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# Stories and Statistics: A Mixed Picture of Gender Equity in Mathematics

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**STORIES AND STATISTICS:  
A MIXED PICTURE OF GENDER EQUITY IN MATHEMATICS**

**ABSTRACT**

The goal of this chapter is to gain a better understanding of the experiences of mathematics anxiety that some women elementary preservice teachers encounter while learning mathematics during their own K-12 years. Specifically, this chapter is an analysis of the personal well-remembered events (WREs) told and recorded by women during their preservice teaching professional sequence. These narrative writings provide a powerful voice for the degree to which mathematics anxiety shape preservice teachers' beliefs on what it means to learn mathematics. This intersection is important, as these are women who are on the professional track to teach mathematics. The focused analysis for this chapter is aimed at ways in which teacher preparation programs could broaden current views of women who have anxiety and confidence issues in mathematics.

**INTRODUCTION**

I have had the opportunity to teach mathematics in first through seventh grades. Early on in my teaching career, what became clear to me was that the boys in my various classes tended to be excited about mathematics whereas many of the girls did not seem to feel very confident about their mathematical abilities. During parent teacher conferences a mother of a girl in my class would often state that she was not very good in mathematics and that she did not expect her daughter to excel in mathematics either. After all, the mother would add, she had been able to get through life just fine without a strong mathematics background. From my perspective, statements that make mathematics seem not attainable or necessary can give girls permission to exit themselves from being successful in mathematics.

When I taught accelerated middle school mathematics, the girls in my class would enter the room as if they could not quite believe they were there and that somehow they managed to be recommended for the “smart kid” mathematics class. The boys would enter confidently and with a sense of assurance that they had every right to be in the fast tracked class. While working together throughout the year, much effort was needed to convince the girls that they were capable mathematics students and that they had much to offer by sharing their mathematical reasoning and thinking. In other words, I hoped my teaching would send a message that being capable in mathematics did not inherently belong to the boys in the class.

After ten years of teaching children, I began a Ph.D. program in education. I was given the opportunity to teach preservice teachers, and what I observed in the area of mathematics is that many young women seemed to suffer from mathematics anxiety and confidence issues. Here I was again, only with the grown up versions of the girls I had taught in my elementary and middle school mathematics classes. One preservice teacher shared with me that for her, she is not sure why but math is just always going to be one of those subjects that makes her tense up and is really, really hard.

As a result of my various teaching experiences, I became interested in learning more about gender issues in mathematics and the anxiety and confidence problems I had seen many girls and young women experience. Alongside me, my colleagues and I began a research journey to examine the narratives that women elementary preservice teachers have to tell about their experiences of learning mathematics.

## **Mathematics Anxiety and Women Elementary Preservice Teachers**

Mathematical anxiety in women who are entering the elementary teaching field is a subject that has gained the interest of mathematics teacher educators. Previous research has revealed that women who pursue elementary teaching careers are often individuals who themselves have confronted anxiety in mathematics during their own K-12 experiences (Ball, 1988; Brady & Bowd, 2005; McGlynn-Stewart, 2010; Sloan, 2010). There is great concern, as presently over 90% of all elementary school teachers are women (Beilock, Gunderson, Ramirez & Levine, 2010) and the number continues to increase (NCES, 2010).

Fennema's groundbreaking work that started in the 1970s led mathematics researchers to seriously begin to consider gender equity issues in mathematics and to investigate what needed to be studied to ensure that girls could reach their full mathematical potential (Fennema, 1974). Unfortunately, as Fennema & Peterson (1985) discovered, gender related issues in mathematics are "some of the most pervasive and persistent educational inequities that exist" (p.17). In this chapter, we examine experiences of mathematics anxiety that some women elementary preservice teachers narrate while learning mathematics during their own K-12 experiences. We also present evidence of how preservice teachers believe their own experiences of mathematics anxiety impacted their future mathematics teaching.

### **Stereotyping About Girls and Mathematics**

An important variable that has been linked to mathematics anxiety is stereotypes. Powerful stereotypes still exist that suggest boys are stronger in mathematics than girls (Boaler, 2008). Girls often believe they are not expected to excel in mathematics as they

try to make sense of the stereotypical messages they receive from some parents, teachers, and peers (Boaler, 2008; Gavin & Reis, 2003). These stereotypical messages can lead to a detrimental academic effect on girls in mathematics classes (Gavin & Reis, 2003).

Some teachers also help to perpetuate the stereotype that boys are stronger in mathematics than girls as they often overestimate boys' potential in mathematics whereas they underestimate mathematical potential for girls (Goodell & Parker, 2001). Another concern with teachers believing the boys in their class are stronger in mathematics is that teachers may interact differently with the girls and have lower expectations for them. The result can lead to girls having negative feelings about their mathematical abilities (Beilock, 2010; Fennema, Carpenter, Jacobs, Franke, & Levi, 1998; Fennema, Peterson, Carpenter, Lubinski, 1990). In addition, if teachers hold a stereotypical view of girls as being less capable than boys in mathematics and interact differently with girls than boys, then gender differences in mathematics achievement have a greater likelihood of developing because of the difference in expectations (Fennema et al., 1998).

### **Mathematics Achievements Among Girls**

Promising academic progress has been made by girls in the area of mathematics. Recent quantitative outcomes suggest the equity issue in mathematics between boys and girls is no longer a concern (Corbett, Hill, & St. Rose, 2008; Gresham, 2007; Huebner, 2009, Liu, 2008; Vinson, 2001). National statistics in mathematics show that presently, girls do very well in mathematics, achieving at equal or even higher levels than boys (Boaler, 2008). There is great optimism for girls in mathematics (Huebner, 2009). However, a closer look at what standardized test scores actually reveal is warranted.

McGraw, Lubienski, & Struchen's (2006) analyzed the 2003 mathematics data from the National Assessment of Educational Progress (NAEP). Their study revealed that there remain small but persistent gaps that favor boys. Although both boys and girls average scale scores have risen, the gender gap in mathematics remains, with significant differences that favor boys on average at the 4<sup>th</sup>, 8<sup>th</sup>, and 12<sup>th</sup> grade levels (McGraw et al., 2006). In addition, the gender gap is not equally disbursed across the different mathematical content areas but varies as much as 5-7 points, depending on the strand (McGraw et al., 2006). Therefore, evaluating how girls are doing in mathematics when compared to boys by the use of a single test score does not tell the whole story.

McGraw et al. (2006) also evaluated student questionnaires that were completed by the test takers during the 2003 NAEP testing period. The results of the evaluation unveiled that boys were more likely to report they liked mathematics and were good at mathematics as compared to the girls' responses (McGraw et al., 2006).

Clearly, more variables than test scores need to be examined in order to have a fuller understanding of why girls are less likely to like mathematics and feel successful in mathematics, as test scores tell only part of the story. Such a study that explores girls' mathematics classroom experiences may lead to a better understanding of the mathematical anxiety that some women experience.

In summary, the literature suggests that boys and girls may have variable experiences in the mathematics classroom. This is an important issue to consider as women elementary preservice teachers are preparing to teach mathematics. The documented K-12 experiences of women elementary teachers has provoked the teacher education community to explore how women's experiences have shaped their

mathematics experiences and how their experiences might impact their journey of learning to teach.

To this end, we report findings from a multi-year narrative-based study of women elementary preservice teachers experiences in the K-12 mathematics classroom. Through the use of narrative writings, the focused analysis for this chapter is to gain a better understanding of issues of mathematics anxiety that some women elementary preservice teachers experience. With this information, perhaps teacher preparation programs could address mathematics anxiety that some women elementary preservice teachers experience.

### **GUIDING FRAMEWORK FOR CONCEPTUALIZING THIS CHAPTER**

To better understand this mixed picture of gender equity in mathematics, two distinct frames provide both the background and impetus for this chapter: (1) mathematics anxiety and (2) narrative research in teacher education.

#### **What is Mathematics Anxiety?**

Mathematical anxiety is more than just not liking mathematics (Vinson, 2001). “Mathematics anxiety refers to such unhealthy mood responses which occur when some students come upon mathematics problems and manifest themselves as being panicky and losing one’s head, depressed and helpless, nervous and fearful, and so on” (Luo, Wang, & Luo, 2009, pp. 12-13). Physiological reactions such as sweaty palms, tight fists, being sick, vomiting, having dry lips, and a pale face can also occur which can result in students losing not only their interest in mathematics but their confidence in their ability to learn mathematics (Luo et al., 2009).

Teachers who are anxious about mathematics often pass their own anxieties to their students, which can result in a perpetuation of the problem (Beilock et al., 2010; Vinson, 2001). Indeed Beilock et al. (2010) reported that mathematically anxious women elementary teachers often impact the mathematics achievements of the girls in their class. The study revealed the more anxious the teacher was about mathematics, the more likely the girls in the class were to believe boys were better at mathematics. Discarding this “mathematical baggage” is critical for preservice teachers (Brown, Mcnamara, Hanley, & Jones, 1999.)

### **Narrative Research in Teacher Education**

For the past twenty years, scholars have successfully used narratives in the field of education as a research framework to provide a clear focus of how new teachers make sense of teaching, including how it relates to their own school experiences (Author 2, 1993, 2008; Authors, 2016; Author 2, 2003; Author 1, 2015; Authors, 2011; Authors, 2016, Authors, 2015; Clandinin & Connelly, 2000). Narrative inquiry creates a means for teachers to talk and write about their storied lives while making connections to teaching (Author 2, 1993, Connelly & Clandinin, 1990). In order to move forward toward a productive and meaningful understanding regarding the role mathematics anxiety plays in women elementary teachers, a narrative research agenda provides a mechanism to examine the cognitive understandings and personal-sense making strategies used by the participants to “converse” about their mathematical experiences, as students and teachers. The use of narratives is a powerful research tool that can be used to develop new understandings of mathematical anxiety in women who are elementary preservice teachers. It is these voices and stories of preservice teachers that potentially inform the

mathematics teacher education community about the necessary work needed to equip elementary classrooms with competent and confident mathematics teachers.

### **INSTRUCTIONAL CONTEXT**

Participants in this five-year study included 228 undergraduate women elementary preservice teachers from a large Research 1 University located in the southwestern US region. The majority of the participants were White and were in their early twenties. They were enrolled in a semester long generic methods course built from the research on classroom management, teaching strategies, teacher planning, and personal narrative in learning to teach. The overall purpose of the course was to enable students to (1) know and be able to use the standard practices of the profession; (2) have the knowledge structures and planning strategies necessary to recognize major classroom dilemmas and problems and to construct adequate solutions to these problems; and (3) understand how their life histories have shaped their personal conceptions of what it means to act as a teacher.

### **NARRATIVE APPLICATIONS RELATED TO SUBJECT MATTER**

The participants in this study were asked to write a personal mathematics experience. In these narratives, termed “well-remembered events (WRE), the preservice teachers were asked to describe and analyze a particularly salient mathematics event from their own experiences as students during their K-12 years. This genre of personal narrative was derived from Author 2’s (1993, 1994) work on well-remembered events as windows into the understandings preservice teachers have of teaching.

The task consisted of a three page paper organized around the following sections (1) the selection of a particularly salient mathematics event from one’s past experiences

in mathematics as a K-12 student; (2) a detailed and rich description of the remembered event including pertinent contextual details (i.e. grade level, subject matter, number of people present both active and observers, classroom set up), duration of the event, and a detailed account of the event itself; (3) an analysis of why the mathematics event was so memorable to them; and (4) a reflection on how the event shaped their developing understanding of what it means to be a teacher as well as what questions or concerns had arisen as a result of their analysis of their well remembered event.

Career studies imply that teachers can often recall in considerable detail specific incidents that have been especially critical in their development (Sikes, Measor, & Woods, 1985). This suggests that having preservice teachers focus on specific well-remembered events may be useful in understanding gender equity issues in mathematics that may still exist. Moreover, preservice teachers often discover during their teacher education programs that their future actions as teachers are connected to their beliefs about mathematics and themselves as mathematics learners (Stuart & Thurlow, 2000).

## **ANALYSIS**

A multi-phased analysis was used in an effort to capture the richness and nuances of the mathematics well-remembered events without losing the larger themes and structures present in the compilation. After an initial reading of all 228 narratives, we began an iterative analysis (Bogdan & Biklen, 2006) by demarcating the basic story structures (i.e. positive mathematics experience, negative mathematics experiences, challenging mathematics experiences, turning point experiences, etc.). This phase of analysis allowed us to identify patterns along story structure lines (i.e. accomplishment, pride, humiliation, shame, embarrassment, turning points, etc.).

Next, we began the thematic development of the narratives by utilizing an emergent coding scheme (Marshall & Rossman, 2006) to organize and sort the narratives. We sorted the narratives as being positive, negative, or neutral mathematics experiences. We then highlighted and labeled particular phrases or sentences of each narrative to summarize key patterns across participants' mathematics experiences as well as capture their implications for teaching mathematics in their future classrooms. We then titled each thematic category using a composite of the preservice teachers own words to encapsulate the essence of the narratives.

## **FINDINGS**

The findings of this study suggest that many of the preservice teachers did not perceive themselves to be capable or confident mathematics students. When asked to recall an experience that occurred sometime during their K-12 schooling years in mathematics, the experience or the "well-remembered event" was overwhelmingly a negative one. In fact, 182 of the 228 narratives included at least one element of embarrassment, failure, humiliation, shame or struggles in learning mathematics. Each thematic finding is presented below.

### **Theme 1: Losing My Breath In the Mathematics Classroom**

The largest category of narratives (forty-eight) centered on incidences that created feelings of embarrassment, humiliation nervousness, or shame while attempting to learn mathematics. Many of these WREs also included descriptions of the physical sensations they encountered such as trembling, sweating, crying, shaking, frozen in place, unable to speak, racing heart, sinking feeling, burning red ears and face, lump in the throat, panic, and drawing a complete blank. One preservice shared how her seventh grade teacher

began each class by randomly calling on students to answer a mathematics question.

When it was her turn to answer one of the problems she recalled:

I was so nervous and startled by this that I lost my breath for a second. I looked around the room as calmly as I could trying to do the math really fast in my head. ... This event really mattered to me because from this point on I felt uncomfortable in math. To this day, thinking about math makes me cringe.

Another preservice teacher wrote about a mathematics experience that occurred during her fourth grade year. While struggling to learn mixed fractions she reported:

I was trying desperately to fly under the radar and when Mr. M called out my apparent lack of understanding, I was utterly mortified. I did not care about learning mixed fractions at that point; I simply wanted to crawl under my desk or cry from embarrassment. I was trying to get him to stop making such a production of helping me that I even lied to him that I understood to get him to go away. ... I was one of the slower students in math and would have appreciated him being more sensitive to that instead of using that opportunity to make a joke out of my inability to comprehend mixed fractions. When he threw open the blinds and yelled, "Do you see the light?" it was one of the most embarrassing moments of my life. ... As a result of that incidence I was unable to ask him for his help ever again.

This preservice teacher stated that she wished Mr. M had waited for her to ask for his help when she was ready instead of him drawing the class' attention to her lack of understanding of mixed fractions.

Another preservice teacher wrote about her yearlong struggles with ninth grade algebra. When the day of the final arrived she recalled the following experience:

I walked into class and sat at my desk. Mr. S began to hand out the finals and when he approached my desk he kept walking. He told everyone to begin, and then walked up to me and said, “Sit at the desk in the back corner of the room.” I gathered my belongings and sat down, and then he handed me the newspaper and said, “Don’t even bother taking the final, you’re going to just fail anyways, sit here and read this until class is over.” All the students pointed and laughed at me for a while and then they finally continued with their final. ... Although this event only lasted a few minutes, it had a damaging impact throughout my life.

The public embarrassment that each of the three preservice teachers experienced seemed to fuel their belief that they were not capable mathematics students. Moreover, this belief continued to follow them through their K-12 mathematical experiences.

## **Theme 2: Compromised Female Mathematical Capital: Diminished Return on Investments**

Twenty-one participants recalled mathematics experiences with teachers who had low expectations for them. One preservice teacher shared her ninth grade experience of being unsupported by her teacher. She stated:

Ms A. was not keen with the fact that she had a student entering her classroom with a learning disability. ... I was moved to the back corner on the right side of the classroom near the bookshelf. No one sat there, nor did they ever want to. I was basically secluded. When the period ended, I asked Ms. A. why I was placed there and she said, “Because other students deserve to learn and succeed more

than you do.” I was horrified and heart broken. ... In all my time in her classroom, I was never called on and whenever my hand was raised in hopes of answering a question, I was blankly ignored.

Another preservice teacher shared an experience that occurred during her eighth grade math class review session:

Ms. M wrote four math problems on the white board and instructed to solve them as quickly as possible. The first student who would solve the problems correctly would get bonus points added to their grade at the end of the semester. After a few minutes, I raised my hand catching Ms. M’s attention and signaling that I had completed the task. The next words I heard from Ms. M were, “[Student]? Are you sure? I don’t think it’s possible that you completed all the problems so quickly. I am sure you didn’t solve them correctly, as you are very weak in math. In fact, you are the weakest in this class.” All I could hear after that was my fellow students and my teacher laughing out loud. ... This event impacted me in such a way that even today, if I solve a problem before any of my classmates, I don’t raise my hand due to lack of confidence.

These two narratives illustrate how devastating it can be for students when teachers send the message that they are not capable of learning mathematics. Students may become very anxious about learning mathematics if they are told they do not “deserve” or are too “weak” to successfully participate in this content area. Further, if teachers follow stereotypical images that men are better in mathematics than women, their respondent choices over time, bankrupt young women’s opportunities to grow in mathematics.

### **Theme 3: Race to the Finish But Stalled from the Start**

Twenty-three preservice teachers spoke of the embarrassment they experienced when presented with timed fact tests. Moreover, some participants reported the humiliation they experienced in classrooms where each student's progress was displayed for everyone to see. One participant shared her third grade experience of failing a timed multiplication test:

The feeling of anxiety I got from taking these [tests] was through the roof and will stick with me forever. . . . These feelings made this event stick with me for more than 10 years. The first timed test I took impacted my math learning for the rest of my life, it made it a very stressful and unenjoyable experience for me. I have always felt anxiety when in a math class, and I think it stems from this experience.

Other preservice teachers reported the humiliation they experienced in classrooms where each student's progress was displayed for everyone to see. One preservice teacher said the following:

I had to look at it everyday in math class, the giant neon-green poster at the front of the room. This was not a poster of Albert Einstein or of an inspirational quote; it was a chart of everyone in Mrs. H's math class with stickers. The stickers were used to track every child's progress with the timed table quizzes. The chart was also used as a subject of ridicule on the playground due to the fact that fourth graders also considered it to be an accurate representation of everyone's IQ. Today, like every day this week, the poster showed I was the dumbest. I was the only student out of twenty-three in the class who was still stuck on multiples of seven.

Both preservice teachers added that to this day, they struggle to do mathematics quickly and on the spot. However, six preservice teachers in the study spoke positively about being able to compute quickly for timed tests or games that required one person to answer more rapidly than another. As one preservice teacher noted:

One of my favorite multiplication drills was the infamous Around-the-World game. A little healthy competition and strength in math made for an exciting review. Many of the students dreaded this review activity, but another student, [A] and myself always looked forward to it.

Taken together these narratives of preservice teachers suggest that creating competition and competence in mathematics where one student is seen as a winner while another is seen as a loser should be carefully considered in the mathematics classroom.

#### **Theme 4: Girl Gravity: Free Falling in Mathematical Confidence**

Sixteen preservice teachers wrote WREs that talked about the challenges they encountered as a result of being identified as a capable or fast tracked mathematics student. Some of the participants encountered mathematics anxiety as they tried to maintain their elevated status while experiencing incidences of not understanding specific content. One preservice teacher spoke of having successful mathematics experiences until she encountered an elevated high school calculus class. She said:

Calculus was something I just couldn't grasp. This moment in class was a sort of tipping point for me. It was hard for me to want to do problems after this because I began to establish a mindset that every problem I was attempting was done wrong. . . . I no longer thought I was good enough at math to be able to solve them.

Other preservice teachers spoke of the teasing they received from boys in their accelerated mathematics classes. One preservice shared her experience of her teacher announcing that she received the highest grade in the class. She reported:

As soon as she [the teacher] said those words, two boys sitting behind me started saying things like teacher's pet, over-achiever, nerd, and calling me names in front of the entire class because of the score I got. I remember after that moment Ms. J did not say anything but laughed at the comments the two boys made along with the rest of the class. ... This impacted me because before this event I really enjoyed math and after it happened, I no longer cared about math because I was made fun of for doing it well. ... I lost my confidence and then began to stop trying because of the fear I had of being made fun of again.

These two narratives highlight how tedious and often fragile the relationship can be between girls believing that not only can they do mathematics but that they can be highly successful mathematics students.

### **Theme 5: F = Failure Forever**

A smaller subset of narratives (six) focused specifically on preservice teachers who recalled receiving an F on a mathematics assignment. They described feelings of great shame and embarrassment as well as believing that the F impacted their mathematical abilities from that point forward. One participant described the humiliation she felt as she received feedback on her third grade mathematics assignment.

I remember being nervous as heck because even though I completed it, I had no idea if I did it right. ... My name was then finally called and when I got up there, Mrs. R showed me my paper, took out her red pen, wrote a big, fat F, and circled

it while simultaneously saying it out loud in her stern and scary voice. Ashamed, I took my paper and ... upon turning around, all the eyes in the classroom were on me and the air was dead silent.

Seeing a “big, fat F” on her paper seemed to imply to this preservice teacher that this was her mathematics status. The shame she experienced as she felt the “dead silence” and the eyes of her classmates casted upon her appeared to ignite feelings of mathematics anxiety.

### **Theme 6: The Power of One: Making a Mathematical Difference**

Thirty-five narratives highlighted how important a teacher’s positive influence and calm and caring demeanor can be for struggling and anxious mathematics students. Moreover, the preservice teachers spoke powerfully about the positive impact of having a teacher believe they could be mathematically successful despite having had previous negative mathematics encounters. One preservice teacher recalled such an experience while taking algebra in seventh grade. She reported:

I did not understand any concepts that were being taught. ... Mr. M discreetly asked me to come in after school. ... I walked into his classroom and I remember him having all of my previous (and extremely butchered) homework assignments lying out on all the desks. ... Mr. M spent almost two hours explaining. ... I remember as he explained each problem to me lights and whistles were going off in my head. ... I ended up developing a love for algebra.

Another preservice recalled being tracked in the “regular” mathematics class while her friends were placed in the “advanced” group. Already feeling less than capable

in mathematics, she discovered that she received a C on her first chapter test. It was at this she sought the extra support of her teacher. She reported:

As I entered through the wooden doors of Room 251, I felt my stomach turning as I approached Mrs. C alone during lunchtime. As soon as she greeted me with her graceful, kind presence I felt a sudden ease build up and I was no longer nervous. The butterflies in my stomach had disappeared. ... We sat together at her desk and we proceeded to go over all of the problems I had missed. ... After our first meeting I felt comfortable and confident that I would be able to receive the help I needed in order to succeed.

These preservice teachers spoke of clear instances where the guidance and support of their teachers allowed them to access the mathematics they needed to learn. Moreover, these type of experiences may have helped to whittle away some the past mathematics anxiety they encountered.

### **Theme 7: Luminosity Remembered: Stand Up and Stand Out Moments in Mathematics**

Twenty-eight narratives illustrated how powerful it can be for students to be publically recognized as a competent mathematics student, especially if individuals have had previous experiences with mathematics anxiety. One preservice teacher shared the following seventh grade mathematics experience:

I dreaded walking into math class. ... I felt like I was the dumbest. ... The time came for Mr. W to call on people to share their homework. I normally was apprehensive to raise my hand but that day my hand shot up so fast. ... I walked up to the smart board and wrote my answer. ... Everyone in the class started

raising their hands. It seemed that they got a different answer. Mr. W started calling on other people and I felt embarrassed. ... Mr. W called on three other people and then told the class that I was actually right. ... I will always remember this moment because it changed my view of math.

Another preservice recalled that mathematics was always a challenge for her, requiring her to spend a lot of time and effort in this content area. During a particularly difficult eighth grade algebra lesson, the students were given time in class to work on their homework problems. The preservice teacher stated:

I started working on the first problem and after I read it I was able to compose an equation and then solve for the answer. Since I had a bad history with math in the first place I was skeptical about the accuracy of my answer, therefore, I approached Mrs. M's desk to ask her to check my work. When she examined my paper, she smiled and said that my work was correct and so was the answer. I was so happy and shocked to hear her response. Then Ms. M went on to tell the class that I understood the concept and that they should ask me any questions they had. ... I was stunned and proud of myself for understanding a difficult math concept. Then my classmates began to come up to me with questions about the homework problems and I confidently conveyed my knowledge to them with ease.

These narratives suggest that positive public recognition in the mathematics classroom may potentially create moments of mathematics success. This may be invaluable for students who do not see themselves as competent and competent mathematics students and may help to diffuse mathematics anxiety.

### **Theme 8: Mathematical Mirth: Where Meaning and Merriment Come Together**

Forty-five preservice teachers spoke of the importance of making mathematics fun and/or relevant. Some preservice teachers recalled learning fun songs to remember mathematic formulas. For example, one preservice teacher stated that half of our pre-calculus class (including herself) struggled to learn the quadratic formula. She said:

Mr. S told us that he knew another way to memorize the formula and he believed that the rest of us would really benefit from it. He told us that the quadratic formula can be remembered in song form. We did not believe this was possible, but we were interested to see how the tune went. He then sang the song. ... In my head, all I could think of was that song. ... Today when someone asks what the formula is I will tell them right away because of that song.

Another preservice teacher recalled her eighth grade experience of learning positive and negative numbers. She states:

After we settled in our groups he [the teacher] announced my biggest fear. We would be sharing our homework answers with our tables to make sure we got them all right. I knew I had gotten none of them right and did not want to share. ... After we shared the answers with the class Mr. C hung up a poster on the board, and finally positive and negative numbers made sense to me. The poster had pictures of smiley faces on it and was color-coded for positive and negative numbers. ... It took Mr. C three minutes in front of the class to explain a concept I had struggled with for several days.

One preservice teacher shared how her feelings of mathematics anxiety subsided when the concept being taught seemed relevant and important for students to learn. She

recalled successfully solving a third grade combination problem of socks, pants, and shorts:

I believe this event impacted me so much because it was truly the first time I realized that math was being used in everyday life and that I could relate to the word problems that were being described. Ms. O made math relatable and meaningful.

These WREs indicate how students may be able to make stronger and more positive connections to mathematics when it is taught in a manner that is relevant and that students perceive as fun.

### **CONCLUSION**

This study suggests that much can be learned about women elementary preservice teachers who experience mathematics anxiety during their K-12 years. There is deep concern about whether teachers who experience mathematics anxiety can be successful in teaching mathematics (Bursal & Paznokas, 2006) with previous research suggesting that teachers who have mathematics anxiety may pass their anxiety onto their students (Beilock et al., 2010; Brady & Bowd, 2005; Sloan, 2010). Moreover, as Beilock's et al. (2010) work illustrates, mathematically anxious women elementary teachers may impact the mathematics achievements of the girls in their class.

Narratives such as well-remembered events open a window for mathematics educators to peer inside of the issues that have created and quelled mathematics anxiety for preservice teachers. The narratives examined in this study provide a powerful voice for rethinking the teacher education curriculum to better understand preservice teachers' interpretations of, and responses to, experiences of mathematics anxiety. Of great

importance is the need for teacher educators to create time and space in busy teacher preparation programs to address the issue of mathematics anxiety that some women elementary preservice teachers experience before they will be expected to teach mathematics in their own classrooms. Otherwise preservice teachers may be at risk of entering the classroom ill prepared to teach mathematics.

In closing, we argue that the intersection between mathematical content knowledge and teacher knowledge is important to understand. Teacher knowledge of what it means to teach mathematics may be influenced by teachers' own experiences of learning mathematics. The narrative writings of the women elementary preservice teachers in this study illustrate that many of their experiences in learning mathematics led them to believe that not all students can "do" mathematics. Our study also reveals that preservice teachers' negative experiences in learning mathematics seemed to impair a deep and rich understanding of mathematics that is of critical importance when teaching elementary mathematics. It is essential that all teachers have a strong foundational understanding of the intellectual, demanding, and challenging aspects of mathematics (Ma, 1999) so that all students (girls and boys) have the greatest potential for learning mathematics. The relationship between mathematics content knowledge and teacher knowledge is interconnected and delicate, with both requiring an understanding of the other.

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