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Elementary Prospective Teachers' Visions of Moving Beyond Mathematics Anxiety

Abstract

Previous studies of prospective elementary mathematics teachers' mathematics anxiety have documented that many prospective teachers often worry about managing their repeated experiences of anxiety while developing their pedagogical and content knowledge to teach mathematics. The literature further indicates the importance of developing learning opportunities for prospective teachers to confront their past experiences while they (re)learn and learn to teach mathematics during methods courses. This study is situated within one such learning opportunity and seeks to analyze potential mathematics anxiety coping strategies generated by forty-eight prospective elementary teachers enrolled in a mathematical methods course. Written responses generated by the prospective teachers were subjected to qualitative thematic analysis to identify patterns of key ideas related to lesson planning for content they felt anxious and/or not confident about teaching and patterns focused on episodes of mathematics anxiety they might experience in the moment of teaching mathematics. Findings indicate that prospective teachers envision using between two and seven strategies grouped across eight coping strategy themes when given the opportunity to reflect on how they might deal with future instances of anxiety when they are tasked with teaching mathematics to their students. We highlight how some of the coping strategies that the prospective teachers envisioned as a means to cope with mathematics anxiety may have more potential to be helpful than others and present implications of our research for mathematics teacher educators.

Introduction

Mathematics education researchers have studied the impact of mathematics anxiety on the development of high quality mathematics teachers for decades (Ball, 1988; Bursal &

Paznokas, 2006; Ma, 1999; Mizala et al., 2015; Roberts & Maiorca, 2020; Sanders et al., 2019). Mathematics anxiety has been defined as “a feeling of tension, apprehension, or fear that interferes with math performance” (Ashcraft 2002, p. 181). Some elementary prospective teachers (PSTs) have been repeatedly shown to struggle with mathematics anxiety, both as students (Author, 2017a; Author, 2019; Beilock et al., 2010) and as developing teachers when confronted with performing mathematics tasks and teaching mathematics to their future students (Brady & Bowd, 2005; Brown et al., 2011; Bursal & Paznokas, 2006; Gresham, 2007; Marbán et al., 2020; McGlynn-Stewart, 2010; Peker, 2009; Sloan et al., 2002). High levels of mathematics anxiety in the elementary PST population is important because of the potential for negative impact on the mathematics instruction that occurs in future classrooms (Ball, 1988; Beilock et al., 2010; Bursal & Paznokas, 2006; Mizala et al., 2015; Wilson, 2016).

Previous work has focused on the importance of students having confident and competent elementary mathematics teachers to support their learning of this content area (Beilock et al., 2010; Bursal & Paznokas, 2006; Mizala et al., 2015; Sloan et al., 2002). Bursal & Paznokas’s (2006) study reports that many PSTs question whether they will be able to successfully teach their students mathematics. Beilock et al.’s, (2010) study reveals that elementary teachers who struggle with teaching mathematics can pass their mathematics anxiety onto their students. Although a wide range of studies (e.g. Author, 2019; Jensen et al., 2020; Johnson & vanderSandt, 2011; Swars et al., 2006) have developed a rich understanding of PSTs who experienced mathematics anxiety while learning mathematics during their K-12 days, little is known about how PSTs begin to think about coping mechanisms to deal with mathematics anxiety they may encounter when teaching mathematics.

Elementary Mathematics Methods Courses Focused on Reducing Mathematics Anxiety

Prior studies have indicated the importance of elementary PSTs confronting their past experiences with mathematics anxiety before they step into their own classroom and are expected to teach mathematics (Author, 2017a; Buckley et al., 2020; Johnson & vanderSandt, 2011; Swars et al., 2006). Otherwise, as practicing teachers, they may avoid opportunities to move beyond mathematics anxiety such as seeking guidance from colleagues or pursuing professional learning experiences aimed at tackling or controlling mathematics anxiety (Buckley et al., 2020). Mathematics methods courses hold promise as a space for PSTs to tackle mathematics anxiety (Ganley et al., 2019) in a context that will offer PSTs the opportunity to (re)learn important concepts of elementary mathematics as well as learn to teach elementary mathematics. Additionally, this space may afford PSTs with the opportunity to reimagine themselves with a positive identity around mathematics (Wilson, 2016).

A number of studies have focused on how to construct appropriate learning opportunities for PSTs to address anxiety associated with learning and teaching mathematics (Gresham, 2007; Harper & Daane, 1998; McGlynn-Stewart, 2010; Sloan et al., 2002). For example, Harper and Daane (1998) conducted a study of fifty-three elementary PSTs to examine what elements of a mathematics methods course might help to alleviate mathematics anxiety that PSTs often experience. Findings revealed that forty-four of the PSTs experienced some relief from mathematics anxiety when discussion-based rather than lecture-based teaching was utilized, there were opportunities to work together to solve mathematics problems in multiple ways, they were taught how to use manipulatives as learning tools, the opportunity was provided to write about their mathematics learning and teaching experiences, and the PSTs had an accompanying fieldwork experience to practice what they were learning in their mathematics methods course. Harper and Daane's (1998) work highlights how mathematics methods courses can play a

significant role in addressing mathematics anxiety that many elementary preservice teachers experience.

Studies conducted by Gresham (2007), McGlynn-Stewart (2010), and Sloan (2010) confirm many of the beneficial elements of Harper and Daane's (1998) study. In these studies, the authors focused on providing PSTs with a mathematics methods course that utilized manipulatives to solve mathematics problems, offered cooperative learning experiences, and employed multiple teaching strategies as opposed to the more teacher-directed experiences that many of the PSTs had experienced themselves as students. Their findings showed that when PSTs who suffered from mathematics anxiety were provided with the opportunity to reexamine elementary mathematics content in supportive and collaborative ways, their confidence in mathematics improved. As one PST in McGlynn-Stewart's study shared, "Through practical opportunities in class using manipulatives as well as opportunities to create real-life math lessons with classmates, I feel much more confident in my capabilities" (McGlynn-Stewart, 2010, pp. 180-181). Sloan's (2010) findings further suggest that the regular use of manipulatives by the instructor to model best teaching practices resulted in the PSTs feeling less anxious about learning and teaching mathematics. Many PSTs discovered that manipulatives made the learning and teaching of mathematics fun. One PST reported, "I think that if I can use manipulatives, I'll feel pretty confident. ... I didn't know how to make it fun. So now I feel better about teaching math."

Taken together, these studies reveal that elementary mathematics methods courses may be an important space for PSTs who struggle with mathematics anxiety to begin to tackle and learn how to teach mathematics to their future students despite their own anxious feelings about mathematics. While much is documented about the lessons in content and pedagogy for PSTs

who experience mathematics anxiety to feel more confident and competent about teaching mathematics, little is known about what PSTs take away from mathematics methods courses in terms of coping with their anxiety. For example, it would be beneficial to know how PSTs who encountered mathematics anxiety during their own K-12 experiences of learning mathematics think about coping mechanisms to deal with mathematics anxiety they may encounter while teaching mathematics during their student teaching experience. Research remains to be done on how elementary PSTs envision themselves teaching mathematics to their future students when confronted with an episode of mathematics anxiety. The research question that guided this study is as follows:

What coping strategies do elementary PSTs envision themselves utilizing when confronted with moments of mathematics anxiety while teaching mathematics?

Theoretical Framework

Mathematics Anxiety and Mathematics Teaching Anxiety

The experience of mathematics anxiety has been studied in a number of different ways. For example, some researchers frame mathematics anxiety in affective ways. From these perspectives, mathematics anxiety is a “state of discomfort” triggered in response to situations in which an individual is asked to solve mathematical tasks (Trujillo & Hadfield, 1999, p. 173). This discomfort may be relatively mild, but is often more extreme. As a form of anxiety, it is important to realize that individuals who experience mathematics anxiety do not simply dislike mathematics (Vinson, 2001); they experience an intense state of discomfort (Swars et al., 2006) that can lead them to describing mathematics with extreme negative emotions, such as fear, panic, shame and hatred (Jensen et al., 2020; Tobias, 1978).

Beyond emotional affect, other researchers study mathematics anxiety through a physiological lens. For example, Luo et al. (2009) describe mathematics anxiety as a type of fight or flight response, complete with increased heart rate, sweaty palms, shortness of breath. The body essentially engages in a hormonal stress response wherein the threat is triggered by mathematics performance.

Some researchers argue the anxious feelings are in part elicited by the performance, and in particular, by the possibility of failure and consequent loss of self-esteem (Trujillo & Hadfield, 1999). A number of researchers have looked at the associations between test anxiety and mathematics anxiety (e.g., Author, 2019; Brady & Bowd, 2005; Bursal & Paznokas, 2006) and between mathematics anxiety and self beliefs, such as self-efficacy for mathematics and identity as a “math person” (Author, 2014, 2015; Lee, 2009; McGlynn-Stewart, 2010). Whether poor performance causes mathematics anxiety or anxiety causes poor performance remains unclear (Dowker et al., 2016). However, individuals may experience mathematics anxiety even when contemplating mathematics, with no plans to engage in mathematical tasks (Hembree, 1990).

Buckley et al. (2016) examine mathematics anxiety from two distinct perspectives. They argue that “state mathematics anxiety” (p.161) is experienced when individuals are expected to perform a mathematics task whether it be planned or in the moment. They describe “trait mathematics anxiety” as an ongoing and established negative attitude about mathematics that results in individuals dodging mathematics and careers that require a strong mathematics background. Buckley et al. conclude that both types of mathematics anxiety impede mathematics learning.

As a way to explore mathematics anxiety, many researchers have used retrospective and autobiographical approaches to identify the personal and environmental factors from which

mathematics anxiety develops (e.g., Hadfield & McNeil, 1994; Usimaki & Nason, 2004).

Studies indicate that humiliating and demoralizing experiences in mathematics in K-12 classrooms are associated with later experiences of mathematics anxiety (Author, 2014; Brady & Bowd, 2005; Dowker et al., 2016; Usimaki & Nason, 2004; Wilson, 2017) and that the experience of mathematics anxiety increases significantly across the school years (Brown et al., 1999; Jackson & Leffingwell, 1999). Without resolution, the experience can result in individuals losing interest in engaging in mathematical contexts and confidence in their ability to learn mathematics (Hembree, 1990; Luo et al, 2009; Wilson, 2017).

In conjunction with the motivational effects, the significantly negative relationship between students' mathematics anxiety and mathematics achievement is well documented in the meta-analyses (Hembree, 1990; Ma, 1999). Mathematical anxious individuals are also more likely to opt out of optional and advanced mathematics courses at the post-secondary level and in teacher education (Beilock et al., 2010; Brady & Bowd, 2005).

Teachers may experience specialized forms of mathematics anxiety due to the need to learn and perform mathematics in front of a student audience. This mathematics teaching anxiety is defined as anxiety associated with real or perceived deficits in teaching mathematics (Peker, 2009). It is marked by high levels of concern about being able to correctly teach mathematics and fear that instructional efforts will confuse students, rather than help them learn. Mathematics anxiety potentially exacerbates the experience of mathematics teaching anxiety, as PSTs struggle to learn content and pedagogy (Bursal & Paznokas, 2006; McGlynn-Stewart, 2010).

Research has shown that the two types of anxiety can be distinguished by those who experience them (Brown et al., 2011; Hadley & Dorward, 2011) but the distinction may not be helpful to supporting PSTs as they transition to classroom teaching. Instead, developing

opportunities within teacher education programs to help PSTs process their personal histories with mathematics anxiety and how these histories may impact their instruction has been shown to be beneficial (Author, 2019). The current study attempts to provide one such opportunity for PSTs to process their personal histories, while maintaining focus on future coping strategies. The reflections of forty-eight PSTs who experienced mathematics anxiety during their K-12 student learning days on how they would cope with episodes of mathematics anxiety when they stepped into their own classrooms to teach mathematics to their future students are investigated with the aim of exploring the quantity and content of the coping strategies generated.

Methodology

Participants

The participants in this study were forty-eight PSTs (forty-five women, three men) who were enrolled in a twenty-week elementary mathematics methods class over the course of three academic school years (2017-2020). Consistent with the informed consent procedures approved with the Human Subjects Institutional Review Board at the first author's institution, students enrolled in four sections of mathematics methods courses, provided consent for student work they generated as part of normal instruction to be de-identified and used for research purposes, and for improvement of instruction of future courses. It is important to note that the authors of this paper did not know if the PSTs had granted their consent until after the course grades were recorded.

The PSTs included twenty-four White women, eight Latinas, nine Asian women, two African American women, one Indian woman, and one Persian woman. There were also two men who identified as Latino and one man who identified as Asian. The PSTs were primarily in their early to mid-twenties. All forty-eight of the PSTs had previously received their

undergraduate bachelor's degree and were in a Masters level teacher preparation program in a small private university located in the western United States. They were all in the final part of their program and were scheduled to graduate within the next four months.

The PSTs selected to participate in our study wrote a mathematics autobiography (a required mathematics methods course assignment) during the first week of the class that spoke of experiencing ongoing mathematics anxiety while learning mathematics during their primary and secondary years of schooling. This assignment was used to identify PSTs who experienced mathematics anxiety rather than a standalone measure because it was part of the typical course procedures that the participants agreed could be used for research purposes. In the assignment, the PSTs were asked to write a 'math life story' to reflect on their experiences with mathematics as a student and to think about how those experiences impacted their attitude towards mathematics as well as their understanding of mathematics (see Appendix A for the assignment). The PSTs were also asked to reflect on how they believed their own mathematics experiences might impact their work as a teacher. This narrative source provided a view of their experiences with mathematics and mathematics anxiety.

Consistent with the literature, these feelings of anxiety included negative and strong descriptions that pertained to mathematics performance, affect and emotion, self-beliefs, physical reactions, and motivation. Some examples of the key words the PSTs shared were feeling completely lost, nervous and scared, extremely dumb, a racing heart, and turned off from math (see Appendix B for a complete list of key words). The analysis of the autobiographies was used as a tool to identify participants who perceived they experienced mathematics anxiety as described in the literature (i.e., anxiety about mathematics performance, experiences of negative

physical and emotional sensations associated with mathematics, negative self beliefs about mathematical skill, and lack of motivation to learn or do mathematics).

Research Context: The Mathematics Methods Course

The twenty week mathematics course (taught by one of the authors of this study) provided the PSTs with 1) the opportunity to reflect and pinpoint the elements of their experiences of mathematics anxiety, 2) relearn and practice teaching content they struggled to learn as students, and 3) think about how they would cope with experiences of mathematics anxiety while teaching mathematics. A community of trust and care was established so that the PSTs might feel confident about sharing their feelings of mathematics anxiety and mathematics teaching anxiety. This was achieved by making the course a safe place to talk specifically about the worries that the PSTs had about teaching mathematics (e.g. specific content areas, worries about teaching the upper primary grades) without the fear of being judged by their instructor and their colleagues in the class. Time was also spent working on mathematics lessons that the PSTs were expected to teach in their student teaching classrooms.

During the first ten weeks of the mathematics course, the PSTs spent four half days in an elementary classroom in both a lower elementary and upper elementary grade level primarily observing the teaching of their mentor teacher and working one on one with students or in small groups often during mathematics instruction. During the second ten weeks of the course, the PSTs spent five days in one of their assigned classroom placements gradually assuming full-time teaching responsibilities. This provided them with the opportunity to teach multiple mathematics lessons.

Design

This study used qualitative document analysis. The data consisted of written student reflections generated as student work in the mathematics course. During the second to the last week of the twenty week mathematics methods course, the PSTs were provided with a prompt that specifically asked them how they would teach a mathematics lesson that they did not feel confident or competent about and that made them feel anxious. Each PST individually responded to the prompt in writing.

Data Analysis

We (the author and co-author) conducted the data analyses with focused specific attention on the ways in which the PSTs imagined themselves responding to instances of mathematics anxiety while planning to teach a mathematics lesson or during a mathematics lesson. The approved research protocol did not allow for independent raters; however, we examined the data independently before working toward consensus. We began our thematic analysis by separately reading through each of the 48 PSTs' written prompts. We individually engaged in an iterative analysis (Bogdan & Biklen, 2006) by demarcating the words and phrases that pertained to the ways in which the PSTs envisioned themselves preparing a mathematics lesson that they felt anxious and/or not confident about teaching as well as episodes of mathematics anxiety they might experience in the moment while teaching mathematics to their future students.

Additionally, we looked for patterns of key ideas related to planning for mathematics lessons they felt anxious and/or not confident about teaching and patterns focused on episodes of mathematics anxiety they might experience in the moment while teaching mathematics to their future students. We then compared the demarcated words and phrases and patterns that pertained to the PSTs' key ideas to define categories that led to our coding of their responses. Individually,

we coded each PST's prompt and then met to compare our coding. Our inter-rater reliability was 75%. We then reconciled our differences in coding and added and/or redefined any codes until we reached a 100% inter-rater reliability.

We then wrote analytic memos (Maxwell, 2013) to summarize key ideas across the individual prompts of the forty-eight PSTs. We separated the PSTs key ideas into eight themes that captured the main ideas across the PSTs' reflections. Within each category are themes that we titled using a composite of the PSTs' words to encapsulate the essence of the reflections. These themes, in order of prevalence are: (1) Turning to Trusted Colleagues; (2) Finding Relief Through Online Resources; (3) The Importance of Being Prepared; (4) Sharing and Shifting the Teaching Responsibility with Students; (5) The Need to Understand Math to Teach Math; (6) Be Honest with Your Students; (7) Be Kind to Yourself; and (8) Let the Teacher Edition Be Your Guide.

All forty-eight of the PSTs are represented in the strategy themes. However, the number of strategies PSTs identified ranged from two strategies to seven strategies. Table 1 outlines the frequency of strategies they envisioned themselves utilizing when confronted with mathematics anxiety while preparing and/or teaching a mathematics lesson.

Table 1
Frequency of Strategies PSTs Listed to Cope with Moments of Mathematics Anxiety

Number of Strategies	Number of PSTs	Percentage
2	10	21%
3	15	31%
4	14	29%
5	5	11%
6	1	2%
7	3	6%

Findings

We present the findings in order from the most cited strategies that the PSTs reported to the least cited strategies that the PSTs envisioned themselves utilizing when confronted with teaching a mathematics lesson that created anxiety for them. All names have been changed to pseudonyms.

Turning to Trusted Colleagues

The most cited strategy that the PSTs envisioned utilizing as a means to help combat episodes of mathematics anxiety was turning to trusted colleagues. Thirty-five of the PSTs spoke of the importance of asking other teachers or a school mathematics coach for help in understanding a mathematics content area that created anxiety for them. For example, Mia stated that she would “catch up with colleagues who are prepping for or have already taught the lesson or ask for tips or for them to explain how they did it.” Dee Dee reported that she “would communicate with other teachers to see what they have done” to ease her feelings of mathematics anxiety. Kaia and Grace both said that they would find it helpful to observe another teacher teach a mathematics lesson they felt anxious about before teaching it themselves. Grace believed that this “modeling of the [mathematics] material” had great potential in quelling her feelings of mathematics teaching anxiety.

Joy spoke of the importance of specifically “asking an experienced teacher for advice.” Sue agreed with this strategy and shared the following example of mathematics anxiety that she encountered while student teaching. She stated that she felt intimidated when she was confronted with introducing long division to her fourth grade students. After confiding her concern with her mentor teacher who had been teaching for many years, Sue reported that “she [her mentor teacher] gave me suggestions about what concepts to focus on and also helped me to become

aware of potential misconceptions students may have during the lesson.” Sue added that this interaction with her mentor teacher helped her to see how important it is to seek advice from an experienced teacher when she felt unsure or anxious about teaching mathematics. These responses indicate that the PSTs envisioned themselves as able to reach out to other teachers when confronted with teaching a mathematics content area that created anxiety for them.

Finding Relief Through Online Resources

Twenty-eight of the PSTs believed that online resources offered relief from instances of mathematics anxiety they experienced when preparing a mathematics lesson while student teaching. For example, Clara shared that she found the internet to be a major resource when she faced mathematics anxiety. She stated, “finding a lesson that a teacher has taught and recorded is a big help.” Jackie shared that online resources that “teach the teacher how to conduct the lesson” was of great benefit to her. Amelia expressed that she felt less anxious about teaching mathematics when she discovered online inspirational mathematics teaching resources. Kali utilized online resources to learn about different mathematics teaching tools and strategies.

These responses illustrate how the PSTs envisioned the role that online resources could play in helping them to teach mathematics despite feeling anxious about this content area.

The Importance of Being Prepared

Another strategy that twenty-seven of PSTs considered as a means to calm their feelings of mathematics anxiety when confronted with teaching a mathematics lesson was to carefully prepare for it. Amelia reported that she would “teach myself the concept to the best of my ability before teaching to the class.” James’ strategy was as follows:

I think the best thing to do is to break down the lesson, see how it connects to the standards, and work it out yourself. By trying to work it out on your own, you practice it and hopefully get better at it.

Angie and Gina talked about writing step-by-step notes so they knew what to do next in the lesson. Madison stated that she felt it was important to “prepare questions with possible answers ahead of time so that student inquiries don’t throw you off.” Nora reported that by thoroughly preparing each lesson it helps to ensure that “you will not have to worry about not knowing what to do.” Audrey voiced that she prepared mathematics lesson that she herself felt anxious about by using her own confusion and misunderstandings to guide her in anticipating her students’ responses to the lesson. Jackie recounted her student teaching experiences in mathematics as follows:

There have been many times this year in my 4th/5th class that I have felt unsure of teaching a math lesson. I have noticed that when I am more prepared, the more smoothly the lesson goes. It is sometimes hard to prepare, though, mostly because we as teachers have to fully relearn the way to teach math to our classes.

Charli summed it up by saying she would “prep, prep, prep” mathematics lessons that she felt anxious or unsure about teaching. The quotes highlighted above reveal that these PSTs understand the importance of carefully preparing the mathematics content they would be expected to teach as a means to control the anxiety they often experienced with this content area. Additionally, they identified strategies that they hoped would better prepare them for teaching specific mathematics content that created anxiety for them.

Sharing and Shifting the Teaching Responsibility with Students

Twenty-three of the PSTs envisioned they could include their students in “helping” the class reach an understanding of a mathematics content that created anxiety for them. Maude stated, “I encounter this all the time... I often find myself stuck in front of the class and I usually ask the students “what do you think?” Mia believed that if she experienced mathematics anxiety while teaching a lesson that she would “in the moment have students share their understanding and work through it together.” Mimi reported that when she becomes anxious and unsure when teaching mathematics she “makes it a class activity to find out and learn together with the students.” Sara spoke of a specific incident of mathematics anxiety she experienced when she went “blank” while teaching a lesson. She shared how her students were able to lead the class by sharing “their step-by-step problem solving approach through the examples.” These responses suggest that the PSTs hoped that if they encountered a situation in which they felt unsure about the content they were expected to teach their students, they could share the responsibility with their students to teach it, thereby potentially alleviating their mathematics anxiety.

The Need to Understand Math to Teach Math

Sixteen of the PSTs spoke of the importance of understanding the mathematics content they would be expected to teach. For example, Alina planned to “teach myself the concept to the best of my ability before teaching it to the class.” Madison stated that she could “review the concepts thoroughly to gain a better understanding” as a means to feel more confident about a content area that created anxiety for her. Jane reported that she would need to “figure out and solve problems on her own before teaching it, even if it is hard and takes time.” Nora talked about relearning the content until she had an understanding that made her feel like “an expert in it.”

Mary shared how her first whole class experience of teaching a mathematics lesson that she committed to learn the content was a success. She reported:

It has become no secret over the past few months that I am not math's number one fan. My one hesitation in deciding to become a teacher was that not only would I have to teach math but also I have to understand it myself. I was not looking forward to doing this [assignment] so you can imagine my shock when I got up in front of the 4th grade class and talked numbers like I had been doing it all my life. My pre-fall-quarter self would have fainted in disbelief. I even made my master teacher take a picture of me as proof.

These quotes suggest that PSTs teachers who are willing to relearn the mathematical content that create anxiety for them may begin to positively re-envision their relationship with mathematics and move beyond mathematics anxiety.

Be Honest with Your Students

One strategy that twelve of the PSTs considered was letting their students know when they felt unsure about their own mathematics understanding of a concept as a means to ease their mathematics anxiety. For example, Molly thought that it is important to “be open about your level of knowledge with your students. Let them know you are learning, too.” Dee Dee agreed with Molly by saying, “If you have to teach it without being fully comfortable, be honest with your kids.” Then revisit it and try again the next day.” Beatrice also agreed with Dee Dee and thought it was important to “be honest and admit if you find something difficult or make a mistake.” These PSTs believed that by being honest with their students about what they did not know about mathematics, they might feel less anxious about this content area.

Be Kind To Yourself

Ten of the PSTs talked about the importance of being kind to themselves as a means to quell episodes of mathematics teaching anxiety. Jackie reflected on the importance of PSTs to “remind ourselves to breathe and not expect perfection. There is always room for growth.” Sara also voiced the importance of breathing deeply, taking a break and tackling the subject anew when experiences of mathematics anxiety arise. She added to “be mindful of your mindset” reminding herself that “you don’t have to do it yet.” Etsy believed that she might be able to cope with mathematics anxiety by admitting that “teachers don’t need to know everything.” Tabby talked about “going with the flow” when episodes of mathematics anxiety came her way. Amy thought that one way that she would cope with mathematics anxiety would be to “try and give myself the same pep talk I’ll give to students who feel like math is challenging.”

Audrey said that when she faced moments of mathematics anxiety that she needed to remember not to “get down on myself and recognize that it is okay to be confused and unsure at times.” Kallan stated that it is necessary to “cut yourself some slack as teachers are learning new math, too.” Joy talked about the importance of “reminding myself that it’s okay to make mistakes.” Aria shared that she believed taking the time to “think and reflect on what is causing the anxiety” is a helpful strategy to approach mathematics anxiety. Additionally she stated that it is important to investigate if previous mathematics learning experiences are igniting the anxiety. These PSTs envisioned being kind to themselves as a means to limit their instances of mathematics anxiety.

Let the Teacher Edition be Your Guide

Ten of the PSTs reported that they would lean on their mathematics curriculum guide when they felt anxious about a mathematics content area. Grace intended to “thoroughly read through the teacher’s manual” as did Dawn to help them feel more confident about the lesson.

Jenna planned to lean heavily on the teacher's guide by "sticking to the given curriculum lesson directions until you become more comfortable with a concept." Jacey believed that she should "consider the strategy and information given in the teacher's edition" and compare it to her own understanding to help inform her teaching of the lesson. Dorothy envisioned that the teacher's guide would help her in the moments of teaching a mathematics lesson when she experienced anxiety. Taken together, this suggested strategy highlights how the PSTs envisioned themselves moving beyond episodes of mathematics anxiety.

Discussion

Our findings demonstrate that elementary PSTs who have experienced mathematics anxiety while learning mathematics as primary and secondary students are able to identify and explain potential coping strategies they envision using to cope with mathematics anxiety once they enter the classroom as professional teachers. Thematic analysis of the PSTs' written reflections resulted in eight themes describing the focus of different strategies for coping. These, in order of prevalence, included: (1) Turning to Trusted Colleagues; (2) Finding Relief Through Online Resources; (3) The Importance of Being Prepared; (4) Sharing and Shifting the Teaching Responsibility with Students; (5) The Need to Understand Math to Teach Math; (6) Be Honest with Your Students; (7) Be Kind to Yourself; and (8) Let the Teacher Edition Be Your Guide. The PSTs each identified between two and seven potential strategies, with most identifying between two and four ideas of how they would cope.

A growing body of research has focused on how to construct appropriate learning opportunities for PSTs to address anxiety associated with learning and teaching mathematics (Buckley et al., 2020; Gresham, 2007; Harper & Daane, 1998; McGlynn-Stewart, 2010; Sloan et al., 2002). Our study contributes to this literature by exploring the preliminary outcomes of one

potential learning opportunity, specifically, the opportunity to reflect upon and plan how they will teach this content area if and when they are confronted with their mathematics anxiety in the classroom. This opportunity has the potential to bridge experiences of mathematics anxiety and mathematics teaching anxiety, as PSTs are asked to consider both their own experience of anxiety for learning and preparing the content and engaging with the pedagogy of teaching mathematics. The learning opportunity provides instructors with an avenue to address how PSTs will handle mathematics anxiety that they may experience in their role as future teachers.

Our findings demonstrate that PSTs can envision multiple strategies when given the opportunity to specifically think about how they might deal with future instances of anxiety when they are tasked with teaching mathematics to their students. The PSTs generated eight different strategies that they believed might provide relief from experiences of mathematics anxiety. The findings have shown that the PSTs thought of multiple ways in which they might overcome their own anxiety when confronted with teaching mathematics. As illustrated in Table 1, all of the PSTs identified at least two different strategies they believed might help to relieve mathematics anxiety they might encounter and 60% of the PSTs had three or four different strategies. To arrive at multiple strategies perhaps demonstrates the degree to which PSTs are thinking about ameliorating mathematics anxiety in their future classrooms. Previous research has documented that mathematics anxious PSTs run the risk of creating a negative impact on the mathematics instruction that occurs in their future classrooms (Beilock et al., 2010; Bursal & Paznokas, 2006; Mizala et al., 2015; Sloan et al., 2002; Wilson, 2016). Our research suggests that when given the opportunity, PSTs can envision strategies they may call upon when faced with an episode of mathematics teaching anxiety.

It is encouraging that PSTs were able to generate multiple and varied strategies, but reviewing the eight major strategy themes suggests some may have more potential to be helpful than others. For example, turning to trusted colleagues and online resources, the two most cited strategies, may help guide a novice teacher through a particular lesson or mathematical concept. The importance of being prepared in conjunction with these or with using the teacher's guide or other curricular supports may yield effective lessons. Although initially time consuming, we are hopeful these activities may support teachers along a learning trajectory to develop deeper mathematical understandings as teachers find the limits of memorization and last minute preparation. This was expressed by one participant, Nora, who emphasized the importance of learning the content until she was "an expert in it."

Although previous research has documented the importance of students having confident and competent elementary mathematics teachers (Beilock et al., 2010; Bursal & Paznokas, 2006; Mizala et al., 2015; Sloan et al., 2002; Wilson, 2016), it is also clear that teachers must have a deep understanding of the elementary mathematics curriculum they are teaching so that students can develop a rich mathematics background (Ma, 1999). Yet only sixteen PSTs responded like Nora and indicated the importance of needing to understand mathematics to teach mathematics. Together these findings imply that mathematically anxious PSTs may not yet understand the content well and may not necessarily see merit in developing those understandings. The question remains on how mathematics educators might better prepare PSTs in content while also moving more PSTs to value understanding. Mathematics educators and instructional coaches may benefit from knowing more about support of particular strategies and improved classroom outcomes.

While we see potential value in consulting experts in person or online and practicing mathematical lessons, some strategies that the PSTs envisioned offered only short-term or

momentary relief and had the potential to have a negative influence on student learning. For example, we suspect the strategy of being honest with your students (endorsed twelve times) is likely to reduce anxiety in the moment. For example, Molly believed that if she was open and shared with her students that she did not have the understanding of the mathematics, that this would help to ease her mathematics anxiety. Given Ma (1999)'s argument that teachers must develop deep understandings of the mathematical content, the concern is whether this strategy further distances teachers from developing content knowledge and proficiency with teaching mathematics. It may in fact reduce the rigor in the curriculum so that teachers can appear confident and feel successful but may have a detrimental impact on student learning.

Our findings also revealed that ten of the PSTs reported that 'being kind to yourself' was a strategy they could envision using to confront mathematics anxiety. Previous studies document the power that positive attributes such as kindness can have on individuals' learning (Dweck, 2016; Ramirez et al., 2018). This positivity may lead PSTs to engage in a growth mindset that holds promise in learning the mathematics content that creates anxiety for them (Dweck, 2016). As Jackie clearly stated, "there is always room for growth" and as Audrey reported she needed to remember not to "get down on myself and recognize that it is okay to be confused and unsure at times."

Perhaps the most concerning finding was that almost half of the forty-eight PSTs considered that when an episode of mathematics teaching anxiety occurred, they could shift the responsibility of the teaching to the students. For instance, Maude reported that during student teaching she often got "stuck" and relied on her students to explain the concept. Mimi stated that when she felt anxious about teaching a mathematics concept, she learned "together" with her students. Sara shared a specific teaching moment in which she experienced a "complete blank"

while teaching a mathematics lesson. She added that although her students were able to explain the concept to each other, she realized in that particular instance she was “lucky.” Previous research has documented the potential negative impact on student learning in classrooms equipped with anxious teachers who do not have deep understandings of the content (Ball, 1988; Beilock et al., 2010; Buckley et al., 2020; Bursal & Paznokas, 2006; Mizala et al., 2015; Wilson, 2016). Our research raises the concern of teachers potentially relying on strategies that center on luck over learning as evidenced by Sara who understood that she might not always be so lucky as to have students who could explain the mathematics.

Implications for Practice

Our findings suggest several possibilities for practice. There is a potential opportunity for mathematics teacher educators to address mathematics anxiety that accompany many elementary PSTs’ entry into their teacher preparation programs. Our study has also shown that mathematics teacher educators might want to consider that in addition to using autobiographical strategies shown to help open conversations about mathematics anxiety (Hadfield & McNeil, 1994; Usimaki & Nason, 2004), educators may want to provide time in methods classes for PSTs to think about and share strategies they envision might move them beyond mathematics anxiety when they are expected to teach mathematics. Opportunities could move beyond what we attempted in this study to also focus on exploring with PSTs the efficacy of different strategies. It is important to support PSTs in the strategies that they have identified that will bring them closer to a deeper understanding of mathematics so they do not fall prey to strategies that only offer momentary or short-term relief (Author, 2017b). This is especially true, given that the first few years of teaching can be an overwhelming experience for many new teachers, with mathematics instruction often being one of the content areas that many PSTs feel the least prepared to teach

(Author, 2017a; Buckley et al., 2020; Buckley et al, 2016; Johnson & vanderSandt, 2011; Wilson, 2016).

Future Research

Our study suggests several possibilities for future research. Future research might focus on a larger number of elementary teacher candidates including participants across different regional and international settings given that this study centered on forty-eight PSTs from one location.

A future study that more deeply examines PSTs' understandings of how specific strategies may help to move them beyond mathematics anxiety while teaching this content area versus strategies that may only offer momentary relief may be warranted. This line of inquiry would allow mathematics teacher educators to provide reflection and feedback opportunities to PSTs so that they are better prepared to engage with strategies that will work long term in developing mathematics teaching expertise.

Continued research into how and if new teachers, who during their teacher preparation program, identified strategies for dealing with mathematics anxiety utilize those strategies or create new strategies during their first few years of teaching could be fruitful. Such new research has the potential to uncover the strategies that new teachers who experience mathematics anxiety utilize to confront this issue while teaching mathematics. Likewise, research is needed to investigate the trajectory between teachers' chosen coping strategies and the development of high quality mathematics instruction. This line of inquiry would better identify the strengths and weaknesses of engaging with particular strategies as well as the limitations (e.g., time, resources) to sustain strategies through induction and into the first few years of teaching.

Future research may also consider looking more closely at specific strategies revealed in this study that examine the relationship between expectations that new teachers have for themselves in regards to teaching mathematics and the expectations they have for their students, as it relates to mathematics anxiety. For example, an investigation of what it means to share the responsibility of teaching mathematics between a mathematics anxious teacher and her students may be warranted. Future research is also needed to explore the relationship between teachers' expectations for self-directed honesty and kindness when struggling with mathematics and the expectations for students when they struggle with mathematics.

Limitations of the Study

There are some limitations that should be considered in this study. Although the sample was relatively large for a qualitative study, the participating PSTs were drawn from mathematics methods courses from one teacher preparation program. As a result, our study may not provide a complete picture of how elementary PSTs envision coping with mathematics anxiety when they are expected to teach mathematics to their future students.

It is possible that some PSTs might have felt uncomfortable reporting the extent of their mathematics anxiety despite the first author's attempt to create a community of trust and care. Therefore some PSTs might not have shared all coping strategies that they considered as viable when envisioning how they might handle episodes of mathematics anxiety while teaching mathematics to their future students.

Additionally, the data was limited to written reflections of PSTs prior to entering the classroom as professionals. The study does not examine the degree to which they may or may not implement these or similar strategies once working as teachers. Additionally, the design does

not test the effectiveness of the strategies they generated for ameliorating anxiety or for improving teaching.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Appendix A

Math Autobiography – Individual Assignment

This assignment is to write a ‘math life story’ to reflect on your own experiences with mathematics as a student and to think about how those experiences have impacted your attitude towards mathematics as well as your understanding of mathematics. You will also reflect on how your own experiences may impact you work as a teacher.

Begin by reflecting on the following questions. For each question, think about specific experiences and events that you remember, instead of just generalities. Make sure to address the required questions. Be descriptive, this is a chance for you to share your math history and for me to learn more about your relationship with math.

Math Autobiography Reflection Questions (REQUIRED):

1. What do you remember most about learning math in elementary and middle school?
2. How do you feel about math? How have your feelings changed over time?
3. How do you think your school math experiences impacted your attitude towards math?
4. How do you think your school math experiences impacted your understanding of mathematics? What experiences made it easier/harder for you to learn math?
5. What did your teachers do or not do to connect mathematics to your home / cultural / community experiences? How do you think this impacted your experience?
6. How was your math learning supported at home and in your community? Did your parents or other family members engage in activities involving math? Did you do any activities that involved or applied math outside of school (e.g., sports, hobbies, games)?
7. If you received mathematics instruction in a language other than your home language, what was your experience like? What did teachers do or not do to support your learning?
8. In what ways were you alike or different from the other students in your math classes? Consider math backgrounds, ethnicity, race, gender, linguistic, and/or socio-economic backgrounds. Please be specific in your own identification(s) and those of others.
9. How do you think your experiences, feelings and beliefs might impact the kind of mathematics teacher that you will be, or the kind of teacher that you want to be?

Appendix B
Key Words PSTs Used to Describe Mathematics Anxiety

Performance	Affect/Emotion	Self-Beliefs	Physical	Motivation
Completely Lost	Nervous & Scared	Lacked Confidence	Felt Sick to My Stomach	Closed the Door on Math
Difficult	Devastating	Felt Stupid	Tears	Gave Up
Struggled with Understanding Concepts	Defeated	Not Smart Enough to do Math	Heart Racing a Million Times a Minute	Journey with Math Ended
Did Not Make Sense to Me	Despised Math	Not Quick Enough	Panic Attack	Avoid Math Altogether
Just Plain Hard	Fear	Might Not be Good at Math	Made My Stomach Turn	Turned Off From Math
Struggling So Much	Despair	Not Able to Ever Understand	Want to Cringe and Hide	Felt Apathetic Towards Math
Dreaded Math Class	Sadness	Never be Good Enough	Negative Gut Reaction	
Slow Learner	Embarrassed	Unsure		
Struggled	Discouraged	Extremely Dumb		
Trying to Live Up to Others Perceptions of Me	Intimidated	Confidence in Math Plummeted		
Extremely Afraid to Make Mistakes	Feeling Hopeless	Hurt My Self-Esteem		
Tedious Chore	Frustrated	Felt Inferior		
Cloud of Failure Looming Over Me	Burn Out	Math is Not My Thing		
Repeated 4 th Grade Because of Low Scores	Stopped Enjoying Math	Math is not my Strong Suit		
Abandoned & Forgotten by Teachers	A Scary Shadowy Figure			
Not Important to Teachers	Afraid to Take Risks			
Merely Surviving	Pressure			
Hours of Work to Try and Keep Up	Negative Attitude			
Placed in Remedial Math Classes	No Sense of Enjoyment			
My Grades Lowered	Isolated			
Left Behind	Confused			
Experienced Real Struggles with Math	Stressed Me Out			
Hard for Me to Keep Up	Painful & Tortuous			
Hard to Search for Help	Shamed			
Too Confusing	Insulted			
Too Many Steps	Helpless			