student groups throughout the camp day. These elements simulate a school environment where the PSTs are directly responsible for the students.

In this article, we will share about our inquiry into the connections that PSTs made between their informal field experience and their own professional learning. More specifically, we wondered, *In what ways do preservice teachers perceive their development through mathematics camp involvement and*

how do they plan to use this development in their future classrooms? In what follows, we will explore related research and explain the process of reflexive inquiry. We then share our methodology and findings. Lastly, we explicate the implications gleaned from the findings for PST professional learning through informal learning experiences such as mathematics camps.

2 Related Research Literature

We searched for studies that related to PSTs' professional learning through informal field experiences involving mathematics camps. To do this, we used four criteria based on the programmatic design of the math camp experience to establish research relevance:

1. The field experience allowed PSTs to collaborate in designing informal learning experiences for K–12 students and then implement their plans.

2. The PSTs revised their teaching based on their reflections throughout the experience.

3. The field experience was part of a program requirement for all the PSTs in the major.

4. The research studied the impacts on PSTs.

Although we found several minor studies detailing the impacts of summer camps on K–12 students and a few on PSTs, these did not meet the other relevance criteria. Additionally, we found many non-research reports about the pros and cons of summer camps. Though these reports offer anecdotal evidence of the possible value of informal field experiences like the mathematics camp studied here, they did not meet our criteria. Ultimately, only two studies met the criteria of relevance for related research: Cooper and Nesmith (2013) and Matney (2018).

2.1 Cooper and Nesmith (2013)

Cooper and Nesmith (2013) conducted research that analyzed preservice teachers in two types of field experiences. They compared the effects of a traditional field experience versus a non-traditional mathematics camp field experience on mathematics education majors. Overall, they found that the mathematics camp participants were more specific regarding their growth and learning in their reflections than the traditional field experience participants were.

2.2 Matney (2018)

Matney (2018) conducted research involving PSTs from a university in Southeast Asia. The study found that PSTs who enacted mathematics camps developed significant professional relationships with fellow PSTs as they worked together to plan and orchestrate the camps. Through their planning of mathematics instruction for the camp the PSTs continuously improved their teaching practices, making connections to their future classroom teaching. Ultimately, the PSTs' involvement in the mathematics camps developed peer mentoring professionalism. That is, "At the heart of peer mentoring professionalism among these PSTs was the collective pursuit of the professional task . . . and the significance of that professional task allowed PSTs to focus less on who was the mentor and who was the mentee and more on what was needed to accomplish and improve the professional task" (Matney, 2018, p. 79). The research found in these studies highlights the potential value informal learning experiences, such as mathematics camps, might hold.

3 Reflexive Inquiry Framework

Researchers have studied PSTs in informal learning experiences using various frameworks. This study draws upon the framework of Knowles and Cole (1996). Knowles and Cole broke down the inquiry process of PSTs into four categories. These categories are inquiry into self in relation to prior experience, inquiry into contexts and personnel roles, inquiry into relationships, and inquiry into self and ongoing professional development (p. 652). The present study adapted the Knowles and Cole (1996) framework to have three main categories of inquiry: inquiry into self in relation to prior experience, inquiry into contexts and personnel roles, and inquiry into relationships.

4 Research Question and Context

We employed qualitative methods to investigate the following research question: *In what ways do preservice teachers perceive their development through mathematics camp involvement and how do they plan to use this development in their future classrooms?* It is important to note that the overall context of this study occurred within a required informal field experience in which all middle and secondary mathematics PSTs engaged in the design and implementation of mathematics camps for local fourth through ninth grade students. Faculty oversaw the program and collaborated with several local partner schools, which were diverse in students' socio-economic status, race, and ethnicity, and range from small rural schools to densely populated urban schools. Fifteen PSTs participated in all elements of the study.

4.1 Mathematics Camp Description

PSTs' first involvement in this informal field experience began each school year in the early fall with Collegiate Camp. The Collegiate Camp was an overnight experience that served as both a professional learning experience to train the new PSTs entering the program, as well as a retreat to build community among mathematics education majors. The new PSTs went through the experience as campers, while the returning PSTs served in the specified roles needed to run a K–12 mathematics camp: Team Leaders, Station Leaders, and Executive Leadership Team members.

The Executive Leadership Team was comprised of two Co-Leaders, one Energizer, and one Stations Coordinator. The Co-Leaders were the logistical heads of the camp. Some of their tasks included communicating with the school contacts, recruiting volunteers, creating the camp itinerary, and organizing volunteers. The Energizer was responsible for creating and facilitating engagement, establishing a positive environment, and overseeing the Team Leaders. The main roles of the Stations Coordinator position included creating mathematical stations activities and organizing the Station Leaders. Team Leaders were paired up and led a team of about thirteen students through the camp activities. While the Team Leaders traveled with their teams, the Station Leaders remained at one out of the six stations facilitating that station for all six rounds.

4.1.1 Examples of math camp activities

Each team formed a bond by playing "get to know you" games in the morning and by learning and showing off their team-developed synchronous dance throughout the day in between mathematical stations. An example of a station task was Human Number Line. The students became living pieces on a life-size game board that was created on the floor. Working in pairs, students solved content standard-based problems correctly to move forward on the number line. The Towers of Hanoi task was another station that has been used at multiple mathematics camps. The students used higher order thinking to manipulate the tower of disks from one peg to another, following the rules that they cannot move more than one disk at a time and they cannot place a larger disk

on top of a smaller disk. This activity challenged students to denote any patterns they see while completing the tower with successively more disks. Older students worked together to explore algebraic representations for the pattern. Brain Challenge, a series of problem solving questions that the teams solved together, and Jigsaw, a relay race system of equations, have also been features of every mathematics camp. Overall, the context of these mathematics camps was focused on teamwork, energy, and enjoyment of the productive struggle of mathematical problem solving.

4.2 Data and Analysis

The reflexive inquiry framework (Knowles & Cole, 1996) grounded the development of the survey (Appendix A) and the seven semi-structured interview questions (Appendix B) conducted individually with each participant. The interviews were audio recorded and transcribed. To ensure reliability of participants' perceptions about their professional learning from involvement in the mathematics camps, follow-up interviews with each participant were conducted to ensure participants' quotes were correctly interpreted and coded. To ensure confidentiality, each participant was assigned a code name with the abbreviation PST and a random number between one and fifteen (e.g. PST 13). Participants will be referred to by their code names to maintain confidentiality. Data coding and analysis in accordance with the reflexive inquiry framework.

5 Findings

5.1 Inquiry into Self in Relation to Prior Experience

The surveys yielded consistent results that showed a perceived increase in all fifteen PSTs' teaching confidence from before the informal field experience involvement to after it. The mean for PST confidence before the informal field experience was 1.93 on a scale from 1 (not at all confident) to 4 (very confident). On this same scale, the mean for PST confidence after the informal field experience was 3.2. The concept of teacher efficacy arose multiple times ($n = 28$) throughout the interviews. PSTs described increased comfortability in launching mathematics tasks, facilitating a learning/engaging atmosphere, and managing both small and large groups of students. PST 7 shared, "I feel like I was very, very nervous whenever I was in front of people before Math Camp. And I wasn't really sure of how to teach a lesson or explain something. But Math Camp really helped me gain confidence." Through further analysis of the surveys, we noted that each PST had had experience with at least two different mathematics camp roles and that 12 out of the 15 research participants had been a part of three or more camps. The continuous teaching practice that these mathematics camps gave the PSTs may be directly linked to the confidence that they gained. For example, PST 7 reflected, "Math Camp really helped me gain confidence [in teaching]... And I think that's only increased with the more I've been involved with it since then."

Other common codes that occurred in the interviews were in the way PSTs viewed themselves as coaches, guides, and leaders. The role of guide or coach appeared $n = 11$ times while the role of leader or role model appeared $n = 16$ times throughout the interviews. PST 8 and PST 15 stressed the importance coaching or guiding the students, explaining that they used guiding questions and assisted the students in problem-solving, but did not just tell the students how to solve the problems. PST 5 discussed the importance of being a role model through behavior as well as attitude. He explained that it is essential to model respectful behavior for the students as well as show them that they can have fun doing math. PST 1 reflected on her personal growth saying, "The other leaders I have been working with have helped me become a better leader." In summary, PSTs reported increased confidence as well as perceived improvement in their ability to coach students and lead peers.

5.2 Inquiry into Contexts and Personnel Roles

PSTs also made connections between the context of mathematics camps and the context of a mathematics classroom. They connected the planning and instructional processes of the mathematics camp leaders to those of classroom teachers ($n = 34$). For example, PST 4 compared the role of Station Leader to the role of a teacher because as a Station Leader one must, "grab the attention of the students, explain the instructions and goals, hand out the materials, and then engage them in problem solving." PST 5, PST 11, and PST 14 emphasized how much planning goes into a mathematics camp so that the day runs smoothly, including having additional activities in case of extra time, which they compared to lesson planning. The PSTs also suggested ways in which they will use and adapt mathematics camp tasks and activities in their future classrooms ($n = 37$). For example, PST 10 said, "The Go Fish game would be a good way to get the students out of their seats while practicing math facts, academic language, or even spelling words." Another key component of education that the PSTs practiced was classroom management ($n = 15$). PST 4 explained, "Just the simple call back of "Math Hey" is a really good classroom management technique that I wouldn't have known if I didn't do Math Camp." Other PSTs shared that these informal field experiences of mathematics camps taught them how to find their "teacher voice" and establish expectations for their students. Three PSTs stated that mathematics camps provided them with the opportunity to manage students who shouted out or were not taking turns, which was excellent practice for their future classrooms. The last two themes that fall under the framework category of context and personnel roles are energy and attitude ($n = 27$) and the notion that mathematics can be enjoyable ($n = 16$). PSTs commented on the positive, exciting energy at the mathematics camps. They believed that they can make mathematics enjoyable for their classroom students if they model their teaching off of the mathematics camp essence. In summary, PSTs reported that the mathematics camps gave them increased experience with planning, instructing, and creating positive classroom environments that they may build on in their future teaching experiences.

5.3 Inquiry into Relationships

The PSTs discussed two different types of relationships: those that they formed with the students and those that they formed with their peers. They also connected these relationships to how they perceive their future relationships as teachers. First, some of the PSTs realized that patience and careful observation of students are essential when teaching ($n = 14$). For example, PST 10 shared, "I really learned about the patience that it takes when students are trying to solve a math problem, not trying to give them the answer right away." PST 13 learned how to build rapport with students. He stated, "I'm able to make certain connections with some students and if I can do that in that short amount of time, it's helped me realize that it may be not quite as hard as I once thought."

In addition to patience and rapport, some PSTs also reflected on the ethic of care that they want to have for the students at the mathematics camps as well as in their future classrooms ($n = 9$). PST 3 formed a strong connection with a student who was extremely disengaged at first. Taking the time to talk to the student one-on-one, the dialogue went from discussing things they had in common such as watching YouTube videos to the student confiding that he lacks a good relationship with his father. After this conversation that came from a place of genuine care from PST 3, the student began to join in with the team and contributed to the solution of many mathematics tasks. PST 3 reflected, "That kind of connection and the way I approached him, that's what I would bring into my classroom." PST 6 said, "I want [my students] to know that I care. I want to be that teacher they can go to for anything." This concept of building rapport arose $n = 39$ times. In addition to building rapport with students, the PSTs also found value in building relationships with their colleagues with whom a common goal of educating children is shared ($n = 45$). Several PSTs referred to their mathematics camp peers as people they can share ideas with and learn from just like they hope to do

with their future colleagues. PST 13 summed this up by saying, "Ultimately your goal is all the same and you can help each other improve." In summary, PSTs reported making connections between the ways they built rapport with the mathematics camp students and how they will build rapport with their future students. Additionally, PSTs reported that their involvement in the informal field experience allowed them to gain practice with building important collegial relationships.

6 Implications

The PSTs reported evidence suggesting that the informal field experience had several areas of positive professional impact. There was a connection between the type of responsibility the PSTs had during the informal field experience and their comfort level or confidence. PSTs stated that they had gained more confidence through the mathematics camp field experience than they did through other formal field placements involving shadowing and observations of professional teachers. We hypothesize that this finding occurred for two reasons.

First, because the PSTs often felt like a hybrid teacher, somewhere between a college student and a teacher, they were more comfortable in their mathematics camp identities of leaders, role models, coaches, and guides. This likely contributed to a safe professional learning space (Matney, 2018), in which PSTs experienced greater comfort with trying new teaching techniques and learning from mistakes than they typically feel when they step into their field placement schools in full student-teacher mode. Also, during student-teaching, it is likely that majority of the expectations for the classroom are pre-established by the mentor teacher. With classroom management being such an essential skill for a teacher to have, it was valuable that the PSTs recognized their practice with it through the informal field experience, prior to their formal internship.

The second reason PSTs reported an increased confidence is the "professional family" supporting them. In the mathematics camp context the PSTs are part of a "professional family" support system made up of both peers and professors, which we believe may lead to comfort and confidence to safely try various strategies and then learn from the success or failure of each attempt (Matney, 2018).

We found connections among this study and those of Knowles and Cole (1996), Matney (2018), and Cooper and Nesmith (2013). Knowles and Cole focused their research on uncovering why certain field experiences do not provide quality educational opportunities for PSTs and questioned how these experiences can be improved. Knowles and Cole (1996) stated that many field experiences are "too structured . . . and too detached from the personal; consequently, they often provide little more than superficial, 'rites of passage' experiences" (p. 654-655). Therefore, the PST does not gain a strong sense of self as a teacher because the experiences are not personally impacting him/her (p. 654). The results in this research study, however, point to the fact that there is something different about these mathematics camp field experiences, because the PSTs who were interviewed spoke to the strong identities and personal growth they gained. Revisiting Knowles and Cole's (1996) statement, perhaps it is the personal responsibility and direct involvement with the informal field experience that brings about this impact. PSTs are responsible for all aspects of the organization, norms, planning, and teaching. Similarly, the research reported by Matney (2018) concluded that "There is evidence here to support that an important degree of teaching efficacy and authenticity comes about for these PSTs as a result of having the responsibility to foster learning and engagement of a large group of students" (p. 79).

Knowles and Cole (1996) also spoke to the important role that context plays in a field experience, because according to their research, placing PSTs in single classrooms, where they are focusing their attention solely on the techniques of teaching, perpetuates a feeling of isolation and narrow

perceptions of what teachers actually do each day (p. 657). The mathematics camp context described here provides PSTs with the opportunities to collaborate, observe other teachers, interact with different students, and juggle various tasks such as instructional, management, and engagement responsibilities (Matney, 2018).

Another striking piece of information revealed by Knowles and Cole (1996) was that, according to university mentors in various studies, "most preservice teachers who fail are unable to determine and respond to students' needs and relate to students well enough to engage their interest and participation" (p. 661). With rapport being an integral part of effective teaching, the reflections that the PSTs had about building rapport during the informal field experience ($n = 39$), hold great significance.

According to Cooper and Nesmith (2013), the PSTs that participated in mathematics camp were able to provide more specific observations than the PSTs who participated in the traditional field experience. With the theme of Patience and Observation appearing $n = 14$ times in our study, it is evident that mathematics camp environments at both universities influenced more careful observation from the PSTs than traditional field experience. Matney (2018, p. 78) reported that PSTs were able to apply many connections from their involvement in mathematics camps to teaching. The PSTs in our study also compared mathematics camp preparation and execution to planning and instructing in a typical school day ($n = 34$). Lastly, in alignment with our findings, the research from both Cooper and Nesmith (2013) and Matney (2018), reported that the mathematics camp participants left the experience feeling more confident in their ability take what they learned to apply it to future teaching experiences.

7 Limitations

Although this research study uncovered and addressed several components of PST professional learning through the context of mathematics camp informal field experiences, the findings here should be mitigated through careful consideration of the following limitations. There are a wide variety of implementations of "camps" across the world. The findings of this study are dependent on the specific structures and choices made in its design and partnerships with local area schools. As such, the mathematics camp context described here is not necessarily applicable to other informal field experience contexts. The conclusions here should be carefully considered and not generically applied to any field experience that uses the name of "math camp" or other such informal learning experiences without appropriate justification.

8 Conclusion

The study revealed that PSTs positively perceived their professional learning through mathematics camp involvement and were able to connect how that professional learning could be used by them in their future classrooms. PST 11 shared her personal story of how the mathematics camps "gave teaching math a new light" for her. She reflected:

> I think honestly my life would be different without Math Camp because before, I was really questioning becoming a teacher. What I've learned at [the university] was superficial situations that could happen in school, but Math Camp showed me what a real classroom would be and what I would have to do to help prepare these kids... Math Camp gave me new light on what it means to be a teacher; it's not about handing them a textbook or lecturing them about math, but about giving the students a chance to

> see that math can be fun and they can learn just about anything if they put their minds to it. I found a new love for teaching, and Math Camp helped pave this new trail for me.

Overall, the study revealed ways in which PSTs have been impacted by the mathematics camps, and this information can be used to assess what other components of informal field experiences can be adapted to better serve the needs of PSTs. As such, the study demonstrates proof of what is possible when PSTs engage in teaching practices through mathematics camps.

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APPENDICES: Volunteer Survey & Interview Protocol

Appendix A

Math Camp Volunteer Survey

1) How many Math Camps have you been involved in?

2) What role(s) did you play in Math Camp? (Leadership, General Volunteer, Team Leader, other)?

3) Check the box that best describes your confidence level as a teacher *before* your Math Camp experience.

Not at all confident (0)	Minimally Confident (1)	Somewhat Confident (2)	Mostly Confident (3)	Very Confident (4)

4) Check the box that best describes your confidence level as a teacher *after* your math camp experience.

Not at all confident (0)	Minimally Confident (1)	Somewhat Confident (2)	Mostly Confident (3)	Very Confident (4)

5) Check the box that best describes how you feel about your overall Math Camp experience.

Not at all satisfied (0)	Minimally Satisfied (1)	Somewhat Satisfied (2)	Mostly Satisfied (3)	Very Satisfied (4)

Appendix B

Semi-Structured Interview Protocol

1) Do you see any correlations between your involvement with Math Camp and your future as a teacher? (Can you elaborate on that?)
2) How is the teaching process of Math Camp similar or different to the teaching process of a class?
3) How did you conduct yourself as a teacher in your Math Camp volunteer role? How is this similar or different to how you will conduct yourself as a teacher in your future classroom? Why?
4) What (if anything) would you take from Math Camp to your future classroom? Why?
5) Did you/How did you establish rapport with the math camp students? Is this similar or different to how you would establish rapport with students in your classroom? Why?
6) Do you think relationships with the other Math Camp volunteers are beneficial? Do you see any connections between your relationships with them to your relationships with your future colleagues? If yes, can you speak to those connections?
7) Has math camp taught you anything about yourself as a teacher that you did not know before?