



Laura L. Saylor, Ph.D.
Mount St. Joseph University, Cincinnati, Ohio



Introduction and Background

The purpose of the study was to track the experiences of pre-service teachers (PST) as they participated in a Math Talk Learning Community in an early childhood teacher preparation course on mathematics' teaching methods. The study additionally sought to determine if there are any specific Math Talk Learning Community components that made an impact on the study's pre-service teachers.

Literature

Literature Regarding Pre-Service Early Childhood Teachers and Mathematics:

- Teachers are highly anxious about mathematics (Bursal & Paznokas, 2006; Gresham, 2007; Vinson, 2001).
- Of all undergraduate majors, education majors have the highest levels of mathematics anxiety (Cady & Rearden, 2007; Harper & Daane, 1998).
- PST have negative views of mathematics: "mathematics is my enemy" and "math is something I hate" (Cady & Rearden, 2007).
- These fears and negative views are often a result of early childhood teachers' prior negative experiences with math instruction (Brady & Bowd, 2005; Harper & Danne, 1998)
- This anxiety has also been found to be negatively correlated with their mathematics teaching efficacy (Bursal & Paznokas, 2006; Swars, Daane & Giesen, 2006).
- Low mathematics self-efficacy among early childhood teachers influences their teaching abilities, can create anxiety, and can impact classroom practices (Beswick, 2006; Cakiroglue, 2008; & Cooper & Robinson, 1991).

The process then becomes:



Math Talk Learning Community

Definition:

- A Math Talk Learning Community allows for rich mathematical discussions that support the mathematical learning of all participants (Hufferd-Ackles et al., 2004).
- Teachers guide and extend students' thinking as the learning community listens and learns to consider other students' ideas (Ball, 1993).
- Students are accountable for justifying their reasoning, therefore increasing their mathematical knowledge and understanding (Rawding and Wills, 2012).
- When the goal of the group is to learn mathematics, the purpose of the discussion remains mathematical, and understanding increases. Students become co-investigators and resources of mathematical knowledge (Zack and Graves, 2001).

Framework, Purpose and Questions

Math Talk Learning Community

Key Components:

- Questioning:**
 - Students and teacher are co-questioners.
 - Students are encouraged to ask questions of the other students in order to understand one another's mathematical thinking and to enhance their own.
- Explaining mathematical thinking**
 - Students are given opportunities to articulate their mathematical ideas to the teacher and to each other within a supportive and safe environment.
- Source of mathematical ideas**
 - Students are able to explain, defend and justify their mathematical thinking with confidence.
 - The mathematical discourse often features the negotiation of student understanding of a particular concept, and the ideas of students are considered as valid and worthy of further exploration.
- Responsibility for learning**
 - Students increasingly take responsibility for their own learning.
 - "When student thinking began to be elicited, students became more engaged and involved in classroom discourse as speakers and listeners. Their responsibility for their own learning was indicated by their desire to ask questions in class, their eagerness ... to demonstrate their understanding of problems, and their volunteering to ... assist struggling students" (Hufferd-Ackles, Fuson, and Sherin, 2004, p. 106).

Math Talk Learning Community

Possibilities:

What if A Math Talk Community could:

- reveal pre-service teachers' understandings and misunderstandings?
- support pre-service teachers' deeper reasoning?
- support pre-service teachers' academic language development?
- be a positive mathematics experience for pre-service teachers?

And perhaps, could providing a positive mathematics experience for pre-service teachers ultimately result in better classroom practices?

Accordingly, the purpose of the study was to explore how pre-service teachers experienced a Math Talk Learning Community in a teacher preparation course.

Research Questions:

- How do pre-service early childhood teachers experience a Math Talk Learning Community in a mathematics methods course?
- As the early childhood pre-service teachers experience a Math Talk Learning Community in their mathematics methods course, which specific components of it do they identify as particularly impactful?

Multiple Case Study

Participants: Seven early childhood education students enrolled at MSJU in a methods of teaching mathematics course. A Math Talk Learning Community approach was used in the course.

Instruments:

- Quick Writes: course activities that took place twice during the semester. Each contained the following questions or prompts:
 - Could you describe what you think or understand about math talks?
 - Could you describe any experiences you have had with math talks?
 - What do you think or understand is the role of math talks in the early childhood classroom? Please describe an example of a number talk.
 - Please describe how you anticipate using math talks in your future practice.
- Researcher observations contained:
 - a core section for the narrative of the observation periods that occurred during the students were engaged in talk and work time.
 - a section to later code the observations regarding the participants' activities and conversations regarding math talks.
- Quick Writes and observations were scored on rubric for Math Talk Learning Communities developed by Hufferd-Ackles, Fuson, and Sherin.

Results by Case

Lauren:

- Starting Level: 1: "Talking to students to help them understand"
- Lauren began the course very quiet. She listened to others but did not offer up her own ideas or procedures. Then, when discussing a conceptual issue with her own early subtraction experiences she shared her way of thinking about the subtrahend.
- Ending Level: 3: "Math talks allow students to learn from one another."

Anna

- Starting Level: 1: "Time for me to ask questions"
- Anna was engaged from the start and very confident in her answers. However, early in the semester, when she was challenged by one of her classmates she replied, "it is just the answer". Later in the semester she willingly supported her answer with procedures.
- Ending Level: 3: "It is a way for students to make their own connections and to deepen their own understanding."

Maureen

- Starting Level: 1: "Just talking about a math activity"
- Maureen started the semester by announcing that "math was not her friend" and that teaching math "scared" her. Later in the course, as we talked about a multiplication problem (7x4), she said, "I like that my way of solving this problem was okay and that I could share how it worked."
- Ending Level: 2: "Children become more curious about math problems and solutions when a teacher engages them in math talks."

Debby

- Starting Level: 1: "Using new math terms"
- Debby stated at the start of the course, that she always did well in math, but was never really "turned on" by it. She was usually very involved in the math talks, and while she typically employed standard strategies, she found an appreciation for alternative procedures.
- Ending Level: 2: "By taking math problems away from sheets of paper and to a lively discussion, math became more alive. I think kids would find it more fun and then they would be more engaged."

Dorothy

- Starting Level: 1: "Discussing math"
- During one of the final classes of the semester said, "I am going to miss these math talks, they are kind of fun".
- Ending Level: 3: "Students challenge one another and defend their mathematical thinking and procedures."

Results by Case (Continued)

Sarah

- Starting Level: 1: "Conversations with their peers and teachers about math"
- Sarah had a light bulb moment when we practiced a discovery of doubling and halving for multiplication (5 x 28). She said, "I knew it worked, but I never thought about how it looked."
- Ending Level: 3: "Rich and lively discussions that help young children make sense of math problems and the related concepts."

Frannie

- Starting Level: 1: "A way to get children familiar with mathematical terms"
- Frannie started off the class willing to take risks and wrestle with this mathematical procedures openly. When I asked her about this she replied, "Well, I have known my classmates for three years, and I feel pretty safe...I would not be so open in a class offered by the Math department."
- Ending Level: 4: "It helps the children be teachers for one another and discover other ways to solve problems from their classmates."

Discussion & Montessori Connections

Summary of increase in levels on Math Talk Rubric:

- From 1 to 2: 2
- From 1 to 3: 4
- From 1 to 4: 1

Themes:

- Students learning from one another
- More opportunities for sense making
- Student engagement and joy in learning
- Safety in community

Connection to Montessori and further research:

Themes that emerged with this research (students as teachers for one another, sense making, and student engagement) are consistent with Montessori philosophy and with Montessori teacher preparation. However, to what degree are our teachers prepared to create Math Talk Learning Communities with their students? Do Montessori mathematics albums include methods to encourage students to go beyond solving and to question, explain, be sources of ideas, and to assume responsibility for their own learning.

Future research will look to identify where Montessori mathematics and Math Talk Learning Communities overlap, where Montessori pedagogy aligns with Hufferd-Ackles, Fuson, and Sherin's Rubric, and how this current research may improve mathematics outcomes for Montessori students.

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