Exploring Exceptional Education Preservice Teachers' Mathematics Anxiety

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This study investigated preservice teachers' levels of mathematics anxiety before and after a mathematics methods course. Changes were measured using manipulatives and other activities to make mathematics concepts more concrete and meaningful. Both quantitative and qualitative measures were utilized. Informal discussions, informal interviews, and questionnaire-guided narrative interviews were conducted. Data revealed a statistically significant reduction in mathematics anxiety ($p < .001$). Results have implications for teacher education programs concerning the measurement of mathematics anxiety levels among exceptional education preservice teachers and the determination of specific contexts in which mathematics anxiety can be interpreted and reduced.

INTRODUCTION

Research has documented mathematics anxiety in preservice teachers for decades (Adeyemi, 2015; Aslan, 2013; Luo, Wang, & Luo, 2009) and has focused on the origin of their prior negative mathematics experiences, mathematical beliefs, the effect of prior teachers, and teacher education training programs. The findings have concentrated on factors that contribute to teachers' mathematics anxieties and ways to address those anxieties in preparation for teaching mathematics Gresham, 2008; Belbase, 2013). Researchers have long regarded teachers as one of the most significant factors in improving children's learning and educational outcomes (Saracho, 2013; Trondsen & Turmo, 2012). Teachers powerfully influence how mathematics is taught and how children will ultimately come to view mathematics (Gautreau, Brye, & Lunceford, 2016; Wilkins, 2010). Many teachers in the United States, however, lack the necessary skills and competence to teach mathematics in a way that promotes understanding and helps children develop positive mathematical attitudes. Preservice teachers have poorer attitudes toward mathematics than the general college population (Emenaker, 1996) and were reported to experience higher levels of mathematics anxiety than other undergraduate university students. (Harper & Daane, 1998; Hembree, 1990). This is cause for alarm, considering that teachers who possess higher levels of mathematics anxiety may unintentionally pass these negative feelings to their students (Wood, 1998).

There has been renewed emphasis and research regarding mathematics anxiety as many preservice teachers continue avoidance of the subject due to lack of confidence, ability, and mathematical content knowledge (Gresham, 2019; Beilock, & Maloney, 2015; Novak & Tassel, 2017). The findings have concentrated on factors that contribute to teachers' mathematics anxieties and ways to address those anxieties in preparation for teaching mathematics (Belbase, 2013; Nisbet, 2015). Limited research exists regarding the effectiveness of a mathematics methods course in reducing the mathematics anxiety levels among exceptional education preservice teachers (Adeyemi, 2015; Bursal & Paznokas, 2006; Zettle & Raines, 2002). Therefore, the purpose of this study was to investigate the following research question:

1. **What are exceptional education preservice teachers' levels of mathematics anxiety before and after a mathematics methods course and can changes be determined or made based on the methods course."**

This study was conducted to contribute to this body of knowledge and will identify mathematics anxiety and the research of mathematics regarding instruction and exceptional education preservice teachers (those who will be teaching exceptional education children). It will also highlight the methods used in the study, changed levels of preservice teachers' mathematics anxiety after participation in a mathematics methods course, and provide a discussion and summary of the study's conclusions.

MATHEMATICS ANXIETY: CAUSES &CONTRIBUTING FACTORS

Maloney and Beilock (2012) described mathematics anxiety as a fear or phobia that produces negative or adverse emotional responses when individuals perform mathematics related tasks. Various studies have widely documented that mathematics anxiety can range from minor frustration, uneasiness, worry, and avoidance to overwhelming emotional and physiological reactions (Maloney, Shaeffer, & Beilock, 2013; Mattarella-Micke, Matoe, Kozak, Foster, and Beilock, 2011; Whyte & Anthony, 2012). Lyons and Beilock (2012) and Mattarella-Micke, et al., (2011) affirmed that individuals with mathematics anxiety can experience emotional stress even at the thought of opening a mathematics textbook, entering a mathematics class, or doing everyday mathematical tasks. Individuals with mathematics anxiety tend to avoid STEM-related careers (Beilock & Maloney, 2015) as well as math-related tasks both in daily life and in educational course work thereby limiting their exposure to math and leading to reduced mathematics competence (Barrett, 2013; Brunye, Mahoney, Giles, Rapp, Taylor, & Kanarek, 2013).

Suarez-Pelliconi, Nunez-Pena, and Colome (2016) found that individuals with high mathematics anxiety use cognitive resources differently when performing mathematics related tasks compared to their peers with low mathematics anxiety. Individuals with high mathematics anxiety had a greater interference effect in response times, lost attention more easily, and became more distracted by stimuli compared to their peers with low mathematics anxiety. In another study, Suarez-Pelliconi, Nunez-Pena, and Colome (2014) found that mathematics anxiety affected individuals' processing efficiency or the speed of processing for even basic mathematical problems. They posited that the difficulty in processing was due to the inability of individuals with high mathematics anxiety to block out irrelevant information. This distraction related to mathematics anxiety is significant due to the potential problems it could cause in learning mathematics (Suarez-Pelliconi et al., 2016).

Results from other studies also confirmed that mathematics anxiety stems from a lack of confidence or low self-esteem in mathematics, as well as a fear of failure and past negative experiences with mathematics (Bates, Latham & Kim, 2013; Bekdemir, 2010; Harari, Vukovic & Bailey, 2013). Mathematics anxiety may develop and reoccur in response to a wide range of experiences with mathematics across a lifetime (Stoehr, 2015). Several studies cited teacher's behavior and teaching methods as a prime cause of mathematics anxiety starting as early as the primary grades (Lee & Zeppelin, 2014; Furner & Gonzalez-DeHass, 2011; Whyte & Anthony, 2012). Geist (2010) noted that mathematics anxiety comes from the way teachers' present mathematics to children, not from mathematics itself. Many studies link mathematics anxiety to teachers and the use of inappropriate teaching practices that foster students' lack of confidence in their own mathematical abilities (Bekdemir, 2010; Hoffman, 2010). Burton (2012) discovered that teachers with mathematics anxiety spend less time implementing standards-based instruction and spend 50% less time teaching the subject than those who feel comfortable teaching mathematics (Sloan, 2010). Teachers who have high mathematics anxiety tend to over rely on traditional teaching methods such as lecture, whole-class instruction, flash cards, worksheets, teaching to the textbook, assigning everyone the same problems, insisting on only one method to solve a problem, and focusing on skills rather than teaching for understanding (Gresham, 2009; Isiksal, 2010; Whyte & Anthony, 2012). Emphasizing rote memory, drill, competition, speed, and correctness over concept development, critical thinking, sufficient explanations, and real-world connections can also lead to mathematics anxiety (Boaler, 2014; Geist, 2010).

Mizala, Martinez, and Martinez (2015) examined the effect of mathematics anxiety on the development of teacher expectations, specifically the skills needed for effective learning. They found that preservice teachers project their own mathematics anxiety to the expectations they have for their students. Preservice teachers with above average mathematics anxiety had significantly lower mathematics achievement expectations for students than preservice teachers with lower mathematics anxiety. Preservice teachers also had lower expectations for girls than for boys, confirming the presence of gender stereotyping that is common in mathematics as confirmed in a previous study (Beilock, Gunderson, Ramirez, & Levine, 2010). Findings from Mizala, et.al's study suggest that mathematics anxiety can affect teachers' capacity to develop inclusive learning environments, as teachers with high mathematics anxiety were also more likely to recommend special education services to students struggling in mathematics.

The Role of Mathematics Methods Courses in Reducing Mathematics Anxiety

Researchers have widely recognized that preservice teachers enter teacher preparation courses with a broad range of mathematics anxiety (Bates et al., 2013; Lake & Kelley, 2014; Wilson, 2013). Although studies about the role of mathematics content courses and preservice teachers' mathematics anxiety exist, fewer studies exist that address the influence of mathematics methods classes on preservice teachers' mathematics anxiety levels (Cardetti & Truxaw, 2014; Johnson & vanderSandt, 2011; Matthews, Rech, & Grandgenett, 2010). Sloan's (2010) mixed methods study concluded that the methods course was an effective intervention strategy for reducing the majority of preservice teachers' mathematics anxiety levels. Gresham (2019) conducted a similar study that examined the effects of a reform-based mathematics methods course on preservice teachers seeking certification for grades K-5. Like Sloan, Gresham (2009) found that a reform-based methods course was successful in reducing the majority of preservice teachers' mathematics anxiety levels. In both studies, preservice teachers attributed the reduction in their mathematics anxiety levels to the reform-based constructivist methods used in the course. Both studies also affirmed that preservice teachers had more confidence in their mathematical ability after instructors modeled effective teaching practices.

Johnson and vanderSandt (2011) also investigated the level of mathematics anxiety present among different education majors to determine if certain education majors benefitted more from mathematics content and mathematics methods courses. They found that the methods course did lead to decreases in mathematics anxiety, but they did not explore factors that may have led to increases or decreases in the preservice teachers' mathematics anxiety levels. While helpful, none of these studies mentioned focused exclusively on exceptional education preservice teachers' mathematics anxiety.

Lake and Kelly (2014) conducted a qualitative study to examine if participating in a mathematics methods course changed female preservice teachers' mathematics anxiety as well as their beliefs and stereotypes related to mathematics. The authors hypothesized that using research-based practices, including the use of modeling with concrete manipulatives, problem solving, and teaching for conceptual understanding, would help to reduce the preservice teachers' mathematics anxiety and negative stereotypical beliefs. Overall, the methods course was not successful in reducing preservice teachers' mathematics anxiety, even though it used similar teaching methods as those mentioned in previous studies conducted by Gresham (2009), Sloan (2010), and Johnson and vanderSandt (2011).

Lake and Kelly's (2014) findings support Geist's (2010) assertion that it is very difficult to break the cycle of mathematics anxiety including the negative views and beliefs preservice teachers hold related to mathematics. These negative views and beliefs tend to be ingrained in preservice teachers by the time they reach their teacher preparation courses (Geist, 2010). Negative beliefs cause preservice teachers to believe they are not good at mathematics, causes them not to like mathematics, and leads them to avoid mathematics; thus, they develop a lack of confidence in their ability to teach mathematics (Lake & Kelly, 2014). It is perplexing why half of the preservice teachers in Lake and Kelly's study experienced a reduction in their mathematics anxiety while half showed an increase in mathematics anxiety. Lake and Kelly's findings confirmed, as Bates, et al. (2013) supported, that there is a lack of consensus regarding what specific methods and strategies used in methods courses help to shape and improve preservice teachers' mathematics anxiety levels.

Barrett (2013) conducted a study to determine whether elementary preservice teachers' attitudes toward using manipulatives would improve and whether the preservice teachers' mathematics anxiety would decrease after participating in a mathematics methods course. The course used a constructivist approach to teaching and focused heavily on the use of manipulatives to teach mathematics to young children. Over half of the preservice teachers surveyed indicated struggling with mathematics at some point in their education, and many identified poor teachers as the main

reason for their struggles and anxiety with mathematics. Unlike Lake and Kelly's (2014) study, Barrett found that preservice teachers' attitudes toward mathematics increased overall as a result of the methods course. Preservice teachers attributed improvement to the instructors' focus on the use of manipulatives to teach mathematics. Preservice teachers showed a decrease of 7% in their mathematics anxiety, but this was not statistically significant. Therefore, based on the different findings this topic warrants additional investigation regarding the effectiveness of mathematics methods courses in reducing preservice teachers' mathematics anxiety levels (Johnson & vanderSandt, 2011).

Preservice Teachers Mathematics Anxiety and Its Relation to Instruction

Many preservice teachers do not feel confident in their ability to do mathematics. Fortunately, attention is being directed toward the mathematics curriculum and in helping those who struggle learning basic mathematics skills, mastering more advance mathematics, and solving mathematics problems. Although the National Council of Teachers of Mathematics (NCTM, 2000) strongly encourages teaching mathematical understanding and reasoning, the reality for teachers with mathematical learning problems including mathematics anxiety is that they spend most of their mathematical time learning and practicing computation procedures and have little confidence in their ability to learn more advanced mathematical skills (Haciomeroglu, 2014).

Being confident and knowledgeable in the subject matter is critical in shaping one's attitude toward mathematics including the attitudes of teachers (Jackson & Leffingwell, 1999). Studies have indicated that mathematics anxiety has implications for teacher practices in mathematics (Gresham, 2008; 2019; Bursal & Paznokas, 2006; Vinson, 2001; Zettle & Raines, 2002). As indicated, teachers with high levels of mathematics anxiety use more traditional teaching methods. They concentrate more on teaching basic skills rather than concepts and devote more time to seatwork and whole class instruction. Therefore, it is very important for teachers to have an understanding of the mathematics curriculum and knowledge of effective non-traditional approaches to teach mathematics effectively. Utilizing non-traditional approaches in the mathematics classroom such as using manipulatives to bridge from concrete to abstract, implementing a variety of teaching techniques such as playing games, problem solving strategies, small-group and individualized instruction, and addressing individuals' attitudes towards mathematics can help lessen mathematics anxiety (Vinson, 2001). One commonality found among mathematics programs reporting a reduction in mathematics anxiety is that teachers introduced the material very slowly, the instructor assumed no prior mathematical knowledge, and individuals were encouraged to discuss their own thought processes in learning. The most successful instructional mathematical programs were those featuring teachers who attempted to change the way mathematics was perceived and learned as well as through changes in instructional strategies (Bursal & Paznokas, 2006).

To ensure effective instruction, adaptations and modifications for instruction are necessary in the areas of lesson planning, teaching techniques, formatting content, adapting media for instruction, and adapting evaluation. Some teachers have limited teaching experiences and, therefore, have lessened opportunities in identifying mathematics learning concerns and mathematics anxiety in the students they directly teach. Obviously, limited teaching experiences, coupled with high levels of mathematics anxiety is a concern as it may certainly carry over into inservice practice. As a result, it is believed that teachers must be adequately prepared in mathematics and should be done through mathematics methods courses offered by teacher education programs (Aslan, 2013; Gresham, 2009; 2019; Mizala, et. al., 2015). The National Council of Teachers Mathematics Standards (2014) advised teachers to use a variety of instructional techniques and strategies to benefit all types of learners in the classroom. Unfortunately, many mathematics educators who teach primarily through lecture and rote memorization of algorithms often neglect to meet the needs of all students, and therefore, may unintentionally perpetuate mathematics anxiety. The quality of mathematics instruction at the K-6 level depends on the preparation of teachers to teach mathematics.

In this article, the literature review was structured to first focus on the definition of mathematics anxiety to obtain knowledge of its academic and emotional effects as it relates to mathematical learning. Research on mathematics as it relates to preservice teachers was visited as it was critical to establish a foundation of constructs in determining how mathematics anxiety affects teacher practices.

THE STUDY

This study utilized a quantitative and qualitative approach in fall and spring semesters. Specifically, the study examined exceptional education preservice teachers' (i.e., preservice teachers that will be teaching exceptional education students) levels of mathematics anxiety before and after a mathematics methods course. The population consisted of thirty-one exceptional education preservice teachers getting a K-6 endorsement. All preservice teachers enrolled in the mathematics methods course were in their junior year within the program. The participants were overwhelmingly female (30 of 31); therefore, no attempt was made to differentiate results by gender. All subjects completed at least two university mathematics courses and one elementary mathematics content course. Students were informed both verbally and in writing that their participation in the study was completely voluntary and would not influence their grade in the course.

The mathematics methods course featured many of the same strategies (concrete manipulatives, representations, journal logs, and discussions) found in the studies previously mentioned. However, it differs from other studies in that exceptional education preservice teachers actively participated in a 12-week teaching experience practicum throughout the duration of the mathematics methods course.

Data Collection

Two data sources were used for this study: a paper and pen questionnaire and oral interviews. All preservice teachers enrolled in the methods course completed the Mathematics Anxiety Rating Scale (MARS) developed by Richardson and Suinn (1972), The 98-item, self-rating Likert-type scale may be administered either individually or to groups. Scores range from 98 to 490, where the higher scores correlate with higher levels of math anxiety. The MARS was given on the first and last day of the semester.

(Author's note: Despite the usefulness of the original scale, researchers have sought a shorter version of the scale partly to reduce the administration time of the original scale. However, because some of the preservice teachers involved in this study

are also participating in a longitudinal study, the same 98-item scale was used for consistency.)

Bruner's model of instruction was introduced on the first day of class. During the semester course, preservice teachers participated in discussion sessions (discourse), teacher directed large and small group activities, literature based mathematical activities, journal writing, student group presentations involving hands-on manipulatives, implementation of hands-on approaches to teaching mathematic content that involved the use of various concrete materials commonly utilized in mathematics teaching, and a 12-week field experience practicum in the K-6 classroom (6-weeks in the K-2 grades and 6 weeks in the 3-6 grades). During the field experience practicum, each exceptional education preservice teacher taught a minimum of 4 lessons involving the use of concrete manipulatives and the integration of literature in the mathematics curriculum. The field experience was supervised by both a university faculty member and the preservice pupil's full-time teacher. Preservice teachers were required to write detailed lesson plans describing all their planned instructional activities for the field experience practicum. Following the MARS pretest, one entire class period was used to explain the required format/guidelines for the lesson plan used in the field practicum experience. The format included: teaching a new mathematics concept for each lesson, identifying national, state, and local standards, lesson objectives, lesson planning procedures, ESOL and special needs modifications, assessment procedures, use and implementation of manipulatives, and the integration of literature.

The researcher coded themes from questionnaire-guided interviews (See Table 1 for interview questions) and journal prompts asking them to describe their view of mathematics, of themselves as a student or learner of mathematics, and their view of themselves as future mathematics teachers. All 31 preservice teachers enrolled in the mathematics methods course were involved in writing responses to journal prompts during the semester.

Table 1. Interview Questions

1. What do you think when you hear the word mathematics?
2. For me, mathematics is most like….?
3. Do you perform well in mathematics?
4. How confident do you feel when asked to perform mathematics problems?
5. Describe your most memorable teaching moment while teaching mathematics in your internship. Why does this stand out in your mind?
6. How do you feel about mathematics?
7. How confident are you when teaching mathematics?
8. Describe your feelings when teaching mathematics?
9. What do you think contributed to your mathematics anxiety?
10. Do you feel class discussions have helped you this semester? Why or why not?
11. Did this course help you address your mathematics anxiety? How? Why or why not?

Data Analysis

Descriptive and inferential statistics were used for the analysis of mathematics anxiety for both the pre-and post-testing. Paired sample t-tests were completed to consider differences between pre-posttest anxiety levels. Pretest MARS scores were subtracted from posttest MARS scores to reveal score differences. (See Tables 2 and 3). A positive difference score meant that the preservice teacher's mathematics anxiety increased during the semester. A negative score meant that the preservice teacher's mathematics anxiety decreased by that much.

Table 2: Mathematics Anxiety Raw Score Means

Semester	Pretest	Posttest	Gain	Students Per Semester
Fall-1	215.76	166.92	-48.84	4
Spring-1	217.42	194.64	-22.78	7
Fall-2	221.71	201.73	-19.98	5
Spring-2	220.41	180.92	-39.49	5
Fall-3	201.33	155.00	-46.33	4
Spring-3	219.77	165.05	-54.72	6
All Groups	216.06	177.37	-38.69	31

Note: * p < .001

Table 3. Paired Sample t-test Results

Semester	Variables	t	df	P
Fall-1	Pretest-Posttest	12.74	3	.0000*
Spring-1	Pretest-Posttest	17.54	6	.0001*
Fall-2	Pretest-Posttest	38.33	4	.0048
Spring-2	Pretest-Posttest	24.72	4	.0001*
Fall-3	Pretest-Posttest	18.88	3	.0000*
Spring-3	Pretest-Posttest	21.65	5	.0000*

Note: * p < .001

The journal entries were analyzed before the interviews, and the data from the interviews and journal entries were combined when reporting the data. The mathematics journal entries allowed the researcher to examine any changes in their mathematics anxiety. Data from the interviews and math journal entries were analyzed and then coded by the researcher using cross-case synthesis. This data analysis strategy was recommended by Yin (2014) when dealing with multiple cases. Cross-case synthesis involves treating each case as a separate study. Coding involves organizing the material into segments and labeling it according to themes or patterns that emerge. The researcher produced word tables according to reoccurring themes or categories that emerged from the data. Analysis of the word tables allowed for the development of cross-case conclusions. Literature supports this analysis and coding technique because it allows for the recognition of similarities and differences as well as the development of themes both within and across cases (Stake, 1995; Turner & Danks, 2014). The researcher analyzed data inductively to find patterns or themes that emerged, as well as deductively to compare themes and key concepts as recommended by Patton (2002). The researcher predicted that the preservice teachers might report similar methods as being either effective or ineffective in changing their mathematics anxiety. When different cases indicate similar results, this enhances a study's credibility and validity (Stake, 1995). The researcher used narrative passages to represent themes that emerged from the data. To validate the study and provide greater construct validity, participants had the opportunity to review the report to check for accuracy and correctness in the representation of their thoughts and statements.

FINDINGS

Table 2 shows the raw score means for the whole group (semester). Although the gain for Spring 1 and Fall 2 semesters were not as great as the Spring 2 and 3 and Fall 1 and 3 semesters, there was a change indicating a reduction in preservice teachers' mathematics anxiety. This table also reveals that the greatest difference in change scores from pretest to posttest existed between Fall 2 (-19.98) and Spring 3 (-54.72). This means that the average

reduction of mathematics anxiety was significantly greater in the Spring 3 semester than in Fall 2 semester. A possible reason for this could be that during Fall 2 semester two separate severe weather-related instances caused the cancellation of classes for an extended period of time. Spring 1 also indicates a lesser reduction of mathematics anxiety from pretest to posttest. A possible explanation for this lack of significant reduction may attribute to the instructor's extended absence (the researcher of this study) due to a family emergency/death. Although courses were moved online and instruction continued in both semesters, active participation in the Bruner model of instructional practices were interrupted. Twenty-seven exceptional education preservice teachers showed positive gains from pretest to posttest in MARS scores while 4 showed negative gains. Of those showing negative gains, one was enrolled in Spring 1 semester and three were enrolled in Fall 2 semester when instruction was moved online due to circumstances previously described.

Six themes emerged from the informal interviews, questionnaire-guided narrative interviews, discussions, and journal logs. Preservice teachers perceived the following as instrumental in reducing their mathematics anxiety: (1) the introduction of a variety of strategies/representations through modeling and teaching (mathematics teaching practices), (2) attitudes towards mathematics, (3) the instructor's positivity and teaching style including the positive classroom atmosphere, (4) teaching experiences with children, (5) prevalent classroom discourse, and (6) journaling.

Theme 1

Preservice teachers were specifically asked what they felt contributed to their decrease in mathematics anxiety. Many described in detail specific events that occurred during their elementary school years that directly related to the beginnings of mathematics anxiety and with difficulties in learning the mathematical content as presented (i.e., no manipulative use, excessive workbook pages to complete and problems to solve, and minimal teacher instruction if at all). The methods course offered opportunities for active engagement with manipulatives, peer/teacher discourse, a variety of problem-solving strategies, and other activities. They expressed that being involved in this type of teaching enabled them to understand and see it all come together particularly when the focus was on multiple ways to solve a problem. Some commented that mathematics was now less "foreign" or "scary" to them, noting that perceptions of their abilities to understand mathematics concepts were now enhanced due to how the instructor presented the mathematics. Others commented they finally "understood concepts such as algebra, probability and statistics, fractions, decimals, and percents when the topics were presented in a concrete and practical format. It was most effective when the instructor used multiple strategies and illustrations to teach and model concepts. One commented feeling more assured with her "teacher role" particularly because the strategies and activities presented related to real-life situations. The most unanimous and interesting comment was that they felt as though their mathematics anxiety could have been prevented in elementary school, if they had received instruction of mathematical concepts through the use of concrete manipulatives.

Of the twenty-seven preservice teachers who had positive mathematics anxiety gains, twelve of them attributed the reduction to the methodology and the use of concrete manipulatives provided in the course to teach the subject content, experiences in using them, and implementing them within their lessons with students.

Theme 2

At the beginning of the semester preservice teachers' negative attitudes surfaced very quickly. All of them indicated they did not like mathematics and really struggled with the subject. Their statements described negative emotions with words such as "stressed", "embarrassed", "frustrated", "fearful", "discouraged", and "struggling". They associated these words directly with their personal mathematical experiences as a former student, with remembrance of negative mathematical experiences as early as 2nd grade for one preservice teacher. Their words suggested confidence inadequacies in their ability to effectively reach their students both academically and emotionally and identifies their well-entrenched beliefs about mathematics teaching and learning. Preservice teacher comments illustrated their fears for a lack of solid understanding of mathematical content and have linked this skepticism with prior experiences. At the semester's end some who experienced a positive gain used words such as "less stressed or nervous", "more confident", "more assured", "prepared", and "mathematically optimistic".

Theme 3

Six preservice teachers attributed their lowered mathematics anxiety levels to the enthusiasm of the professor in teaching the subject content and inviting atmosphere of the course. Nine preservice teachers thought their mathematics anxiety levels were reduced by a combination of implemented methods including the methodology and use of concrete manipulatives used throughout the course, the instructor's enthusiasm and inviting atmosphere, and journal writing. They liked the instructor's sense of humor and ability to make them feel relaxed. One posited that the instructor was "honest, firm, fair, and consistent without being overbearing when we struggled with problems." One explained that she felt the instructor "believed in them and helped us work through problems without chastising and humiliating".

Theme 4

Preservice teachers expressed both positivity and negativity in relation to their teaching experiences with children during their field experience practicum. Several expressed excitement about getting excellent reviews for lesson delivery and with the need to have teaching experiences. Those who expressed positivity seemed to have established a strong rapport with their coordinating teacher even if they did not like their teaching styles. They also indicated the need to understand the complexities of teaching and how experience could help with teaching tasks such as helping navigate their ability to manage many agenda of the classroom including lesson planning, classroom management, and knowledge of content. Many commented that having a mentor that was positive was critical to their positivity and successful teaching experiencing.

Negativity towards teaching experience was also present. One teacher commented that she felt she should have learned much more during the practicum experience but did credit the university methods course for positive experiences and the acquisition of new knowledge. She felt her coordinating teacher did not offer the mentorship she was seeking. Others indicated witnessing their coordinating teachers becoming frustrated when teaching

mathematics or discovered that teachers would skip the subject altogether. Many sensed the teachers' negativity towards mathematics. Several posited how frustrating it was to see the use of so many worksheets with little to no manipulative use or input from the teacher in offering instruction or guidance.

One student had a particularly significant negative increase in her mathematics anxiety. After interviewing this student, she indicated that her teaching experience and having to work with *all* types of students in the classroom was very stressful and not what she had expected. She implied that being unfamiliar and intimidated by manipulatives, having to learn how to use them for classroom instruction, and adapting when teaching was extremely difficult. She indicated that having to modify lessons based on student needs was very time consuming and a task she certainly did not enjoy or want to do on a daily basis. She questioned her decision to be an exceptional education teacher. She expressed a great desire to discontinue the exceptional education program and did indeed withdraw moving to a non-education program at the semesters end.

Theme 5

All preservice teachers posited that peer and/or instructor discourse and openness to address feelings regarding mathematics during class was very beneficial to the lessening of their mathematics anxiety. One preservice teacher stated that publicly addressing their lack of content knowledge without embarrassment was beneficial and comforting, particularly when learning that others experienced the same. However, one preservice teacher who had a negative gain posited that even though the class was enjoyable and free for open discourse, her disdain for mathematics would not change. She called herself a "teacher fraud" for trying to convince herself she could and would be a successful mathematics teacher.

Theme 6

All preservice teachers commented on how the use of journal writing helped them work through their mathematics anxiety. One stated that writing about what she was learning enabled her to understand and find the missing mathematics puzzle pieces, particularly when the focus was on basics of mathematics including the integration of multiple strategies with which to teach and multiple ways to solve a problem. Another said her growth in mathematics was evident in her journaling, while another indicated her journal became her "mathematics security blanket". All preservice teachers expressed a desire to implement student journaling as an effective mathematics practice once inservice.

The four preservice teachers who showed negative gains expressed concern and much difficulty with modifying and adapting the lesson(s), trying to learn mathematics while incorporating manipulatives into the lesson planning, and in knowing which strategies to use according to student needs. They also found it intimidating to integrate mathematics and literature into their lesson planning. Preservice teachers were given numerous book lists and websites with literature. However, they posited hardship in finding the appropriate reading material for their grade level. All four preservice teachers indicated that having to move instruction online and while not physically engaging in class interactions affected them greatly. One conveyed that losing discourse with peers for an extended period of time caused her mathematics anxiety to increase. Even though preservice teachers were provided discourse opportunities through Zoom and chat rooms, she felt it was not sufficient preferring face-to-face interaction. Another felt isolated due to losing face-to-face instruction and active engagement in the learning process. Being in the physical presence of others was a comfort to her. Seeing the instructor explain manipulative use online was helpful but not being able to touch the manipulatives and communicate with peers during the process affected her mathematics anxiety negatively. She also felt a strong lack of mathematical confidence in using manipulatives within her mathematics lessons and indicated she would not be successful in introducing them to students.

All preservice teachers indicated a specific need to address *their* deficiencies in mathematics before they could identify and address their exceptional education students' needs. Their comments focused more on enhancing instruction through a variety of practices, modification, and adaptation of the lesson(s). Perhaps this was due to their specialized course program, but no generalization was made.

DISCUSSION

The results of the study revealed a statistically significant difference between pre- and post-mathematics anxiety levels of exceptional educational preservice teachers as a direct result of their participation in a standards-based mathematics methods course. This finding indicated that at the completion of the mathematics methods course, overall preservice teachers' mathematics anxiety levels were significantly reduced from their levels at the onset of the course. Thus, it seems reasonable to conclude that the mathematics methods course was an effective intervention strategy for reducing mathematics anxiety. The results of this study also agreed with the findings of other studies, which reported that the mathematics anxiety levels of preservice teachers can be reduced by a mathematics methods course (Albayrak & Unal, 2011; Bahr, Shala & Monroe, 2013; Harper & Daane, 1998; Novak, & Tassel, 2017).

Many strategies to reduce mathematics anxiety in preservice teachers were provided and implemented throughout the study. Employing best practices for teaching mathematics helps lessen mathematics anxiety (Zemelman, Daniels, & Hyde, 1998). Preservice teachers perceived the variety of strategies and methods the instructor used to teach and model concepts as most effective in reducing their mathematics anxiety. Sloan (2010) found that preservice teachers attributed the reduction in their mathematics anxiety levels to the reform-based constructivist methods used in a mathematics methods course. They found that preservice teachers had more confidence in their mathematical ability after teachers modeled effective teaching practices. Mathematics methods courses that used a variety of strategies to help build conceptual understanding of mathematics have proven effective in previous studies in reducing preservice teachers' mathematics anxiety (An, Ma, & Capraro, 2011; Aslan, 2013; Nisbit, 2015).

Preservice teachers also perceived that the instructor and the classroom atmosphere was instrumental in reducing their mathematics anxiety. This finding was expected and consistent with previous literature as Sloan (2010) found that the instructor's disposition to help students feel at ease and create a positive classroom atmosphere helped contribute toward reducing preservice teachers' mathematics anxiety. Because research demonstrates that teachers can foster mathematics anxiety in students by their attitudes and the classroom environment they establish, it serves to reason they can also help reduce students' mathe-

matics anxiety (Eden, Heine, & Jacobs, 2013; Whyte & Anthony, 2012). In Lake and Kelly's study (2014), many preservice teachers noted the importance of the instructor's enthusiasm and energy as preservice teachers did in the current study. The way teachers teach mathematics significantly affects students' attitudes and views toward mathematics (Gautreau, et.al., 2016).

Preservice teachers were encouraged to use best practices for teaching mathematics during their practicum experience in the classroom. Studies have found that the effects of interventions such as reform-oriented instruction defined as pedagogy that is student-centered, implements hands-on strategies, uses group work and explorations, and emphasizes children's thinking have shown notable effects upon preservice teachers' mathematics anxiety (Hart, Oesterle, & Swars; 2013). Findings indicate certain classroom characteristics support student learning, especially with adequate instructor positivity and availability, clear descriptions and explanations of mathematical practices, classroom discourse particularly amongst students, and a caring classroom environment that builds student confidence (Powell-Mikle, 2003).

NCTM (2000) indicated that excellence in mathematics education requires equity—high expectations and strong support for *all* individuals. The principles acknowledge that individuals need high-quality instruction and materials in learning environments that support them. Individuals with learning disabilities in mathematics may need special accommodations to meet high mathematics expectations (Furner & Duffy, 2002). Preservice teachers with mathematics anxiety may need the same or different approaches, to prevent or reduce mathematics anxiety to assist them in becoming confident mathematical thinkers. Teachers are the single most important influence on the quality of an individuals' mathematical learning. They take the lead in organizing instruction, choosing what mathematics content should be emphasized, and in shaping other's attitudes and dispositions to learn mathematics (Gresham, 2008; Joyner & Reys, 2000).

Concrete experiences helped all exceptional education preservice teachers have a better understanding of the procedural purposes and mathematical concepts. As per the interviews, the use of manipulatives aided in learning how to teach mathematics and illustrated how to incorporate a variety of methods to meet each student's unique needs. Teaching that enables *all* individuals to learn mathematics calls for teachers who have the knowledge and skills to meet students' needs, organize sound instruction, and are supported in their efforts to improve their own skills and knowledge. Providing preservice teachers with non-threatening, risk-free opportunities to learn and practice math skills is greatly encouraged. Celebrating both small and great advances is also important. If preservice teachers learn to provide instruction that is effective for individuals with mathematics anxiety and for those with learning disabilities, we will help students learn mathematics. Teachers who understand the learning needs of others are more empowered to provide the kind of instruction their own students' need. Knowing why a preservice teacher is struggling to learn mathematics provides a basis for understanding why particular instructional strategies and approaches are effective. Researchers and teachers must continue to work together to determine which curricula and instructional practices will bring the best results in mathematics achievement. There is no doubt that for some, mathematics is and will remain challenging. However, we want individuals to understand mathematics. As teachers' model problem solving strategies daily, monitor the use of them, and encourage the use of these strategies in a variety of ways, individuals will learn to generalize these strategies into other areas and become independent learners. Educators do have an impact upon their students. Understanding mathematical content and its presentation will help exceptional education teachers teach their students effectively, thus preventing or reducing mathematics anxiety in their future students.

The usefulness of the mathematics methods course and experiences as reported by teachers' was a salient finding. Looking back at preservice teachers' comments it is evident that learning, development, and growth did take place not only in the mathematics methods course but for some through actual practicum teaching experience. Results of the study seem to indicate that preservice teachers need opportunities for discourse to address their past mathematical experiences. They indicated the benefits of the mathematics methods course when opportunities were provided for them to openly express their feelings.

This research provides support to the importance of mathematics methods courses, collaborative experiences, and the use of manipulatives in shaping preservice teachers' eventual practices and recognition of their personal impact on their students. The results from the study provides insight into the durability and effectiveness of teacher training programs that emphasize manipulatives (Jong & Hodges, 2015). This study further supports the importance of having teacher education programs that influence the development of effective instructional practices (Zee & Hooman, 2016). NCTM (2014) principles acknowledge that individuals need high-quality instruction and materials in learning environments that support them. These instructional practices are not unfamiliar to mathematics educators, as the *Principles to Action* (NCTM, 2014) support the use of such methods in all mathematics classes. The implementation of specific strategies as presented through these actions such as engaging students in mathematical thinking, reasoning, and sense making to significantly strengthen teaching and learning allows for mathematical understanding and confidence thus directly affecting mathematics anxiety (Beilock & Maloney, 2015). Preservice teachers' comments reiterated how the implementation of these approaches not only helped them academically but helped themselves better understand the content through the use of these actions within their lessons. The utilization of these principles in mathematics classrooms and in more college mathematics courses presents an opportunity to potentially create stronger preservice teachers (Hart, et.al., 2012; Swars, 2009). This research study presents and reinforces compelling evidence that a methods class that used a constructivist approach emphasizing inquiry, hands-on methods and strategies, mathematics pedagogy, children's mathematical development, and active engagement helped to decrease preservice teachers' mathematics anxiety. Sackes, Flavares, Gonya, and Trundle (2012) confirmed that providing hands-on activities, inquiry-based strategies, and mastery experiences or successful teaching experiences during methods classes helped build preservice teachers' mathematical confidence while lessening mathematics anxiety. Bandura (1994) noted that mastery experiences such as the aforementioned were essential to developing mathematical understanding. A weakness of some prior studies is that they lacked detail regarding which methods or specific strategies used in a methods course were instrumental in helping to change preservice teachers' mathematics anxiety. Therefore, this study will add to the current literature.

Some preservice teachers perceived discourse as effective in reducing their mathematics anxiety. This was an unexpected finding and not specifically referenced in the literature. When preservice teachers openly reflect on their mathematical experiences, they can attribute their success or failure to factors outside of themselves, or they can assess the personal factors they brought to the task (Swars, 2009). Mathematics methods courses should provide a self-awareness of past mathematical experiences among preservice teachers, particularly negative experiences in order to facilitate positive changes in mathematics anxiety. These experiences will help build positive and effective changes in preservice teachers (Knoblauch & Hoy, 2008; Swars, Daane & Geisen 2006). At this point knowledge of these findings is not enough as we must advocate and be focused on teacher preparation programs that include the most effective contexts and experiences for teacher learning in mathematics and how mathematics anxiety affects these contexts.

IMPLICATIONS, RECOMMENDATIONS AND LIMITATIONS

The purpose of this study was to explore exceptional preservice teachers' mathematics anxiety. This study has implications for teacher education programs, particularly mathematics methods courses. According to Swars, et.al. (2012) and Hart et.al., (2013), teacher preparation programs must be focused in providing experiences for teachers in learning mathematics and build in-depth understandings through inquiry and problem-solving, grounded in theories in how mathematics is learned. Teachers who are reluctant to broaden their mathematical knowledge, may not be interested to learn about alternative teaching methods that could help students learn mathematics. Research shows that teachers tend to use traditional teaching methods and the same lessons plans that they have developed over time (Swars, et.al., 2006). Therefore, exceptional education preservice teachers must learn how to incorporate a variety of effective teaching methods and practices to meet each student's unique needs. Effective teachers possess an amazing array of tools perfectly designed to meet the varying needs of every student. Teachers who understand the learning needs of others are more empowered to provide the kind of instruction their own students' need as was evidenced for some in this study. There is no doubt that for some, mathematics is and will remain challenging. The reality for preservice teachers with mathematics learning problems including mathematics anxiety is that they spend most of their time learning and practicing computation procedures and have little confidence in their ability to learning more advanced mathematics skills (Aslan, 2013). The qualitative findings from this study show some lacked mathematics confidence which negatively affected their mathematics anxiety, however, preservice teachers should discard false beliefs and resist intimidation due to lack of confidence, for this construct has a profound effect on learning and the potential to become effective exceptional education teachers at the K-6 grade level.

At this point, knowledge of these findings is not enough as we must advocate to eradicate mathematics anxiety among preservice teachers. Tobias (1998) suggested that for individuals to overcome mathematics anxiety, they must take initiative in the learning process. Teachers are an important influence not only on the quality of an individuals' mathematical learning but also with their own learning as well (Beilock et al., 2010). We know from prior preservice teacher research that those with mathematics anxiety may need a variety of methods to prevent or reduce mathematics anxiety to assist them in becoming confident mathematical thinkers. Teacher preparation programs have a responsibility to help preservice teachers reduce their mathematics anxiety (Hurst & Cooke, 2014; Peker & Ertekin, 2011; Wilkins, 2010). Reducing mathematics anxiety in teachers and ultimately students depends heavily on the proper preparation of preservice teachers (Geist, 2010; Maloney, Sattizahn, & Beilock, 2014). Reform-based constructivist mathematics classrooms as advocated by the NCTM (2014) principles, mathematics learning is student-centered, and collaboration and problem solving are emphasized along with constructivist methods involving discovery and hands-on learning (Connor, Edenfield, Gleason, & Ersoz, 2011). In some studies, reform-based constructivist mathematics methods courses successfully reduced mathematics anxiety (Evans, 2011; Holm & Kajander, 2012; Rethlefsen & Park, 2011). By being knowledgeable of mathematics anxiety and factors that contribute to it, teacher educators can better identify and support the needs of exceptional education preservice teachers (Brown, Westenskow, Moyer-Packenham, 2011; Gautreau et al., 2016; Peker & Ertekin, 2011).

Preventing early problems in mathematics, including the development of mathematics anxiety, depends heavily on the quality of reform-based mathematics instruction that children receive in the classroom starting at an early age (Gautreau et al., 2016). The manner in which teachers teach mathematics seems to be a powerful predictor of students' attitudes toward and views of mathematics. If preservice teachers have mathematics anxiety, they are more likely to lack confidence in their own mathematical ability, have a negative view of mathematics, and teach in ways that develop mathematics anxiety in their own students (Bekdemir, 2010). Preservice teachers must be well prepared to teach mathematics. This preparation occurs best in the context of preservice teachers' mathematics methods courses.

The results lend themselves to transferability to other exceptional education preservice teachers with mathematics anxiety (Bahr, et.al., 2013). Results from the data analysis provide teacher educators with a greater understanding of the educational needs of exceptional education preservice teachers and also help teacher educators better plan and develop more effective mathematics methods courses. Identifying what methods are effective in changing exceptional education preservice teachers' mathematics anxiety is critical to helping improve teacher education as well as the mathematics education of children.

Limitations of the study do exist. Even though this study is situated in the context of a smaller sample size, the argument has demonstrated the complexity of mathematics anxiety as a universal concern for all mathematics educators. When considering the findings, a determination is not made that changes in mathematics anxiety will persist or will continue to change. However, carefully examining the process of change even with this study's sample size may help us become better informed not only about the effectiveness of our mathematics methods courses, but also about the usefulness in understanding the important outcomes of those mathematics methods courses across time. In addition, studying the longitudinal effects of mathematics anxiety in preservice teachers may be a critical component for institutions of higher education to make informed decisions about the mathematics methods courses included in teacher education programs. A recommendation to study the longitudinal effects of mathemat-

ics methods courses could be a critical component for institutions of higher education to make informed decisions about the mathematics methods courses included in teacher education programs. However, further longitudinal studies are recommended to determine such decisions.

Another limitation was the disruption of classes due to unforeseen circumstances during 2 fall/spring semesters. Even though instructor and peer discourse was offered during online instruction, some preservice teachers felt opportunities to utilize teacher and peer discussion and utilize discourse during class instruction as it related to powerful inquiry-based instruction was decreased or ineffective. Since teachers can often perpetuate mathematics anxiety in the classroom, understanding preservice teachers' mathematics anxiety and ways to reduce or prevent it is crucial to preventing mathematics anxiety in children and improving mathematics instruction and learning. Preparing preservice teachers to use appropriate instructional practices, including discourse, depends largely on reducing preservice teachers' mathematics anxiety (Haciomeroglu, 2014). Teacher educators must recognize the profound role that mathematics anxiety plays in shaping the beliefs of exceptional education childhood preservice teachers with regards to teaching mathematics because mathematics anxiety also affects their ability to become effective mathematics teachers (Wilson, 2013).

This study supports the importance of having teacher education programs that influence the development of effective instructional practices while specifically addressing the reduction of mathematics anxiety in preservice teachers. NCTM (2014) principles acknowledge that individuals need high-quality instruction and materials in learning environments that support them. The research that does exist indicates that preservice students' participation in methods courses that are student centered, cognitively demanding, and build conceptual understanding can help decrease mathematics anxiety (Adeyemi, 2015; Boyd, Foster, Smith, & Boyd, 2014; Dove, 2014). These instructional practices are not unfamiliar to mathematics educators, as the Principles to Action (NCTM, 2014) support the use of such methods in all mathematics classes.

Examining this topic in greater depth can help teacher educators design mathematics methods courses to better prepare preservice teachers to teach mathematics. Teacher educators must model through constructivist pedagogy to help bridge the gap between preservice teachers' past mathematical experiences and beliefs and their future mathematics teaching as advocated by Lee and Zepplin (2014). Mathematics methods course instructors can serve to influence directly preservice teachers' mathematics anxiety simply by their teaching style, enthusiasm, discourse, and the type of classroom environment they establish. Instructors must create a classroom environment where students feel safe, respected, and comfortable. By being aware of mathematics anxiety and instructional methods that help to reduce it, instructors within mathematics methods courses can better identify and support preservice teachers' needs (Brown et al., 2011). Results of the study will help fill the gaps in the literature by focusing on the needs of exceptional education preservice teachers with varying degrees of mathematics anxiety, a factor previous studies have not addressed.

CONCLUSIONS

It is important that teacher educators understand preservice teachers' mathematics anxiety. Preservice teachers with high mathematics anxiety tend to have low competence levels, but if mathematics anxiety is reduced, their competency levels tend to rise (Gresham, 2019). An individual's cognition, behavior, and environment all play an important role in learning new knowledge and skills. Stress and anxiety arise when individuals feel they cannot adequately handle a problem or situation, thus affecting how individuals perceive their competence and abilities (Williams & Williams, 2010). The powerful effect of preservice teachers' prior educational backgrounds and experiences cannot be overlooked during teacher training as mathematics anxiety can serve as a barrier to their teacher education training (Wall, 2016). Effective teacher training programs offer valuable opportunities to improve not only preservice teachers' subject knowledge but also their beliefs about teaching and learning mathematics, particularly as it relates to mathematics anxiety (Lee & Zeppelin, 2014).

To improve teacher preparation for exceptional educational preservice teachers and ultimately the students they will teach, research that examines the effectiveness of reform-based constructivist methods used in a mathematics methods course to change preservice teachers' mathematics anxiety is needed (Bates et al., 2013; Briley, 2012). Therefore, it is important to consider this study in developing mathematics methods course as it illustrates and supports the importance of having teacher education programs that influence the development of effective instructional practices and field experience while specifically addressing the reduction of mathematics anxiety in preservice teachers (Aslan, 2013; Beilock & Maloney, 2015; Bekdemir, 2010; Hart, et.al., 2013). This study provides a foundation for more investigation of opportunities that specifically addressed mathematics anxiety in exceptional education preservice teachers and its influence on instruction. Working together to determine which curricula and instructional practices will bring about the best results in mathematics achievement, and thus, eliminate the cycle of mathematics anxiety is critical. The key now becomes using this knowledge to extend what we know and improve the methods we use to develop the construct as we seek to maintain momentum and growth from teacher education preparation programs. From this study, we are reminded that the preservice teachers' voice should be heard as it relates to the effectiveness of a mathematics methods course and how it is implemented within programs. The results prove insight into the durability and effectiveness of teacher training programs that emphasize manipulatives and other strategies to help reduce mathematics anxiety in exceptional education preservice teachers.

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