

IMPACT OF SINGLE STUDENT MATHEMATICAL FIELD EXPERIENCE ON ELEMENTARY TEACHERS OVER TIME

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Mewborn and Stinson (2007) explored three tasks implemented in a preservice teacher education program, which supported awareness of beliefs and reflection on teaching practice. In this study, we investigated one of these tasks, a single student mathematical field experience, to study its impact on learning and to determine its effects over time. We studied elementary teachers starting at their preservice teaching experience into their second year of teaching and after their tenth year teaching. We found this experience fostered development of implementation of multiple questioning strategies during their preservice teaching experience, which grew during their career as educators and is consistent into their tenth year of teaching.

Some literature reported that teacher education programs have minimal impact on preservice teachers' future teaching styles (e.g., Hiebert, Gallimore, & Stigler, 2002). However, we investigated a teacher education program that had a significant impact on four elementary teachers' teaching practice as well as their beliefs (Spangler, Sawyer, Kang, Kim, & Kim, 2012). Mewborn and Stinson (2007) explored three tasks from this education program, which supported belief awareness and change: critiquing a reflective teaching essay, participating in a single student mathematical field experience, and observing a mathematics lesson from an experienced teacher. In this study, we explored the impact of the single student mathematical field experience (SSMFE) to investigate the teachers' learning trajectory through the field experience and determine the staying power of the teaching practices developed from this event. The SSMFE was an activity where one preservice teacher assisted one elementary student over 8 weeks in various tasks. Four teachers were followed from their junior year in their teacher education program into their second year full time teaching and after their tenth year teaching to study the lasting affects of this experience. We found the SSMFE helped to foster teachers' development of a variety of questioning styles as described by Boaler and Brodie (2004).

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Mewborn and Stinson (2007) explored the interplay between students' personal theories, field experiences, and mathematical methods courses to suggest that specific tasks in teacher education program could assist preservice teachers' examination of their beliefs about teaching. The authors identified the single student mathematical field experience (SSMFE) as one of the activities that influenced preservice teachers to become aware of beliefs and reflect on their teaching practice. However, the authors explicitly stated their goal was not to identify a belief change but rather to illustrate the

tasks. Mewborn and Stinson (2007) advised that future research was needed, “to develop robust descriptions of their learning trajectories and to ascertain the staying power of the teaching practices they began to develop *with assistance* in their preservice program” (p. 1484). With this field experience, we investigated the teachers’ learning trajectories and determined the teaching practice’s staying power.

Field experiences provide opportunities for preservice teachers to develop questioning strategies to gain knowledge of students’ mathematical thinking (Chamberlin & Chamberlin, 2010; Mewborn & Stinson, 2007). Mewborn and Stinson explained, “Field experiences provide a rich ground for questioning why we do the things we do and how we might do them differently if we are serving the goal of creating opportunities for preservice teachers to engage in assisted performances” (p. 1483). Chamberlin & Chamberlin (2010) found, “Many of the teachers mentioned questioning the students to stimulate their thinking, to refocus them on the problem at hand, to understand the students’ thinking, or to challenge the students in their thinking” (p. 402) in the preservice teachers’ field experience. However, the articles did not explain the kinds of questioning occurring during field experiences.

One of the most common forms of questioning patterns initiated in schools is teacher Initiation, student Response, and teacher Evaluation (IRE) (Cazden, 2001). This form of mathematical conversations sets a norm where the teacher asks the questions, and the students provide answers. IRE has the teachers dominating the mathematical talk and determining what mathematics is “correct” in the classroom. The United States of America’s Common Core Standards (NGA Center and CCSSO, 2010) advocate that students need to be *constructing viable arguments and critiquing the reasoning of others*. The IRE mode of questioning does not support students’ construction of thought because the teacher validates the mathematics. Other questioning strategies were advocated, and many researchers sought to determine the actions teachers should make to support students’ mathematical thinking (Boaler & Brodie, 2004)

Boaler and Brodie (2004) categorized nine different forms of questions: gathering information, leading students through a method, inserting terminology, exploring mathematical meaning and relationships, probing, generating discussion, linking and applying, extending and thinking, orienting and focusing, and establishing context. The authors determined that the majority of questions given in a traditional classroom were focused on gathering information while reform-oriented teachers implemented a variety of questions in their classroom (Boaler & Brodie, 2004). Therefore, supporting development of a variety of question types in preservice teachers may help them develop into reform-oriented teachers.

METHODS

The data corpus for this study was collected in two parts. The first study included 15 participants across a 4-year period from their first year in a teacher education program through the end of their second year of teaching. The second study included 3 of the 15

previous participants 10 years after the initial 4-year study. In this investigation, we explored 4 of the participants, 3 of whom span both studies.

Participants

We began by analysing existing data on participants who we knew were still teaching and selected two pairs of participants for detailed analysis. These 4 were chosen because they entered the teacher education program with similar beliefs, but their teaching practices differed markedly by the end of their second year of teaching. One of these participants became a reading specialist immediately prior to his tenth year in the field, so he did not participate in the follow up study. The 4 participants were assigned the following pseudonyms: Laura, Jennifer, Jayne, and Alex. The initial study began during their junior year in college where they took one mathematics content course for elementary education majors prior to the study. During the study, they completed 2 mathematics methods courses for elementary education majors, the first of which included the SSMFE. During the second and third semesters they participated in 4-week field experiences in local schools; the fourth semester was a traditional student teaching experience. After graduating, the participants were employed at elementary schools for at least 10 years.

Single Student Mathematical Field Experience (SSMFE)

During the first mathematics methods course, the participants assisted the mathematical learning of one elementary student once a week for 8 weeks focusing on understanding the student's thinking, explanations, and interpretation of mathematical problems the preservice students constructed. This interaction was designed to focus on the mathematics of the students, allowing preservice teachers to build confidence in their abilities to develop problem-solving activities.

During the SSMFE, the instructor of the mathematical methods course and her two teaching assistants assisted the preservice teachers by coaching them in real time with questioning, adjusting instructional pace, and paying attention to the student's mathematical thinking. For each session of the SSMFE preservice teachers prepared comprehensive written plans and wrote follow up reflections. They also constructed a final portfolio documenting their growth and the growth of the child with whom they worked over the course of the semester.

Data Collection

During the initial study, the participants were interviewed once per semester for four years, observed once during an early field experience, twice during student teaching and approximately 4 times during each of the first two years of teaching. They were also asked to complete the Integrating Mathematics and Pedagogy (IMAP) web-based beliefs survey (Ambrose, Philipp, Chauvot, & Clement, 2003). The survey is designed to assess beliefs about mathematics, about learning or knowing mathematics, and about children's learning and doing mathematics.

During the tenth year study, the participants were individually interviewed and observed 3 times over the course of a semester, and they participated in a focus group. They were also asked to complete the IMAP web-based beliefs survey and Known Factors Affecting Belief Change survey created by one of the authors.

Analysis

Data from both studies were analysed using the constant comparison methods. We first identified what the participants stated they learned from the SSMFE in their first methods course's final portfolio and then compared what they said with their teaching practices over the first two years of teaching and then 10 years afterward. We understand that just because a participant stated something does not necessarily mean it will be enacted in their classroom practices. Individuals often are not aware of their beliefs, so we interpreted the participants' understanding using multiple strategies to ensure an accurate representation of their views (Leatham, 2006).

FINDINGS

We followed our participants' progress through this SSMFE in three stages. First, we identified what they said influenced their teaching practice as stated in their final portfolios from their first methods course. Next, we described the four teachers' teaching practices through their first 2 years of teaching to assess the preservice teachers' self-identified impact. Finally, we asked the teachers in their tenth year of teaching about these experiences and observed their teaching practices to see what impact still existed from the SSMFE.

Laura

In Laura's final portfolio of her first methods course, she stated that she learned how to address issues in behaviour, how to assess student understanding from student's work, and how to ask appropriate questions from the SSMFE, and these teaching practices were observed during her first two years of teaching.

When she began full time teaching, Laura demonstrated learning when to press a student mathematically and when to "take a break" in her own teaching. Laura implemented her skills of assessing students' understanding of concepts throughout her first two years of teaching through her use of questioning. Laura learned a lot about questioning from her SSMFE. She showed this by implementing different questioning styles in her classroom. When she was observed even as soon as student teaching, Laura would ask questions like, "Does this make sense?" "How do you know?" Laura explained that there was a difference between her student in the SSMFE and her kindergarten students by saying "I guess with the kindergartners, I had to ask a lot more leading questions, but with the [SSMFE student], I could just assume that she could make a lot of connections." But she still admitted to learning how to construct different forms of questions from the SSMFE.

Jennifer

From the SSMFE, Jennifer identified in her final portfolio learning how to engage gifted students, how to implement appropriate wait time, and how to help students feel successful. However, the skills that had a lasting impact on her teaching were how to use questioning strategies to determine what students learned and how to help students enjoy mathematics.

When she started teaching, Jennifer had a deep desire to make mathematics fun, and each lesson had some element to engage her students. This went along with her belief in helping students feel successful. Jennifer stated that she found a connection between questioning and her SSMFE. She did not originally identify questioning as learned from the SSMFE, but she explained, “I think personally I grew, like as a teacher” from the field experience because it taught her to think about questioning. She said, “I don’t know if I was asking as many of the right questions then as I might have. So yeah, I think I got better at it.” Although Jennifer did not initially identify questioning as learned from the SSMFE, reflecting on the process helped her to see her own mistakes, thus helping her develop questioning skills. In her observations, she showed improvement in asking a variety of questions over the course of the two years. In the beginning, Jennifer mainly implemented the IRE pattern, but over time she developed probing, exploring, and orienting questioning patterns as was suggested by Boaler and Brodie (2004).

Jayne

In Jayne’s final portfolio, she expressed that she had a strong belief in doing what was best for her student, which influenced what she learned from her SSMFE. Jayne identified from her SSMFE learning: how to select appropriate mathematical tasks, how to implement mathematical discourse, and how to follow students’ thinking.

Jayne demonstrated selecting appropriate mathematical tasks by having a student-centred stance in her first two years of teaching. Jayne insisted students needed to conceptually understand the mathematics, not just recall the facts. Jayne believed that all teachers should prepare students for what they would need in the future rather than just for standardized examinations. In addition, she emphasized that knowing her students was the critical foundation in teaching, and she assessed her students’ understanding individually through asking questions. She explained that appropriate questioning was one of the most efficient means to assess students’ thinking. This matches with Boaler and Brodie’s (2004) categories of probing or getting students to explain their thinking. Jayne admitted assessing students’ performance takes a lot of time, and teachers need to be patience in this process. Finally, she continually implemented her belief in following her students’ thinking through her first two years of teaching. Jayne admitted that her school’s curriculum did influence what was taught, but she believed she still controlled how that material was taught to her students. Thus, Jayne preferred maintaining her student’s pace of learning, rather than a pace dictated by others.

Alex

In working with his student in the SSMFE, Alex learned how to ask effective questions, how to explore and understand a child's mathematical thinking, and how to learn a student's unique problem solving techniques.

In Alex's first two years of teaching, he emphasized the use of questioning strategies to explore and understand children's mathematical thinking. Alex assessed students' understanding through a multitude of questions and also encouraged his students to ask questions in mathematical activities. For example, he had his students asking "how does this work" and "why did this happen" probing questions which is constant with Boaler and Brodie's (2004) fourth questioning type. Although he tried hard to build on his students' mathematical thinking, Alex felt a lot of pressure from the school administration for his students to perform on standardized tests. Thus, many of his teaching practices were defined by the curriculum designated by the school, which hindered him constructing mathematical tasks.

10 Years Later

Ten years after the SSMFE, Laura was the only participant to remember the activity. The student she was paired with was unresponsive and lacked key mathematical knowledge necessary to explore many of the tasks she planned for their sessions. Laura explained, "I should have approached it differently, but at the time I didn't really know. I mean I think it was a growing experience. It was struggle time." Laura still remembered this experience because of her struggles with her student, but what she learned about behavioural management and questioning during that time was apparent during her observations.

Jayne and Jennifer did not remember the SSMFE when asked after their tenth year of teaching. Yet, they both explained experiences like that were beneficial. As Jennifer stated, "because, you know, how else are you going to learn about how kids think without sitting down and working one on one with them and listening to them?" They explained field experiences helped them to develop skills in building relationships with their students. Jayne still showed a desire to do what is best for her students through her pacing based on students' needs and the student centred hands on activities she implement in her classroom. They both still demonstrated using multiple questioning types in their lessons. Altogether, the teachers explained that they mostly did not remember details about what they did in the SSMFE, but they believed it to be valuable and they still demonstrated knowledge of different questioning styles ten years after they were introduced.

DISCUSSION

Each of our participants identified that his/her questioning strategies were initiated from their SSMFE, and over time they improved in their use of different questioning types. We believe the field experience was a beneficial activity that fostered

development in this area, yet beliefs developed before entering into the teacher education program did influence the preservice teachers learning trajectory as well.

Beliefs about Teaching Influenced Learning

The four participants demonstrated a focus on students' learning from their preservice teaching experience into their second year of teaching. However, even though they all consistently showed this behaviour into their second year of teacher and some into their tenth year of teaching, this teaching style appears to have been more influenced by their personal beliefs about students' mathematical learning rather than any particular activity they did in their preservice experience. For example, Jennifer held a strong belief in making mathematics fun, and she even expressed that she found mathematics only to be meaningful if the students enjoyed what they were doing. Her actions to make students feel more successful were consistent with her belief in making mathematics fun. Jayne, on the other hand, had a strong belief in doing what is best for students. Her actions were influenced by her beliefs about student learning rather than a single activity from her teaching program.

Questioning as a Learned Skill

The participants demonstrated using multiple questioning types in their classrooms after the SSMFE, and there is evidence that they learned this skill from that activity. Each of our participants identified that his/her previous experiences with mathematics were in traditional classrooms. Questioning was not stressed in the traditional classroom, but it was stressed during their preservice teaching experience (Cadzen, 2001). Laura, Jayne and Alex initially identified questioning as a skill they learned from their field experience, and Jennifer later asserted that she originally began learning questioning from her SSMFE even though she did not feel proficient in the skill at the time. Laura identified learning the different properties of questions, which is similar to what Boaler and Brodie (2004) categorized. Jayne worked on phrasing questions carefully to assess her children. Although Alex struggled with the accountability-driven system, he believed the advantage of questioning benefitted both teachers and students and applied it in assessing students' mathematical understanding. Questioning students can be an unnatural activity for teachers. By giving them the chance to practice this skill, they can become more proficient. Thus, it appears that this SSMFE reinforced questioning strategies for these teachers.

Lack of Memory of the Activity Does Not Influence Past Learning

Ten years after the SSMFE most of the participants could not identify what they learned or what they did in the experiences. However, just because they could not identify that specific activity does not mean that it was not significant in their growth. Many people are not aware of their own beliefs or know why they developed (Green, 1971). Jennifer, Laura, and Jayne were able to show how they focused on student thinking by using questioning during their observations. Because the participants did not remember the activity but still demonstrated skills learned during the SSMFE, we take this as evidence that SSMFE does have a lasting effect on preservice students.

CONCLUSION

The SSMFE fosters the development of teachers' questioning over time. This experience reinforced their ability to construct multiple questioning types and facilitate student thinking in their classroom. To focus on understanding students' mathematical learning, the activity provided the preservice teachers an opportunity to learn about what they should do to become teachers without the pressure of dealing with classroom management. Further research is needed to determine if these findings can be duplicated in other schooling environments, but we can say for the four participants studied ten years after the introduction of the activity it continues to influence their teaching practice.

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