Almost two decades have passed since the publication of Jackson and Leffingwell’s (1999) influential article on math anxiety in preservice school teachers and their worst math experiences. The present dissertation represents both a replication and an extension of the original study. Study Arm A was the replication study with preservice school teachers. Study Arm B was the extension to preservice school counselors. The participants were graduate-level preservice teachers and school counselors matriculated at a public university on the west coast of the US. The method used for both arms was a cross-sectional survey design. The data were collected using machine-readable paper forms that the researcher created. Measures used were the Abbreviated Math Anxiety Scale (AMAS) and the Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT).
The study arms used the same six research questions. The first two questions focused on rates of math anxiety and worst math experience. Results for the teacher arm were: 47% reported moderate to high math anxiety, and 97% noted having a worst math experience. Results for the counselor arm were: 53% reported moderate to high math anxiety, and 88% noted having a worst math experience. The subsequent four research questions involved inferential statistics. Two of these four research questions returned statistically significant results. Research question three addressed whether participants’ levels of math anxiety differed from a known college student norm. A one-sample $t$ test was performed with both Study Arm A and Study Arm B. In neither arm were the data significant. Research question four examined whether the proportion of participants who reported a worst math experience differed from a known proportion among American educators. In neither study arm did a one-sample $z$ test of proportions yield significant results. Research question five explored whether the proportion of participants who reported a worst math experience differed from a known proportion among Turkish educators. Significant results with a one-sample $z$ test of proportions were found in both arms. The sixth research question was about the timing of a worst math experience (i.e., occurred in grade ranges of 1 to 5, 6 to 8, 9 to 11, or 12 to 14). A chi-square goodness-of-fit test produced significant results in both arms. In both arms, the worst math experience occurred earlier for the Turkish educators.

For research questions that yielded significant results, this paper discussed reasons for the obtained results. With research question five, the most probable reason for the obtained results was that preservice educators who selected math as a career did not differ in math anxiety related to their classroom experience. With research question six, the most probable reason for the obtained results was that preservice educators reported worst experiences in both the US and Turkey, but the grade levels of when these worst experiences occurred differed. The
implications of the results of this dissertation were fivefold. First, in terms of teacher preparation, the results suggest that a substantive number of preservice teachers have a problematic level of math anxiety that should be addressed in their math pedagogy classes. Second, with reference to teacher education research, the results evidence that an overwhelming majority of preservice teachers had negative experiences in their own math education, which should also be addressed in their math pedagogy classes. Third, with regard to school counselor preparation, the results conclude that preservice counselors experience math anxiety similar to preservice teachers. Counselor educators who are responsible for statistical instruction must attend to the identified barrier. Fourth, with reference to counselor preparation, counselor educators responsible for career counseling coursework should help preservice counselors who had negative math experiences in their own math education become aware of how those experiences may influence their career guidance work. Finally, in terms of both teacher and counselor preparation, the timing of when negative math experiences most commonly occur suggests the points at which students are most vulnerable in math class. As such, teachers and counselors are alerted to when extra support of students could be most valuable.
Prevalence of Mathematics Anxiety in Preservice Teachers and Preservice Counselors

by

Gurpal K. Gill

A DISSERTATION

submitted to

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APPROVED:

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Major Professor, representing Counseling

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Dean of the College of Education

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Gurpal K. Gill, Author
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Cass Dykeman assisted with the methodology and research design in addition to refining the narrative document. Cass Dykeman contributed both to the design and writing of manuscripts #1 and #2. Dr. Bergquist assisted with statistical computation of the data in this dissertation.
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DEDICATION

This dissertation is dedicated to my parents.
Chapter 1: A General Introduction
Introduction

Mathematics anxiety in preservice educators may not appear to be a topic of significant importance; however, the cyclic impact is important for consideration and careful research. In the United States, math education ranks poorly. Based on the American School Counselor Association’s (ASCA) National Model, “America now finds itself in 24th place in science assessments and 28th in mathematics assessments (ASCA National Model, p. 96). In addition, “America is also falling behind in the number of science and engineering degrees awarded to its students. As a result, STEM education has been at the forefront of political initiatives and reforms occurring in the American education community” (p. 96). This fact is significant because the US is falling further and further behind in innovation in the areas of science, technology, engineering, and mathematics (STEM). If math is not a focal point of study, this gap will continue to widen. The United States allocates up to 1.5 million considerations for immigrants who possess these skills to migrate to the US (p. 96). This statistic is serious because utilizing the American population in these careers is equally as important as delegating immigrant considerations, and the question of why this issue is not being seriously researched and considered is of major concern. When considering well developed areas and the lack of STEM education, imagine the impact in rural areas and the limited training available to address this concern, hence further impacting the quality of education. If the facts demonstrate a lack of understanding of this phenomenon that impacts many Americans, it is important that research continue in this area. It is vital for the survival of STEM careers in the US, and educators will need this information to better their teaching strategies. With researched data about the causes of a decrease in America’s math performance, Americans could increase their skills to be considered competitive in STEM careers. This, in turn, would allow for Americans to compete
worldwide in math performance and innovation. The causes and outcomes are cyclical, and the impact is not just on a domestic level but on a global one as well. How and why is the population in the United States falling significantly behind in the realm of math and STEM careers? How can the United States innovate and compete in the international global market? Does the workforce’s ability to possess STEM skills affect our competitive capacity, and do these skills impact global innovation? The lack of STEM careers leaves many jobs unfilled and many careers in the STEM field vacant, which places the United States further behind in global innovation. One can conclude by the stated information that math access is significant, as is math performance.

**Overview of The General State of Scientific Knowledge**

If we consider the impact of a decrease in STEM careers on an individual level, the prevalence of math anxiety needs to be researched and understood. Math anxiety can be one of the variables that limits the courses a student will take, which directly impacts the major or career they may choose in their long-term educational pursuits. This choice can be made at a young age, putting the US even further behind other countries based on earlier generations’ decisions regarding individuals’ performance in math. Many variables related to success in math performance can be considered; for example, how other countries teach math in comparison to the United States. Many countries gain a clear understanding of how students rank in math academics and performance by giving exams at various levels during a student’s academic performance. In the United States, such an understanding is not as clear, given that students can change their path of study with access to community college education. Most students are not tested on their math performance levels until they are in high school and considering graduation. Some proficiency exams are administered in the elementary years; however, the performance
levels in both the elementary years and high school years can be challenged by performing in the community colleges prior to transferring to a university. Students in the US have to complete a certain amount of math to graduate from high school. Based on an average, the amount math required in 50 states, the minimum is the completion of Algebra I. Some states in the US require at least the completion of both Algebra I and Geometry in 9th through the 12th grades. A minimum of 2–4 years is the average requirement for math courses in the US (Commissions of the States, 2018, Your Education Policy Team). In comparison, countries like Turkey, Hong Kong, and Greece engage in high-stakes testing, which begins in middle school or earlier (Kalaycioglu, 2015). At the community college level, the US provides another opportunity for mastery of the skills expected. This type of option does not exist in other countries outside of the United States. This option leaves the US further behind in terms of performance and student data regarding success rates in mathematics. A decrease in math performance, or anxiety in math performance, eliminates the personnel available for significant STEM careers and individual career interests. Another perspective worth exploring concerns when students’ interest is there, but the educators are anxious about math. How does this dilemma impact what individual students will choose (or not choose) to study, explore, and overcome when considering mathematics? When looking at these possibilities carefully, it is important to think about who is teaching math, and with whom students plan their coursework and discuss their math performance stressors in the education system. Educators come to mind when considering math access, math education, math performance, and math anxiety. In particular, elementary teachers and school counselors can be considered as a narrowed-down population of educators who assist with math education.
When considering elementary school teachers, the California school system is composed of teachers who must pass a credentialing process to instruct in the public education system; however, keep in mind that elementary school teachers are not specialized in math instruction. They are provided with an overview of math courses that is made up of algebra and a math class designed for elementary school educators. These elementary school educators have the option of taking either a statistics or a business calculus course. When considering the data of community college and universities, most preservice educators take the course designed for their teaching credential, which is a math course for preservice educators. Interestingly, preservice counselors face the same expectations, or they complete a statistics course. Elementary school teachers in the US are then instructed to take the CBEST in California but not in all states, which assesses math skills up to geometry. Other states do not have an exam like the CBEST to assess math levels prior to being credentialled as a teacher. This requirement does not add up to much math instruction when compared to other countries. For example, in Sweden, Japan, China, and India, math specialists provide the math instruction. The United States does not practice this requirement for math educators. Let’s consider another population: preservice school counselors, who assist students with class and major selection. In fact, they help students at the high school level pick courses that align with the particular career path they choose. If preservice school counselors are not prepared to discuss math beyond what they have taken in their academic career, they may have limited input to share with students. They, too, can exhibit math anxiety, which can limit the students that they assist and further strengthen the assumption that math is difficult and hard to learn. Considering the coursework that preservice school counselors complete, one can see that they are not required to take extensive math courses; in fact, they complete the same amount of math instruction as preservice teachers. Preservice
teachers and preservice counselors take the California Basic Educational Skills Test (CBEST) exam in California to obtain their credentials to practice in their field. The CBEST is a standardized test that Californians need to take and pass to teach and counsel in California. This exam measures proficiency in mathematics, reading, and writing (California Basic Skills Test, 2018). Preservice teachers and preservice counselors have to pass the math portion of this exam, which requires math mastery of high school- and college-level math. The highest level of math that needs to be mastered is measurement and geometry; therefore, preservice teachers and preservice counselors are not expected to perform beyond measurements and geometry. This limited knowledge of math, which is based on 40% arithmetic and 20% performance on algebra, measurements, and geometry, requires only a narrow level of math proficiency (California Basic Skills Exam, 2018). Given this information, would preservice teachers and preservice counselors be able to assist students who demonstrate advanced math skills, or who are seeking studies in advanced math classes, majors, or careers? Could it be possible that preservice educators are math anxious, given they are not math specialists? Can it be that this anxiety can impact how they provide instruction to students? In addition, can their instruction hinder how students access math and affect the way they feel about their math performance? It is easy to see how this can become a cyclical pattern of success or failure that depends on the performance and teaching of preservice educators. If preservice educators are math anxious, they may not be able to teach beyond their capacity and perceptions of math. Therefore, it is imperative to consider this impact due to the gap in filling STEM careers in the United States.

Mathematics anxiety in preservice educators may not appear to be a topic of significant importance; however, the cyclic impact is important for consideration and careful research. It is important to understand the causes and why cyclical patterns for poor math performance exist in
math education and addressing these identified causes of math anxiety in preservice educators is vital to end subpar math performance and the decline in STEM careers. In the United States, additional policy has been created to encourage STEM education and careers due to poor ranking. Based on the study by Atkinson and Mayo (2010), STEM careers stimulate innovation and world economy competition. Atkinson and Mayo (2010) found that; “At the B.S. level, growth in STEM students was fairly steady (about 2 percent per year) from 1993 to 2003, with the growth rate slowing since 2003” (p. 25). This is concerning because most of the STEM talent that the US has are recruited from other countries: “While overall number of STEM-trained students is growing, albeit modestly or in some cases slowly, a large fraction of these students, particularly at master’s and Ph.D. levels are not U.S. citizens (Atkinon & Mayo, p. 27).

In addition, Atkinson and Mayo (2010) found that the gap between STEM jobs and STEM degrees has increased and the gap is addressed by hiring foreign workers. This isn’t assisting with the cyclical pattern the US is facing with regards to math performance and STEM careers. If other countries are pushing harder for rigorous math performance at younger ages and the US is not, this gap in the workforce will continue to widen and this is detrimental for US jobs, innovation, and the economy. In other words, the US is not keeping up with the rate of STEM academic performance and job performance in the global economy. Atkinson and Mayo (2010) additional findings stated; “Overall, the United States is not highly ranked internationally in average K-12 math and science test scores. Its tests score deficiencies are often cited to suggest that weak STEM education will lead to a shortage of STEM workers in the future” (p. 32). These facts are significant because the US is falling further and further behind in innovation in the areas of science, technology, engineering, and mathematics (STEM).
If math is not a focal point of study, this gap will continue to widen. The United State allocates many jobs to foreign workers who have stronger STEM training. This is serious because utilizing the American population in these careers is equally important as delegating immigrant considerations. Why this discrepancy is not being seriously researched is a cause for concern. If the research demonstrates a lack in understanding of this phenomenon that impacts many Americans, then it is important that research continue in this area. It is vital for the survival of STEM careers in the US, and educators will need this information to better their teaching strategies. With researched data about the causes of a decrease in American’s math performance, Americans can increase their skills to be considered competitive in STEM careers, which in turn would allow for Americans to compete worldwide in math performance and innovation. The causes and outcomes are cyclical, and the impact is not just on a domestic level; it is also on a global level. How and why has the population of the United States fallen significantly behind in the realm of math and STEM careers? How can the United States innovate and compete in the international global market? Does the workforce’s possession of STEM skills impact this ability to compete, and do these skills affect global innovation? The lack of STEM careers leaves many jobs unfilled and vacant in that field, which places the United States further behind in global innovation. One can conclude from the stated information that math access is significant, as is math performance.

If we consider the impact of a decrease in STEM careers on an individual level, the prevalence of math anxiety needs to be researched and understood. Math anxiety can be one of the variables that impacts math performance and limits the courses a student will take, which directly affects the major or career they choose in their long-term educational pursuits. This choice can be made at a young age, which puts the US further and further behind other countries
based on earlier generations’ decisions regarding individuals’ performance in math. Many variables related to success in math performance can be considered; for example, how other countries teach math in comparison to the United States. Many countries have a clear understanding of how students rank in math academics and performance by giving exams at various levels of a student’s academic performance. For example, countries such as Hong Kong, Japan, and Turkey have testing procedures prior to students entering middle school (Kalaycioglu, 2015).

Less clarity regarding math performance exists in the United States because students can change their path of studies with community college education, which can differ greatly from their high school education and performance. In California and Oregon, US students are not tested on their math performance levels as a requirement for graduation purposes until they are in high school. Students take some proficiency exams in the elementary years; however, both the elementary years and high school years can be challenged by performing differently at the community college level prior to transferring to a university. Students can also make agreements with universities at the community college level that if they fulfill the requirements expected of them, they can transfer to the university of their choice.

The present dissertation examines the level of math anxiety and the presence of traumatic experiences for two groups of preservice educators during their own mathematics education. These groups are: (a) elementary school teaching candidates, and (b) school counseling candidates. When reviewing the literature on these math topics and preservice groups, four issues emerged: (a) what is known about the level of math anxiety in K-12 educators, (b) what traumatic experiences occurred during their own mathematics education, (c) for preservice teachers, how traumatic experiences during their own mathematics education are related to their
own instructional behaviors, and (d) for preservice school counselors, the relationship of such behaviors on populations for which they provide support and counseling services. After an examination of the literature on these topics, the manuscripts that form the focus of this dissertation will be detailed. Extensive literature has been devoted to the level of math anxiety in K-12 educators. It has been researched and reported that K- through 12th-grade educators have undergone traumatic math experiences of their own. Research that Jackson and Leffingwell conducted (1999) shared these experiences of preservice teachers, who reported experiencing hostile behaviors from instructors, perceptions of insensitive and uncaring attitudes of instructors, and both overt and covert instructor behaviors that increased their math anxiety. Bekdemir (2010) found that preservice teachers reported experiencing hostile instructor behaviors related to math, inadequacy of instructors, and negative attitudes towards math when their teachers discussed the subject. Boyd et al.’s (2014) study shared that preservice teachers in the United States experience a high level of math anxiety. This feeling is rooted in teaching experiences that demonstrated negative attitudes about math, pedagogical approaches to teaching math, and their primary school experiences with math. Multiple research studies have demonstrated that a prevalence of math anxiety is present in preservice teachers. It is important to understand math anxiety and why it exists. It becomes equally important to further understand what these traumatic experiences are and how they impact educators during their own mathematics education.

Studies that a number of researchers conducted have shown the specific traumatic experiences that occurred for educators during their own mathematics education. The effects included a decrease in confidence in preservice educators, an increase in nervousness when teaching math, and experiencing internal negative attitudes towards math (Boyd et al., 2014).
Additional preservice teachers reported that they were traumatized as early as kindergarten and the first grade (Jackson & Leffingwell, 1999). Jackson and Leffingwell also found that preservice teachers reported that instructors did not decrease hostility in the learning environment when other students would criticize a peer’s math abilities. In addition, these authors noted that preservice educators were more verbally abused if they were female. The authors’ further research revealed that when preservice teachers asked their instructors for clarification for better learning and understanding, the instructors exhibited an increase in angry behaviors. Embarrassment and communication barriers were also contributors to preservice teachers undergoing an increase in traumatic experiences when they considered their own math instruction (Jackson & Leffingwell, 1999). Much literature has described preservice teachers as experiencing math anxiety related to their previous instruction in math. This fact leads into another important area of consideration: How do these experiences impact preservice teachers’ instruction?

For preservice teachers, how are traumatic experiences during their own mathematics education related to their own instructional behaviors? It is important to consider this aspect due to the cyclical impact of math anxiety on generations to follow. If previous instructors can negatively impact preservice educators, then these newly educated preservice teachers will also impact the students they teach. Jackson and Leffingwell (1999) reported that “Students tend to internalize their instructors’ interest in, and enthusiasm for, teaching mathematics. Conversely, if students think that the instructor is not happy teaching and does not enjoy being with them in the classroom, they will be less motivated to learn” (p. 585). Jackson and Leffingwell further reported that the impact of negative math experiences was extensive for students, and effects could last up to 20 years. The fact that these memories were lasting and detrimental for years to
come leads to the question: If preservice teachers believe that their experiences were normal, then how will they instruct differently when they engage their own students? This question addresses what behaviors will impact which populations in future years. It is important to consider other educators who can have a profound impact on math anxiety in addition to preservice teachers.

For preservice school counselors, what is the relationship of such behaviors to the populations they support and those for whom they provide counseling services? When considering the preservice counselors’ impact on students and their direct access to them, it becomes imperative to address math anxiety and preservice counselors. The literature has never considered this population; however, based on the American School Counselor Association National Model (ASCA), school counselors have a significant role in guiding students in their learning and career exploration. Based on the ASCA model, school counselors support students in the realm of Science, Technology, Engineering, and Mathematics (STEM) education, yet preservice counselors do not complete extensive math preparation. Consider this fact for a moment: Students access the school counselor to explore, organize, and plan their careers. If preservice school counselors demonstrate math anxiety, how can they discuss and guide students in their math preparation? Would school counselors be comfortable discussing specific math needs, math curriculum, and math planning, especially if they have not thoroughly explored math or have math anxiety? This discrepancy has led to a serious gap in the literature because preservice school counselors have not been researched or considered as a population that may have math anxiety. This apprehension can lead to the transfer of that math anxiety or a lack of exploration with the students they are assigned to counsel and advise. ASCA partners with the Sally Ride Foundation to assist school counselors in following a framework or coordinating with
teachers of STEM careers (The School Counselor and Comprehensive School Counseling Programs, ASCA, 2017). What would happen if school counselors have math anxiety or a lack of expertise in STEM careers? Would they be able to follow this program and assist students, or would they lack skills due to the prevalence of math anxiety? One of the steps that the Sally Ride Foundation has outlined is the responsibility of counselors to help students explore their self-image and both short- and long-term career goals. What happens if preservice counselors have not explored their own thoughts and feelings regarding STEM education and careers? This neglect could significantly impact student success and increase the population of the math-anxious students simply due to the counselors’ own anxieties regarding math.

Let’s consider the training a preservice school counselor completes. School counselors are expected to take a statistics course or business calculus class to fulfill math requirements at a community college or a four-year college/university. They complete the CBEST, which is composed of a little geometry, algebra, and basic math. Preservice school counselors do not take extensive courses in math, yet they are responsible for preparing students of all ages for STEM careers; therefore, they are a significant population that must be researched and considered when exploring the prevalence of math anxiety. Studying preservice school counselors will fill a pivotal gap in the research because the level of preservice school counselor student access is high in the areas of course planning, class scheduling, career exploration, and the depth of their relationship with students.

The target journal for the publication of preservice school counselors would be the Professional School Counseling Journal. This journal was selected because it looks to advance the practice of school counselors. This journal must adhere to the American Psychological Association 6th edition. The Professional School Counseling Journal does not have an ISI score
despite its rigorous review and selection of researched work. The Professional School Counseling Journal has published articles on topics such as theory, best practices for counselors and practitioners, and current policies regarding counseling.

Glossary of specialized terms: preservice teachers, preservice counselors, and math anxiety.

**Description of the Research Manuscripts**

**Manuscript 1**

**Rationale for the first study.** Given that the United States is ranked poorly in STEM careers and in math, it is necessary to discover the cause. According to research that Drew completed (2011), Americans rank near the bottom for math education. Drew’s research further stated that American businesses are looking to hire scientists and engineers from international countries. This is a concern for Americans in terms of profitable innovation and competitive global job opportunities. Falling further behind in STEM careers has generated an interest in finding a solution for why Americans underperform in math and STEM careers. What could possibly cause the poor math performance? Jackson and Leffingwell’s (1999) article found that responses from 157 students in a senior level elementary math class showed that only 7% of these students reported a positive math experience. Why are their positive math experiences limited? According to the article, students reported that they were math anxious due to “hostile instructor behaviors, perceptions of instructors as insensitive and uncaring, and other overt and covert behaviors” (p.584-585). Jackson and Leffingwell demonstrated in their research some of the reasons that students had negative math experiences. Given that it is almost two decades later, could it be that students still experience similar negative math experiences? If math performance in the US has declined further, and the majority of students do not choose STEM careers, could the cause be attributed to negative math experiences in preservice teachers?
Bekdemir (2010) completed additional research to address math-anxious experiences that he categorized as “worst experiences” and “most troublesome experiences.” Bekdemir wanted to assess math anxiety in the Turkish population. By addressing these negative experiences, the researcher wanted to see if these experiences have a direct impact on anxiety in preservice teachers. He also stated that “If these teacher trainees are mathematically anxious, they have a very good chance of becoming teachers who lack confidence in their own mathematical ability, have a negative attitude towards mathematics itself, and hence teach in ways that develop mathematics anxiety in their own students. Thus, a mathematics anxiety cycle is formed” (Bekdemir, 2010, p. 313). Much of the literature has focused on these three researchers; additional researchers have considered topics such as working memory, learning communities, and gender discrepancies. Further research has not been published about the topics that Jackson, Leffingwell, and Bekdemir covered. It will be important to identify if American educators have negative math experiences and worst math experiences. The results of this study will fill the gap in the professional body of research by providing evidence that the prevalence of both negative math experiences and worst math experiences occurs in American preservice educators.

**Target journal for publication.** The target journal for the first manuscript is *Educational Studies in Mathematics.* This journal had an impact score of 0.959 in 2016 and a five-year journal impact factor of 1.370 (SpringerLink, InCites, Journal Citation Reports, 2017). *Educational Studies in Mathematics* is an appropriate journal for publication due to its focus, which is as follows: “Presents new ideas and developments of major importance to those working in the field of mathematical education. It seeks to reflect both the variety of research concerns within this field and the range of methods used to study them. It deals with didactical, methodological, and pedagogical subjects rather than with specific programs for teaching
mathematics” (Springer Link, 2018, p. 1). This journal also has a wide range of topics that are also reviewed in this dissertation: For example, a recent study discussed the social functions of mathematics education, and another article discussed developing mathematics fluency (Springer Link, 2018).

**Research questions and methodology.** This manuscript reviews the design, procedures, and data analysis.

**Design.** This study employed a cross-sectional observational design (Jepsen, Johnsen, Gillman, & Sørensen, 2004) to answer the following six research questions:

- What is the level of mathematics anxiety among preservice teachers?
- How many preservice teachers reported having a worst experience?
- Does the preservice teacher participants’ level of math anxiety differ from a known college student norm?
- Does the proportion of preservice teachers who reported a worst math experience differ from a known proportion among American educators?
- Does the proportion of preservice teachers who reported a worst math experience differ from a known proportion among Turkish educators?
- Do the proportions of when preservice teachers reported the occurrence of a worst math experience differ from known proportions among Turkish educators?

The independent variable was the prevalence of math anxiety in preservice teachers. The dependent variables were (a) negative experiences, and (b) worst math experiences. The Abbreviated Math Anxiety Scale was used to gather information from the survey population from a public university on the west coast of the US. The effect size of the students surveyed was established by using data drawn from Table 2 in Bekdemir (2010).
**Procedures.** A questionnaire containing the WMTMCERT, AMAS, and demographic questions was administered to preservice elementary teachers. These questionnaires in a pencil and paper format were administered to preservice teachers in math classes in a university on the west coast of the US. A printing company created both the demographic questions and the AMAS in the optical mark recognition form (i.e., Scantron) so that data could be easily compiled and organized.

**Description of Manuscript #2**

**Rationale for the second study.** It is important to consider the significant amount of influence that counselors exert on students’ lives with regard to class selection, career selection, and academic performance. In 2011, the National Survey of School Counselors, *Counseling at a Crossroads* stated that nearly half of school counselors are former teachers and have a unique role of supporting students. Considering the amount of influence and impact counselors have on the lives of students, the aim of the second study was to uncover and address the specific impact of counselors regarding math anxiety. Given the fact that preservice counselors and preservice teachers are educators who work with students, math anxiety will most likely be a topic of discussion among these educators and students. Compiling data from preservice school counselors can be used to build a nomenclature net around preservice teachers and preservice counselors.

**Target journal for publication.** The target journal for the second manuscript is the *Professional School Counseling Journal*. This peer-reviewed practitioner-oriented journal does not have an impact score. *The Professional School Counseling Journal* would be an appropriate journal choice given the study topic and the journal’s requirements for submissions. The *Professional School Counseling Journal* applies great rigor when selecting articles to publish. It
has a strong balance of theory, research, and best practices for the counseling profession. The *Professional School Counseling Journal* also focuses on counseling roles, networking among counseling professionals and various counselor settings for practice (American School Counseling Association, 2018). The second manuscript was completed following the *Professional School Counseling Journal*’s submission guidelines.

**Research questions and methodology.** To complete this manuscript, the same research design, procedures, formatting, methods, and statistical analysis were used. It answered the following research questions, similar to manuscript 1.

**Design.** This study employed a cross-sectional observational design (Jepsen, Johnsen, Gillman, & Sørensen, 2004) to answer the following six research questions:

- What is the level of mathematics anxiety among preservice teachers?
- How many preservice teachers reported having a worst experience?
- Does the preservice teacher participants’ level of math anxiety differ from a known college student norm?
- Does the proportion of preservice teachers who reported a worst math experience differ from a known proportion among American educators?
- Does the proportion of preservice teachers who reported a worst math experience differ from a known proportion among Turkish educators?
- Do the proportions of when preservice teachers reported the occurrence of a worst math experience differ from known proportions among Turkish educators?

**Glossary of Specialized Terms**

**Abbreviated Math Anxiety Scale (AMAS)**


The Abbreviated Math Anxiety Scale (AMAS) is a Likert Scale that consists of nine items. It is defined as the following: “The AMAS is a nine-item scale derived from factor analytical studies of the Math Anxiety Rating Scale-Revised (Hopko, Mahadevan, Bare, and Hunt, 2003). The AMAS uses a fully anchored five-point Likert scale (1 = Low Anxiety, 2 = Some Anxiety, 3 = Moderate Anxiety, 4 = Quite a bit of Anxiety, 5 = High Anxiety). Thus, the overall score can range from 9 to 45. Hopko et al. reported excellent internal consistency (α = .90) and test-retest reliability (r = .85)” (Dykeman, 2017, p. 3). The AMAS was used to collect data in both manuscripts using preservice teachers and preservice counselors.

**Math Anxiety**

Brady and Bowd (2005) defined math anxiety as “general anxiety that is multidimensional” (p. 311). Richardson and Suinn (1972) defined anxiety as “a feeling that interferes with the manipulation of numbers and solving math-based problems” (p. 551). Bekdemir (2010) stated the following to define math anxiety: “It is an illogical feeling of panic, embarrassment, flurry, avoidance, failing and fear, which are physically visible, and which prevent solution, learning, and success about mathematics” (p. 312).

**Worst Math Experience**

Worst Math Experience can be defined by using Bekdemir’s research from the Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT). The “worst math experience” is defined as “a negative and anxiety-creating experience” (Bekdemir, 2010, p. 317).

**Preservice Teachers**

Preservice Teachers are defined as “teacher candidates. This term is used to describe student teachers who are enrolled in a teacher preparation program and working toward teacher
certification. They complete supervised field-based teaching experiences with the support and mentorship of university faculty and K-12 cooperating teachers” (IGI Global, 2018, p. 1).

**Preservice School Counselors**

Preservice School Counselors are defined as students in training, who in this case would be school counselors. Local accreditation or national accreditation standards usually define the academic programming. Preservice work is usually supervised work (The Palm Beach Schools, 2012).

**Thematic Linkage of Manuscripts**

When considering these two manuscripts, preservice teachers and preservice counselors are both significant populations when addressing math anxiety prevalence because of the students they impact. Both of these populations have a high volume of access to students who are exploring and establishing a direction of study, both currently and in their futures. Given the fact that the US is lagging behind in STEM careers, it is extremely important to study these populations and the prevalence of math anxiety. Thus, these two studies are thematically connected by (a) K-12 education, and (b) math anxiety in education.

**Organization of Dissertation**

This dissertation is organized in the following sequence: The beginning of the dissertation will have a table of contents and a dedication. The dissertation will transition into chapter 1, which will discuss the importance of researching preservice teachers and the prevalence of math anxiety. In addition to preservice teachers, this dissertation will consider preservice school counselors and the prevalence of math anxiety regarding their experiences with math. The layout of the dissertation at this point will thoroughly discuss the rationale for studying these populations. In chapter 2, the dissertation reviews the design, methodology,
procedures, results, discussion of the results, and the limitations of those findings for
pRACTITIONERS AND FUTURE RESEARCH. IN CHAPTER 3, THE DISSERTATION MANUSCRIPT IS A REPORT OF THE
ORIGINAL RESEARCH FOUND IN MANUSCRIPT 1. IT IS ORGANIZED THE SAME AS CHAPTER 2 IN REVIEWING THE
design, methodology, procedures, results, discussion, and limitations. CHAPTER 4 IS A REVIEW OF
THE CONCLUSION OF BOTH MANUSCRIPTS AND DISCUSSES THE RESEARCHER’S PROJECTED RESEARCH FOR THE NEXT
5-10 YEARS.
Chapter 2: A Research Manuscript
Preservice Elementary School Teachers’ Math Anxiety and Negative Experiences as Students in Math Class

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The research contained in this manuscript was conducted under the approval of the Oregon State University Institutional Review Board (Study ID 7092).

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Abstract

Almost two decades have passed since Jackson and Leffingwell’s (1999) influential article on math anxiety and worst math experiences in 66 preservice school teachers appeared in print. The present study represents a partial replication of the original study. The participants were graduate level preservice teachers at a public university on the west coast of the US. The six research questions that guided the study aimed to assess differences between the present study and (a) the original study, and (b) a Turkish replication of the original study. In terms of worst math experience, a non-statistically significant result was obtained comparing the original and present study. With regard to math anxiety, a statistically significant but clinically negligible result was obtained comparing the original and present study. However, this research encountered significant differences between the present study and the Turkish replication. Possible reasons for the obtained results, as well as implications, were discussed.

Keywords: Math Anxiety, Preservice Teachers, Worst Math Experience
Preservice Elementary School Teachers’ Math Anxiety and Negative Experiences as Students in Math Classes

Elementary school teachers are the first math educators that children encounter when their formal education begins. These teachers help set the attitudes children form with regard to academics, socialization, gender, racial biases, and fear about performance in mathematics. Teaching mathematics, while minimizing or eliminating anxiety, requires effort and awareness on the instructor’s part. That is because teaching this subject requires the instructor to debunk what Morris (1981) referred to as “(such an) irrational fear of mathematics that they are paralyzed in their thinking, inhibited in performance, and of course, prevented from learning” (p. 413); and Miller and Mitchell (1994) termed “the state of panic that takes control of a person’s thoughts” (p. 354). From these descriptions, we can express mathematics anxiety as illogical feelings of panic, embarrassment, flurry, avoidance, failing and fear, which are physically visible, and which prevent solution, learning, and success about mathematics” (as cited in Bekdemir, 2010, p. 312). This experience also requires deeper understanding and self-awareness of the teachers’ experiences with their own math anxiety, which means that math anxiety is not only present in students but also in teachers.

This study is an effort to explore what types of negative experiences preservice elementary teachers had in their own math classes as students. Building such an understanding is important for four reasons. These reasons are to help teachers: (a) decrease anxiety during math instruction (Harper & Daane, 1998), (b) decrease avoidance behavior that leads to limited instruction time on math (Jackson & Leffingwell, 1999), (c) enable the ability to intervene in student math anxiety (Taylor & Fraser, 2013), and (d) avoid a replication of the instructional trauma experienced (i.e., repetition compulsion) (Bekdemir, 2010).
The absence of recent research on American teachers’ negative experiences during their own mathematics instruction as students was the driving force behind the present study. The dated and foreign literature on this topic centers around three points: (a) teachers’ traumatic experiences during their own mathematics education, (b) the relationship between the traumatic experiences and mathematics anxiety, and (c) the impact of the traumatic experiences and mathematics anxiety on teachers’ own instructional behaviors.

Understanding preservice teachers’ traumatic math experiences gives insight and awareness about the root causes of math anxiety. Over the last three decades, only a few studies have examined teachers’ traumatic math experiences. Young, Wu, and Menon (2012) determined that math anxiety is a situation-specific anxiety as distinguished from a generalized anxiety. A question remains about what traumatic mathematics experiences are for teachers. Jackson and Leffingwell (1999) categorized traumatic mathematics experiences as both covert and overt behaviors that preservice teachers have experienced.

Jackson and Leffingwell (1999) studied the challenging mathematics experiences and the grade levels in which these experiences took place for preservice teachers. Results indicated that only 7% of the 157 students interviewed reported having positive mathematics experiences in mathematics courses. The remaining 93% reported experiences that preservice teachers recalled entailed hostility, difficulty of the material, embarrassment, quality of the instruction, and insensitivity, all of which are negative. Jackson and Leffingwell found that overt instructor behaviors consisted of verbal statements, for instance, “You should know this; if you read your textbook, you would not have any problems,” and covert instructor behavior examples in which instructors communicated their disappointment through sighing, avoiding eye contact, and failure to assist students.
Another study by Harper and Daane (1998) identified several traumatic mathematics experiences of preservice teachers before and after taking a mathematics methods course. They found that some of the negative experiences were described as practices that were common to the classroom but uncomfortable at the same time. These routines included “drill and practice, getting the right answers, using the right method, taking timed tests, memorizing formulas, and applying rules” (p. 30). In addition to these uncomfortable classroom experiences, Harper and Daane found that preservice teachers reported specifically that many episodes involved the teacher embarrassing them if they gave the wrong answer, fears about studying and taking tests, and instructors lecturing them sternly.

Bekdemir (2010) argued that the impact of math performance in the lower grades affects performance in the upper grades and future life. The author also noted the importance and need to investigate the origin of math anxiety and how the cycle is perpetuated. He focused further research on preservice mathematics teachers and their negative mathematics experiences. Results showed that the common causes of mathematics anxiety for preservice mathematics teachers stemmed from some of the following behaviors: instructors’ hostile behaviors, inadequacy of instructors, and an authoritarian teaching environment.

Preservice teachers do experience mathematics anxiety, and some of the root causes have been discussed. It is significant to understand the impacts of such findings and how they relate to mathematics anxiety. If preservice teachers experience mathematics anxiety, are there resulting behavior changes? Additional research that Boyd et al. (2014) conducted discussed preservice teacher’s traumatic experiences during their own mathematics instruction that heightened their anxiety in relation to mathematics. Some of the students’ beliefs and attitudes
regarding mathematics and their self-efficacy centered on their teacher experiences, and others were the result of their perceptions of mathematics.

Boyd et al. (2014) reported that preservice teachers in the US experience higher levels of mathematics anxiety than in foreign countries, especially at the elementary level. “Research has identified reasons for preservice teachers experiencing mathematics anxiety, which are: (a) past experiences of failing mathematics (Bekdemir, 2010), (b) the pedagogical approach to the teaching of mathematics (Gresham, 2007), (c) classroom instruction techniques (Hawera, 2004), (d) teaching practices associated with negative attitudes towards mathematics (Swan, 2004), and (d) students’ experiences during their primary school education” (Uusimaki & Nason, 2004, p. 208).

Boyd et al. (2014) also described preservice teachers’ traumatic experiences as (a) not getting support from teachers and falling behind in school, (b) teaching that was boring and taken straight from the book, (c) teachers who did not provide individual support, (d) mean teachers who would laugh at them because of an inability to solve math problems, and (d) certain individual beliefs that people are born to do mathematics and some are not. These experiences led to a heightened level of mathematics anxiety in preservice elementary school teachers.

Bekdemir (2013) contended that preservice teachers’ mathematics experiences led to higher levels of mathematics anxiety. One of the questions Bekdemir asked his participants was, “How do you think your mathematics anxiety influences your mathematics achievement?” The finding was that the main causes of anxiety were teacher driven. In sum, preservice teachers demonstrated an increase in mathematics anxiety based on their previous instructional experiences.
Jackson and Leffingwell (1999) conducted research on preservice teachers’ mathematics experiences and how the outcome for these teachers equated to an increase in mathematics anxiety. These authors asserted, “Whether the instructor behaviors were overt or covert, they interfered with the students’ ability to concentrate in mathematics classes” (p. 585). Jackson and Leffingwell also found that perceptions of uncaring teachers, hostile instructor behaviors, being embarrassed, and other negative factors heightened these students’ personal mathematics performance anxiety. In the upper grades such as the college level, preservice teachers stated that an increase in mathematics anxiety contributed to communication barriers. In addition, insensitive and uncaring attitudes of instructors, the quality of instruction, and the instructors’ dislike of the class level heightened the students’ mathematics anxiety.

Fiore (1999) asserted that teachers are math anxious. Fiore reported that a high percentage of math-anxious people are professional elementary school teachers. Harper and Daane (1998) reported that many studies have indicated that preservice elementary teachers had a weak understanding of mathematics as well as negative attitudes and anxiety about the subject.

Traumatic mathematics experiences and the impact they have on preservice teachers’ own instruction is critical to understanding one factor in the pedagogy of teachers. Gresham (2008) found four popular themes among preservice teachers who were teaching mathematics to elementary students. These themes consisted of negative attitudes towards mathematics and high mathematics anxiety. Other preservice teachers reported experiencing stress, negative attitudes, and worry about mathematics; some even described their worries as big numbers chasing them in their dreams.

Preservice teachers reported that using various modalities was important when teaching mathematics, but most preservice teachers reported not having modalities at all (Gresham, 2008).
Gresham (2008) also noted that preservice mathematics teachers appreciated learning various means of teaching mathematics, which include the use of manipulatives, relating to other preservice teachers’ mathematics experiences, and the use of nontraditional practices when teaching problem solving.

Harper and Daane (1998) indicated that previous instruction from mathematics instructors influenced mathematics anxiety. Some of these practices consisted of drills and practice work, taking timed tests, and memorizing formulas. The instructors placed little emphasis on a collaborative method of learning, which was identified as a more productive way of learning and was beneficial in curbing mathematics anxiety.

Harper and Daane (1998) found that teachers who are math anxious tended to use traditional methods of teaching. Students were assigned more seat work, and teachers focused less on conceptual learning. The authors posited that “math anxiety still persists in many future elementary classroom teachers. The cause of this anxiety has begun, many times, in elementary school. Often, the anxiety has been created by the classroom teacher. If future elementary teachers understand what caused their own anxiety, they may be better able to promote an atmosphere that helps inhibit math anxiety in children” (p. 34).

Boyd et al. (2014) discussed how self-efficacy affects preservice teachers’ teaching abilities. In addition to self-efficacy, practices employing the following methods of instruction increased mathematics anxiety in preservice teachers: (a) past experiences of failing mathematics, (b) the pedagogical approach to teaching, (c) negative attitudes associated with teaching mathematics, and (d) preservice teachers’ individual experiences in elementary school.

Jackson and Leffingwell (1999) shared implications for instructors regarding preservice teacher mathematics anxiety. They found that students will internalize what they are taught,
meaning that if they sense that their instructors do not enjoy being in the classroom, they will be less motivated to participate and learn. Jackson and Leffingwell also shared that preservice teachers’ negative memories of their primary years can have a lasting effect, potentially up to 20 years or more. Based on the literature, preservice teachers could perpetuate the negative cycle of mathematics anxiety in their students because of their own internal reaction to mathematics. Becoming aware of the prevalence of mathematics anxiety can be a vital step in changing teaching methods and providing a positive outcome towards mathematics performance in future generations.

The following six research questions guided this study:

1. What is the level of mathematics anxiety among preservice teachers?
2. How many preservice teachers reported having a worst experience?
3. Does the preservice teacher participants’ level of math anxiety differ from a known college student norm?
4. Does the proportion of preservice teachers who reported a worst math experience differ from a known proportion among American educators?
5. Does the proportion of preservice teachers who reported a worst math experience differ from a known proportion among Turkish educators?
6. Do the proportions of when preservice teachers report a worst math experience occurring differ from known proportions among Turkish educators?

Method

**Design**

**Design and Variables Specifics.** This study employed a cross-sectional observational design (Jepsen, Johnsen, Gillman, & Sørensen, 2004). The study involved the use of a
convenience sample of preservice school teachers. The issues involved with using such a sample will be addressed later in this article. The three variables in the present study were: (a) math anxiety (continuous variable), (b) whether the participants had a worst experience in a math class during their own time as a student (binomial variable), and (c) the grade level at which they had that worst experience (multicategorical variable).

**Power Analyses.** The third through sixth research questions involved inferential statistics. An *a priori* power analysis for each research question was completed by means of G*Power (Faul, Erdfelder, Buchner, & Lang, 2009). With the third research question, the power analysis used was for a one-sample *t*-test. The proper effect size for a *t*-test is Cohen’s *d* (Rosnow & Rosenthal, 2003). The effect size was drawn from a math anxiety study of college students (Primi, Busdraghi, Tomasetto, Morsanyi, & Chiesi, 2014). The power analysis was completed used these inputs: (a) Test family = *t* tests; (b) Statistical tests = means: difference from a constant (one sample case); (c) Type of power analysis = a priori: compute required sample size – given α, power, and effect size; (d) tail(s) = 2, (e) *d* = -0.69, (f) power (1-β error probability) = 0.80; and (g) α = .05. The G*Power 3.1 output included a total sample size of 19 and an actual power of 0.81.

The fourth and fifth research questions included frequency counts. The results formed a two-cell table of frequency counts (Cell 1 = No; Cell 2 = Yes). Thus, the power analysis was for a binomial test. The proper effect size for this power analysis is Cohen’s *g* (Rosnow & Rosenthal, 2003).

For the fourth research question, the proportion observed was drawn from the one that appears on page 583 of Jackson and Leffingwell (1999). Specifically, *p* observed was .93 (146/157). Therefore, Cohen’s *g* was .43 (*p* observed = -.50). The following input parameters
were employed: (a) test family = exact; (b) statistical test = proportions: difference from constant (binomial test, one sample case); (c) the type of power analysis = a priori: compute required sample size given $\alpha$, power, and the effect size; (d) tail(s) = 2, (e) $g = 0.43$; (f) power (1-$\beta$ error probability) = 0.8; (g) $\alpha = .05$; and (h) constant proportion = .50. The G*Power output suggested a sample size of 9 and an actual power of .87.

For the fifth research question, the proportion observed was drawn from the Worst Experience data presented in Table 2 of Bekdemir (2010). Specifically, $p_{\text{observed}}$ was .77 (129/167). Therefore, Cohen’s $g$ was .27 (i.e., $p_{\text{observed}} - .50$). The following input parameters were employed: (a) Test family = exact; (b) Statistical test = proportions: difference from constant (binomial test, one sample case); (c) the type of power analysis = a priori: compute required sample size given $\alpha$, power, and the effect size; (d) tail(s) = 2, (e) $g = 0.27$; (f) power (1-$\beta$ error probability) = 0.8; (g) $\alpha = .05$; and (h) constant proportion = .50. The G*Power output suggested a sample size of 25 and an actual power of .80.

The sixth research question results were compared against expected proportions drawn from Table 5 of Bekdemir (2010). As such, a power analysis was for a chi-square goodness-of-fit test. The proper effect size for such a test is Cohen’s $w$ (Rosnow & Rosenthal, 2003). The effect size was drawn from a study that examined the interaction of learning and addiction variables in an educational setting (Huepe et al., 2011). The input parameters were: (a) Test family- $\chi^2$ tests; (b) Statistical test- Goodness-of-fit tests: contingency tables; (c) Type of power analysis- a priori: compute required sample size- given $\alpha$, power, and effect size; (d) $w = 0.42$; (e) power (1-$\beta$ error probability) = 0.80, (f) $\alpha = .05$; and (g) degrees of freedom ($Df$) = 2. The G*Power 3.1 output suggested a sample size of 55 with an actual power of 0.80.
In summary, the required sample size ranged from 9 (fourth research question) to 55 (sixth research question). As such and given the number of participants in the present study, no analysis will be underpowered.

**Participants**

This study involved 66 preservice teachers located at one public university and a satellite campus for the same university in the western United States. The participants were predominantly female (91%) and male (9%). The mean age was 24.85 ($SD = 6.383$). The majority of the sample size was composed of Caucasian students equaling 86%. Students of color represented 14% of the sample, Hispanic/Latino = 0.015%, African American = 0.0%, Asian American = 0.06%), American Indian/Alaska Native represented = 0.015%, and multiple races/ethnicities = 0.045%.

**Measures**

**Abbreviated Math Anxiety Scale (AMAS).** The AMAS is a brief, nine-item measure of math anxiety with strong psychometric properties including internal consistency ($\alpha = .90$) and test-retest reliability ($r = .85$) (Hopko et al., 2003). The AMAS is widely used in math anxiety research across multiple cultures (Eden, Heine, & Jacobs, 2013; Primi et al., 2014; Tejedor et al., 2009). On this measure, participants are asked to rate each of the nine items on a five-point Likert scale with 1 = Low Anxiety to 5 = High Anxiety. The range of scores is 9 to 45. Primi et al. (2014) found a M= 21.6 (SD = 6.3) in using the AMAS with college students. In their studies using the AMAS with college students, Hopko, Hunt, and Armento (2005) and Hopko, Crittendon, Grant, and Wilson (2005) reported means of 21.8 (SD = 5.2) and 21.5 (SD = 5.5), respectively. Maloney, Risko, Ansari, and Fugelsang (2010) used the following cut scores for the AMAS with college students: (a) Low Anxiety $\leq 19$, and (b) High Anxiety $\geq 30$. As per
Maloney et al., the following coding scheme was used for the analysis:
Low Anxiety ($\leq 19$) = 1, Moderate Anxiety (20 - 29) = 2, and High Anxiety ($\geq 30$) = 3.

Dykeman (2017) examined the AMAS average across 17 studies involving college students. He reported that the weighted average for the 17 studies ($N = 6439$) was 22.66. This weighted average served as the test value for the third research question.

**Worst Experience and Most Troublesome Mathematics Classroom Experience**

**Reflection Test (WMTMCERT) –Presence.** This questionnaire involves participants who answered open-ended questions to describe the “worst” experiences in a math classroom (Bekdemir, 2010; Jackson & Leffingwell, 1999). Consistent with Bekdemir, as well as Jackson and Leffingwell, “worst” was defined to the participants as a negative and anxiety-creating student experience. The following dummy coding scheme was used for the analysis: no report of a worst experience = 1, a report of one or more worst experiences = 2, and missing = -99. The reference proportion for the fourth research question (Americans, Jackson & Leffingwell, 1999) was $p_0 = .93$ (146/157), and the fifth research question (Turkish, Bekdemir, 2010) was $p_0 = .77$ (129/167).

**Worst Experience and Most Troublesome Mathematics Classroom Experience**

**Reflection Test (WMTMCERT) –Timing.** Participants were also asked to report in “what grade (K through 12) did this worst experience occur?” The grades reported were then recoded into the grade categories that Bekdemir (2010) used: (a) Grades 1-5 = 1, (b) Grades 6-8 = 2, (c) Grades 9-11 = 3, (d) Grades 12-14 = 4, and (e) missing = -99. The reference proportions from the Turkish preservice teachers can be found in Table 1.

**Procedures**

A questionnaire containing the WMTMCERT, AMAS, and demographic questions was
administered to preservice elementary teachers. These questionnaires were administered in an introductory pedagogy class in a pencil and paper format. A printing company created both the demographic questions and the AMAS in an optical mark recognition form (i.e., Scantron) so that data could be easily compiled and organized.

Data Analysis

For the first research question, determining the prevalence level involved a calculation of a mean, standard deviation, and skewness. The second research question called for determining frequency counts and percentages. The third research question involved comparing the results of a continuous variable against a national norm. As such, a one-sample $t$-test was applied to the analysis. The fourth and fifth research questions compared an obtained proportion against a known proportion. In this case, a one-sample $z$ test for a proportion was the analysis used. The sixth and final research question involved comparing a multi-categorical variable against a known norm for those categories. Thus, a chi-square goodness-of-fit test was employed.

Missing data were addressed using listwise deletion. For all analyses, calculations were completed using Excel, and the alpha level was set at .05.

Results

The level of math anxiety that the preservice school teachers reported on the AMAS was $(SD = 7.63, \text{skewness} = 0.815)$. The second research question addressed the number of participants who reported having a worst experience, which was 97% (i.e., 64/66). In the third research question, a comparison of the obtained AMAS scores against a known national norm did produce significant results, $t(62) = -2.26, p < .05$. In terms of the fourth research question (i.e., compare to an American sample), a one-sample $z$ test for proportion did not yield a significant result ($\hat{p} = .9697, p_0 = .93, n = 66, z = 1.265, p > .05$). With regard to the fifth
research question (i.e., compare to a Turkish sample), a one-sample \( z \) test for proportion did not yield a significant result (\( \hat{p} = .9697, p_0 = .77, n = 66, z = 3.822, p < .05 \)). In reference to the sixth research question, a frequency count of when preservice teachers reported a worst math experience occurred and can be found in Table 1. The grade category proportions differed from those reported from a Turkish sample, \( \chi^2 (3, N = 64) = 9.737, p < .05 \).

**Discussion**

The six research questions of this study examined levels and relationships of the following in preservice school teachers: (a) math anxiety, and (b) presence of worst experience in a math classroom. Below, the results will be discussed research question by question.

In terms of the first research question (measures of central tendency), the observed mean of math anxiety scores fell slightly over the mid-point of the potential mathematical range of scores (i.e., 36/2 = 18). The skew and kurtosis indicated roughly symmetrical distributions of scores with light tails. Such results are most likely a product of the fact that the participants were drawn from a homogeneous group (i.e., same professional program and grade level from one school).

In reference to the second research question (how many preservice teachers experienced a worst experience), almost all the teachers reported having a worst experience. One explanation for this finding relates to a couple of relationships noted earlier in this paper, specifically, the known relationships between: (1) worst math experience and math anxiety, and (2) choice of elementary school teaching as a career and math anxiety. As such, the high level of worst experience in the participants can be posited as the result of the intersection of these two relationships. In other words, the choice of elementary school teaching is represented as an avoidant behavior to anxiety. An alternative explanation for the obtained results relates to the
idea that those who undergo a trauma seek “… occupations with similar dynamics and structures to the toxic early environments and relationships that created them” (Bamber & McMahon, 2008, p. 96). In essence, those with a worst math experience selected elementary school teaching as a counter-phobic response. Another alternative explanation is that based on the data collected, 64 of 66 preservice teachers surveyed reported a worst math experience, which accounts for 97% of the sample size of preservice teachers surveyed who reported a worst math experience. Bekdemir (2010) listed nine perceived causes for worst math experiences; the top five were: (a) instructor hostile behavior, (b) exam anxiety, (c) inadequacy of instructors, (d) peer pressure, and (e) negative attitudes towards math. Leffingwell and Jackson (1999) found the following reasons for worst math experiences: (a) angry attitudes, (b) gender bias, (c) language barriers, (d) instructor hostile behaviors, and (e) quality of instruction, to name a few. It can possibly be generalized that 97% of the sample size of preservice teachers could have had similar reasons for their math anxiety as well. Which one of these two explanations is the most probable? Teachers are known as an occupational group with average to low risk-seeking behavior (Howard, 2013; Rushton, Morgan, & Richard, 2007). Thus, the avoidant behavior explanation is the most probable.

The third research question examined math anxiety levels with reference to a known college student norm. The result was statistically significant with the participants’ level lower than the American norm. However, on a clinical level, the difference was negligible. The obtained effect size was small \( d = -.284 \); Cohen, 1988). Thus, no practical difference was found in the levels of math anxiety between the two groups. Using the AMAS cut scores that Maloney et al. (2010) outlined, both groups fell within the medium range of math anxiety. One probable explanation for this obtained result is that the preservice teachers reflect the general
college population of which they are members. An alternative explanation is that this convenience sample differs from the general populations of preservice teachers. Between the former and the latter, the literature on higher levels of math anxiety in Education majors than other majors would point to the latter. However, this literature is well over a decade old. More recent studies point to age differences in teachers’ math anxiety with younger cohorts having less math anxiety (Wilson, 2012). This finding suggests that the former explanation is the most probable.

For the fourth research question (proportional differences from American educators), the obtained results were not statistically significant. One explanation is that the preservice teachers experienced a level of worst math experience that was directed toward teaching as a profession for the same reasons as the reference group of educators. An alternative explanation is that both groups of educators possessed equally poor levels of math skills that led to similar negative interactions with math teachers. Between these two explanations, the most probable is the former because research suggests that the causal pathway from poor math skills to math-anxious behavior cannot be substantiated (Ma, 1999).

In terms of the fifth research question, the proportion of preservice teachers who reported a worst math experience differed from a known proportion among Turkish educators. Specifically, the results indicated 97% for American educators and 77% for Turkish educators. One explanation for these results is that the difficult math classroom experiences of those who selected teaching as a career in the US and Turkey do not differ. An alternative explanation is that the social and economic forces that drive people into teaching are the same in both countries, independent of past experiences. The former rather the latter explanation is most likely because
in both societies, teaching represents a low math-intensive academic major for college-able persons who have had negative experiences with math.

In terms of the sixth research question, the proportions of when preservice teachers reported the occurrence of a worst math experience did differ from known proportions among Turkish educators. One explanation is that difficult math concepts (i.e., long division) are taught earlier in Turkey. Kalaycioglu’s (2015) research stated that Turkey has a competitive education system. Kalaycioglu’s research found that students have to perform well in younger years in Turkey to be ranked for academic high schools. This testing begins in middle school to secure access to competitive high schools. As such, the potential for worst math experiences shifts downward in terms of grade level. An alternative explanation is that elementary school teachers in Turkey have greater economic and professional advancement consequences for poor math performance in their students. Based on Kalaycioglu’s research, which stated that students are prepared early on for access to competitive high schools, teachers of students could relate because they had to be equally effective to teach. In other words, they went through similar circumstances to have access to competitive education that advanced them for a career in teaching. Therefore, the higher pressure on teachers precipitates worst math experiences for students. The former rather than the latter explanation is probable because curricular expectations are more uniform than professional advancement pressures across Turkey.

Limitations

The study completed on preservice teachers is a cross-sectional design, also known as a prevalence study. This study would be considered the sample size of a cross-sectional design. Another limitation of this design is that the sample surveyed may have bias due to poor recall of experiences or information. The limitations of the convenient sample were that the
demographics of one region in the Pacific Northwest comprised the sample surveyed; however, at multiple campuses in the Pacific Northwest, the sample surveyed were primarily Caucasian. It would be interesting to find out if the data in more ethnic populations would yield the same results. The generalizability of this research is limited because the participants were from two campuses of a single university. In addition, in this sample survey, eight people did not report at which grade level they had their worst math experience; therefore, some of the data were incomplete. In terms of sample size, this sample, being representative of all preservice math teachers and of different races, has its limitations due to having little to no diversity. A larger sample size could yield better results, as would a diverse sample size.

Implications

The implications for teacher preparation research are twofold. First, no research study has explored why almost all American preservice teachers report a worst math experience. Without knowledge of the reasons, it is impossible to design effective interventions. Second, there exists no evidence as to why worst experiences occur later for American preservice teachers. This lack of knowledge makes it difficult to know when the best time would be to engage interventions to prevent, or at least limit, worst experiences.

The implications of the results for teacher education are twofold. For one, graduating from college requires the ability to complete a certain level of math. High-paying jobs require extensive math training. The majority of science, medical, and engineering careers require a high level of math competence. Preservice teachers have an important role in teaching math at many grade levels. If preservice teachers are math anxious, they will not be as effective at teaching math, which perpetuates an ongoing cycle of math anxiety. The cyclical effects impact the economy, and they are detrimental for job creation. The most obvious impact is that students
can internalize the perception that they are not effective at math early in their development, which could potentially lead to dropping out of school or more serious consequences, like prison. If math anxiety is prevalent, it would be important to ask what types of treatment are available for the problem. If it is difficult to generate awareness around the topic, it would be difficult to generate interest in this type of anxiety or to find potentially effective treatment strategies.

Three additional implications for teacher preparation research should be noted. First, the collected data present the impact of math anxiety in preservice teachers with continual increases of math anxiety in later academic years. These data are significant because these populations enter the work force to assist younger generations, but they demonstrate anxious practices and skills with no new methodology for learning math. Second, if math anxiety continues to increase with limited interventions, teachers will not be able to get needed supports and new skills to overcome the math anxiety. The need for such support may not be transparent for these teachers, and they may suffer increased stress levels silently, which could limit job satisfaction and thus, create a grim outlook for the profession overall. Third, the research has also brought up important discussion and needs regarding this topic. If this topic is not further researched, this cyclical pattern of math anxiety will continue, perhaps at higher rates as the population grows. In the academic setting, performance will continue to be negatively impacted. Limited research can continue, and no changes in needed and effective treatment strategies will be generated. Thus, a math culture that is limited and stagnant will be created.
References

https://www.schoolcounselor.org/school-counselors/publications-position-statements/professional-school-counseling-journal


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https://doi.org/10.1080/10476210802250133


Table 1

*Teacher Grade Level of Worst Experience*

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<th>Data</th>
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<td>1-5</td>
<td>6-8</td>
<td>9-11</td>
<td>12-14</td>
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<td>Observed Proportion-US</td>
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<td>.34</td>
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<tr>
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<td>.34</td>
<td>.25</td>
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<td>Absolute Difference</td>
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</tr>
</tbody>
</table>

*Calculated from Turkish data reported by Bekdemir (2010).*
Chapter 3: A Research Manuscript
Preservice School Counselors’ Math Anxiety and Worst Math Experiences

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Abstract

Almost two decades have passed since Jackson and Leffingwell’s (1999) influential article on math anxiety and worst math experiences in preservice school teachers appeared in print. No studies examining these issues with school counselors exist. The present study represents a partial replication of the original study with 70 preservice school counselors. The participants were graduate-level preservice counselors at a public university on the west coast of the US. The six research questions that guided the study aimed to assess differences between the present study and (a) the original study, and (e) a Turkish replication of the original study. No statistically significant results were obtained comparing the original and present study. However, significant differences between the present study and the Turkish replication were encountered. Possible reasons for the obtained results were discussed along with the implications.

Keywords: mathematics anxiety, preservice counselors, most troublesome experiences, worst experiences
Preservice School Counselors’ Math Anxiety and Worst Experiences as Students in Math Classes

School counselors are often the go-to person when students are trying to sort their educational interests. They play a vital role in directing the path that many students will take in their academic pursuits. Many school counselors are known for their expertise in researching and discovering possible skill sets that students hope to establish, which makes school counselors versatile experts in a multitude of possibilities and careers. Possessing knowledge in a number of areas is significant for students who in their attempts to figure out what the best path for their academic development and endeavors would be. School counselors hold a pivotal role in this exploration, making them knowledgeable in language arts, the sciences, math, and the arts. But what happens when school counselors neglect exploration in content areas that make them uncomfortable to bring up negative experiences in their learning? Can counselors still be effective in directing students to explore a number of academic possibilities, or would the counselors’ narratives taint the possibility of exploration for students in academic areas they may be intimated to explore?

Since the National Defense Education Act of 1958, school counselors have been tasked with directing talented students toward collegiate studies in math and science. This task continues today through the national emphasis on STEM education. However, no literature exists on possible barriers to school counselors who engage in this task. For instance, what percentage of school counselors have significant math anxiety and/or had negative experiences as students in math classes that might adversely affect their ability to perform STEM guidance?

The focus of this study is to discover the degree to which school counselors have significant math anxiety and/or had negative experiences as students. For this study, four topics
covered in the literature will be reviewed: (a) the traumatic math experiences of school counselors, (b) the traumatic math experiences of school counselors as related to their math anxiety, (c) the behaviors associated with counselors who experience math anxiety, (d) the effects of such behaviors on the populations for which they provide counseling services and support. Finally, the specific research questions will be detailed.

Given the limited research on counselors’ specific math experiences, it is pertinent to address that this limitation is an area of concern, and that the research benefits will be endless to such a profession and the populations served when considering the number of students who are impacted by counseling services every day. Math anxiety is prevalent among preservice teachers (Bekdemir 2010). Such knowledge also opens doors to recognize that many preservice counselors work in schools; they may have been former teachers and will encounter student experiences as they struggle and plan their education related to their career choices. In other words, the discussion of math performance is bound to take place. If preservice counselors have had traumatic math experiences or are math anxious, these outcomes can certainly impact the quality of counseling services they will provide to the populations they serve.

Schmidt, Hardinge, and Rakutani (2012) stated that “Given their varied professional responsibilities, counselors may miss the significance of their role in establishing one of the earliest anticipatory expectations with regard to how a student views his or her ability in specific academic areas” (p. 27). A counselor’s role is significant because counselors can open or close doors for students who have an interest in a multitude of subjects such as math. Schmidt et al. noted, “Some authors (Gibbons & Borders, 2010; National Office for School Counselor Advocacy [NOSCA], 2010) have maintained that school counselors serve as gatekeepers of student potential” (p. 26).
School counselors as gatekeepers can help students explore possible academic paths, or they can discourage them. Much discussion has centered on STEM careers, which are heavily rooted in math. “The World Economic Forum (2010) ranked the United States 48th in the quality of math and science education. The 2010 ACT College Readiness report indicated that 76% of high school graduates did not meet high school benchmarks for readiness in one or more freshman-level courses” (American College Testing, 2010, p. 1). To respond to this emerging crisis effectively and thrive within an evolving technological society, “All students need to develop their capabilities in science, technology, engineering, and math (STEM) to levels much beyond what was considered acceptable in the past” (Schmidt, Hardinge, & Rakutani, 2012, p. 25). Knowing this information, it is imperative for school counselors to address the needs of their student population and also assist in increasing STEM interest. However, what happens if school counselors have their own anxieties around math performance, and they hinder discussions in the academic areas in which they have limited success or interest? Counselor limitations become important because these professionals can either increase student interest in math careers or deter students from pursuing these fields due to their own anxiety and fear of math.

Jackson and Leffingwell (1999) researched the traumatic experiences of preservice teachers in their math classes. These experiences were outlined as the following: hostile instructor behavior, unrealistic expectations, embarrassing students in front of peers, gender bias, and insensitive and uncaring attitudes of teachers. Bekdemir (2010) also studied preservice teachers’ math experiences and found that these teachers had both worst and most troublesome math experiences. Given these experiences of preservice teachers, could they also be the
experience of other professionals such as preservice counselors? If they are, then researching them becomes significant.

These math experiences also connote behaviors and implications that become significant for performance outcomes. For example, Bekdemir’s research (2010) discussed the implications for preservice teachers and teaching. Jackson and Leffingwell (1999) described the experiences that preservice teachers encountered as both overt and covert behaviors that produced anxiety during their math education. As research is conducted, it may be safe to conclude that such experiences could also impact preservice counselors in a similar manner with implications regarding how they counsel and affect students in the realm of math anxiety. Math anxiety and negative classroom experiences have been shown to impact instructional practices. For instance, Lazarus (1974) stated, “One obstacle to the prevention of mathophobia is the difficulty of early diagnosis … the educational system inadvertently promotes mathophobia” (p. 19). Moreover, Fiore (1999) wrote, “Evidence suggests that math anxiety results more from the way the subject matter is presented than from the subject matter itself” (p. 403). Boyd, Foster, Smith, and Boyd (2014) reported on the teacher-to-student transmission of math anxiety. The authors posited that “Preservice teachers and math are centered on math anxiety, and if not addressed in the teacher, (the anxiety) is thought to be transferred from the teacher to student with immediate and long-term educational implications” (p. 208). Boyd et al. recognized that the prevalence of math anxiety in preservice teachers has a negative impact on both their own self-efficacy and that of the students they teach. Their research suggested that this awareness be generated and discussed among preservice elementary teachers to aid in diminishing such effects on students through seeking a mentor while teaching. Gresham (2008) studied the impact of preservice elementary teachers’ effectiveness, their instructional effectiveness, and their potential of passing on the
math anxiety to their students. Gresham’s research found that focusing on traditional instructional practices increases the likelihood of math anxiety in students when compared to nontraditional instructional practices. If preservice teachers were aware of this problem, they would find a greater possibility of reducing math anxiety within themselves and employing instructional practices that (a) increase self-efficacy in students and (b) reduce the transference of math anxiety. This information is significant for preservice counselors, who have a major role in helping students process coursework, course selection, and career selection related to math.

School counselors have a pivotal role in guiding and advising students in STEM occupations. Based on American School Counselor Association (ASCA) standards and National Standards for School Counseling Programs, much emphasis is placed on career assistance and guidance. Feller (2011) outlined these expectations as a standard of practice for school counselors: “Beyond helping students (1) acquire the skills to investigate the world of work in relation to knowledge of self and to make informed career decisions, (2) employ strategies to achieve future career goals with success and satisfaction, and (3) understand the relationship between qualities, education training, and the world of work (Dahir, 2001, p. 324), becoming a STEM advocate is gaining traction among school counselors” (p. 16). In fact, school counselors can encourage and assist all students, including underprivileged populations, to enter STEM careers that are in high demand and increase the United States’ competitiveness in science and technology (Feller, 2011). STEM occupations have a strong component of math competence. If counselors are math anxious, the possibility that they will be limited in their efforts to guide students in STEM careers is real. The limited research on counselors’ specific math experiences is an area of concern. Math anxiety is prevalent among preservice teachers. Having such knowledge opens doors to recognize that many preservice counselors work in schools, may have
been former teachers, and will encounter students who struggle in planning their education as it relates to their career choices. In other words, the discussion of math performance is unavoidably bound to take place, which places this responsibility within the purview of school counselors. If preservice counselors have had traumatic math experiences or are math anxious, these outcomes can certainly impact the quality of counseling services they provide to the populations they serve.

The literature has suggested that students are not ready to engage in STEM education. Given that school counselors assist and guide students in the areas of class selection and career and college planning, these counselors can be considered as the gatekeepers of careers. This pivotal role affects how they advise students to plan for their futures and increase their interests to explore STEM curriculum and careers. Some of this impact and significance can be found in Schmidt et al.’s (2012) research, which stated, “It is important that school counselors do not overlook their professional obligation to provide rigorous, well-rounded, exploratory, and relevant opportunities for students; career development trajectories” (p. 27). School counselors play a vital role in assisting students in their learning and career process. When they demonstrate a lack in this area, the implications are seen throughout the United States. The World Economic Forum (2010) ranked the United States 48th in the quality of math and science education. The 2010 ACT College Readiness report indicated that 76% of high school graduates did not meet high school benchmarks for readiness in one or more freshman-level courses (American College Testing, 2010). To respond effectively to this emerging crisis and thrive within an evolving technological society, “All students need to develop their capacities in science technology, engineering, and math (STEM) to levels much beyond what was considered acceptable in the past” (Schmidt et al., 2010, p. 625).
School counselors’ vital role guides students’ learning and opens up their possibilities in STEM education and careers. They can open or close doors for students who have an interest in a multitude of subjects such as math. Research that Schmidt et al. (2011) conducted stated, “Given their varied professional responsibilities, counselors may miss the significance of their role in establishing one of the earliest anticipatory expectations with regard to how a student views his or her ability in specific academic areas” (p. 27). Schmidt et al. reported, “Some authors (Gibbons & Borders 2010, National Office for School Counselors Advocacy [NOSCA], 2010) have maintained that school counselors serve as gatekeepers of student potential” (p. 26). The school counselor’s role in guiding, planning, and introducing students to varied opportunities in learning that they may have missed, not considered, or are too scared to explore, such as the STEM curriculum, can begin with the counselor’s knowledge and training and how he or she direct students to challenge their learning.

The following six research questions guided this study:

1. What is the level of mathematics anxiety among preservice counselors?
2. How many preservice counselors reported having a worst experience?
3. Does the preservice counselor participants’ level of math anxiety differ from a known college student norm?
4. Does the proportion of preservice counselors who reported a worst math experience differ from a known proportion among American educators?
5. Does the proportion of preservice counselors who reported a worst math experience differ from a known proportion among Turkish educators?
6. Do the proportions of when preservice counselors reported a worst math experience occurring differ from known proportions among Turkish educators?
Method

Design

Design and variables specifics. This study employed a cross-sectional observational design (Jepsen, Johnsen, Gillman, & Sørensen, 2004). The study involved the use of a convenience sample of preservice school counselors. Issues involved with using such a sample will be addressed later in this article. Three variables were observed in the present study: (a) math anxiety (continuous variable), (b) whether counselors had a worst experience in a math class during their own time as a student (binomial variable), and (c) the grade level at which they had that worst experience (multi-categorical variable).

Power analyses. The third through sixth research questions involved inferential statistics. As such, a priori power analysis for each research question was completed by means of G*Power (Faul, Erdfelder, Buchner, & Lang, 2009). With the third research question, the power analysis used was for a one-sample *t*-test. The proper effect size for a *t*-test is Cohen’s *d* (Rosnow & Rosenthal, 2003). The effect size was drawn from a math anxiety study of college students (Primi, Busdraghi, Tomasetto, Morsanyi, & Chiesi, 2014). The power analysis was completed using these inputs: (a) Test family = *t*-tests; (b) Statistical tests = means: difference from a constant (one sample case); (c) Type of power analysis = a priori: compute required sample size – given α, power, and effect size; (d) tail(s) = 2; (e) *d* = -0.69; (f) power (1-β error probability) = 0.80; and (g) α = .05. The G*Power 3.1 output included a total sample size of 19 and an actual power of 0.81.

The fourth and fifth research questions included frequency counts. The results formed a two-cell table of frequency counts (Cell 1 = No; Cell 2 = Yes). Thus, the power analysis was for
a binomial test. The proper effect size for this power analysis is Cohen’s $g$ (Rosnow & Rosenthal, 2003).

For the fourth research question, the proportion observed was drawn from what appears on page 583 of Jackson and Leffingwell (1999). Specifically, $p_{\text{observed}}$ was .93 (146/157). Therefore, Cohen’s $g$ was .43 ($p_{\text{observed}} - .50$). The following input parameters were employed: (a) test family = exact; (b) statistical test = proportions: difference from constant (binomial test, one sample case); (c) the type of power analysis = a priori: compute required sample size given $\alpha$, power, and the effect size; (d) tail(s) = 2, (e) $g = 0.43$; (f) power (1-\(\beta\) error probability) = 0.8; (g) $\alpha = .05$; and (h) constant proportion = .50. The G*Power output suggested a sample size of 9 and an actual power of .87.

For the fifth research question, the proportion observed was drawn from the Worst Experience data presented in Table 2 of Bekdemir (2010). Specifically, $p_{\text{observed}}$ was .77 (129/167). Therefore, Cohen’s $g$ was .27 ($p_{\text{observed}} -.50$). The following input parameters were employed: (a) Test family = exact; (b) Statistical test = proportions: difference from constant (binomial test, one sample case); (c) the type of power analysis = a priori: compute required sample size given $\alpha$, power, and the effect size; (d) tail(s) = 2, (e) $g = 0.27$; (f) power (1-\(\beta\) error probability) = 0.8; (g) $\alpha = .05$; and (h) constant proportion = .50. The G*Power output suggested a sample size of 25 and an actual power of .80.

For the sixth research question, results were compared against expected proportions drawn from Table 5 of Bekdemir (2010). As such, a power analysis was for a chi-square goodness-of-fit test. The proper effect size for such a test is Cohen’s $w$ (Rosnow & Rosenthal, 2003). The effect size was drawn from a study examining the interaction of learning and addiction variables in an educational setting (Huepe et al., 2011). The input parameters were: (a)
Test family- $\chi^2$ tests, (b) Statistical test- Goodness-of-fit tests: contingency tables, (c) Type of power analysis- a priori: compute required sample size- given $\alpha$, power, and effect size, (d) $w = 0.42$, (e) power (1-\beta error probability) = 0.80, (f) $\alpha = .05$, and (g) degrees of freedom ($Df$) = 2. The G*Power 3.1 output suggested a sample size of 55 with an actual power of 0.80.

In summary, the required sample size ranged from 9 (fourth research question) to 55 (sixth research question). As such and given the number of participants in the present study, no analysis will be underpowered.

Participants

This study involved 70 preservice counselors located at one public university and a satellite campus for the same university in the western United States. The participants were predominantly female (81%) and male (19%). The mean age was 32.50. ($SD = 7.697$). The majority of the sample size was composed of Caucasian students equaling 80%. Students of color represented 20% of the sample, Hispanic/Latino = 0.029%, African American = 0.014%, Asian American = 0.043%), American Indian/Alaska Native represented = 0%, and multiple races/ethnicities = 0.100%.

Measures

Abbreviated Math Anxiety Scale (AMAS). The AMAS is a brief, nine-item measure of math anxiety with strong psychometric properties including internal consistency ($\alpha = .90$) and test-retest reliability ($r = .85$) (Hopko et al., 2003). The AMAS is widely used in math anxiety research across multiple cultures (Eden, Heine, & Jacobs, 2013; Primi et al., 2014; Tejedor et al., 2009). On this measure, participants are asked to rate each of the nine items on a five-point Likert scale with 1 = Low Anxiety to 5 = High Anxiety. The range of scores is 9 to 45. Primi et al. found a $M= 21.6$ ($SD = 6.3$) in using the AMAS with college students. In their studies using
the AMAS with college students, Hopko, Hunt, and Armento (2005) and Hopko, Crittendon, Grant, and Wilson (2005) reported means of 21.8 (SD = 5.2) and 21.5 (SD = 5.5), respectively. Maloney, Risko, Ansari, and Fugelsang (2010) used the following cut scores for the AMAS with college students: (a) Low Anxiety ≤19, and (b) High Anxiety ≥ 30. As per Maloney et al., the following coding scheme was used for the analysis: Low Anxiety (≤ 19) = 1, Moderate Anxiety (20 - 29) = 2, and High Anxiety (≥ 30) = 3. Dykeman (2017) studied the AMAS average across 17 studies involving college students. He reported that the weighted average for the 17 studies (N = 6439) was 22.66. This weighted average served as the test value for the third research question.

Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT) –Presence. This questionnaire involves the participants answering open-ended questions describing the “worst” experiences in a math classroom (Bekdemir, 2010; Jackson & Leffingwell, 1999). Consistent with Bekdemir, as well as Jackson and Leffingwell, “worst” was defined to the participants as a negative and anxiety-creating student experience. The following dummy coding scheme was used for the analysis: no report of a worst experience = 1, a report of one or more worst experiences = 2, and missing = -99. The reference proportions for the fourth research question (Americans, Jackson & Leffingwell, 1999) was $p_0 = .93$ (146/157), and the fifth research question (Turkish, Bekdemir, 2010) was $p_0 = .77$ (129/167).

Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT) –Timing. Participants were also asked to report in “what grade (K through 12) did this worst experience occur?” The grades reported were then recoded in the grade categories that Bekdemir (2010) used: (a) Grades 1-5 = 1, (b) Grades 6-8 = 2, (c)
Grades 9-11 = 3, (d) Grades 12-14 = 4, and (e) missing = -99. The reference proportions from the Turkish preservice teachers can be found in Table 1 of Bekdemir (2010).

**Procedures**

A questionnaire containing the WMTMCERT, AMAS, and demographic questions was administered to preservice counselors. These questionnaires in a pencil and paper format were administered in an introductory pedagogy class. A printing company created both the demographic questions and the AMAS in an optical mark recognition form (i.e., Scantron) so that data could be easily compiled and organized.

**Data Analysis**

For the first research question, determining the prevalence level involved a calculation of a mean, standard deviation, and skewness. The second research question called for determining frequency counts and percentages. The third research question involved comparing the results of a continuous variable against a national norm. As such, one-sample \( t \)-test was applied to the analysis. The fourth and fifth research questions compared an obtained proportion against a known proportion. In this case, a one-sample \( z \) test for a proportion was the analysis used. The sixth and final research question involved comparing a multi-categorical variable against a known norm for those categories. Thus, a chi-square goodness-of-fit test was employed. Missing data were addressed using listwise deletion. For all analyses, calculations were completed using Excel, and the alpha level was set at .05.

**Results**

The first research question sought to determine the level of math anxiety among preservice counselors. The level of math anxiety that the participants reported on the AMAS was 21.83 \((SD = 7.93, \text{ skewness } = .38)\). With respect to the second research question, the
number of participants who reported that they had a worst experience was 88% (i.e., 61/69). In the matter of the third research question, a comparison of the obtained AMAS scores against a known college student norm did not produce significant results, $t(68) = -.87, p > .05$. In terms of the fourth research question (i.e., compare to an American sample), a one-sample $z$ test for proportion did not yield a significant result ($\hat{p} = .88, p_0 = .93, n = 69, z = -1.493, p > .05$). With regard to the fifth research question (i.e., compare to a Turkish sample), a one-sample $z$ test for proportion did yield a significant result ($\hat{p} = .88, p_0 = .77, n = 69, z = 2.211, p < .05$). In reference to the sixth research question, a frequency count of when preservice counselors reported a worst math experience occurred and can be found in Table 1. The grade category proportions differed significantly from those reported from a Turkish sample, $\chi^2 (3, N = 61) = 10.16, p < .05$.

**Discussion**

The six research questions of this study examined the levels and relationships of the following in preservice counselors: (a) math anxiety, and (b) presence of worst experience in a math classroom. The results will be discussed research question by question.

In terms of the first research question (measures of central tendency), the observed mean of math anxiety scores fell slightly over the mid-point of the potential mathematical range of scores (i.e., $36/2 = 18$). The skew kurtosis indicated a roughly symmetrical distribution of scores with light tails. Such results are most likely a product of the fact that the participants were drawn from a homogenous group (i.e., same professional program and grade level from one school).

In reference to the second research question (how many preservice counselors reported a worst experience), 88% of the preservice counselors reported having had a worst experience. When compared to a survey sample of American educators, the sample results were the same. A
sample size of 69 American preservice counselors demonstrated an 88% result of worst experience; results indicated that 61/69 American preservice counselors demonstrated math anxiety. One explanation for this finding is that counselors have a high existing base rate of math anxiety. Jackson and Leffingwell’s (1999) research showed that out of 157 sampled students, only 11 students reported having positive math experiences.

An alternative explanation is that the prevalence of a base rate of math anxiety has been established; therefore, it can be concluded that preservice counselors will have a high rate of math anxiety. Jackson and Leffingwell (1999) established that the majority of students certified to teach, who were sampled in their research, had math anxiety. It can be concluded that this high rate will exist among preservice counselors. A 2011 National Survey of School Counselors, *Counseling at a Crossroads*, found that 73% of school counselors had a 58% chance of being teachers or administrators prior to becoming counselors. If a high base rate of math anxiety exists, then it has been established that preservice counselors will have a worst experience.

The most plausible reason is that counselors have a high base rate of math anxiety. The base rate norm for this group is high; therefore, it is expected that the prevalence of math anxiety is present in this population, which will thus ensure that this population will have a worst math experience.

With regard to the third research question (math anxiety level compared to a known college norm), the participants did not differ from a known norm of college students. One possible reason for this result is that in terms of math anxiety, those drawn into counseling as a profession do not differ from college students as a whole. Supporting this conclusion is the fact that the third most popular major in the US is Social Sciences and History, and the fourth is Psychology (National Center for Educational Statistics, 2017). An alternative explanation is the
convenience nature sampling in math anxiety research with college students. Most math anxiety researchers are psychologists, and perhaps the research in this field is overweighted with psychology majors. Thus, the nondifference encountered in this study just reflects this overweighting. Between these two explanations, the most probable is the former, given: (a) the breadth of research on college students with various majors (Hembree, 1990), and (b) the known differences in college majors with those in the social sciences (including psychology) having higher levels of math anxiety (Hembree, 1990; Schillinger, Vogel, Diedrich, & Grabner, 2018).

The fourth research question was, “Does the proportion of preservice counselors reporting a worst math experience differ from a known proportion among American Educators?” There is no difference between American educators and preservice counselors who had a worst math experience. American educators demonstrated similar math anxiety results to a known proportion of preservice counselors, which was 88% of preservice counselors who reported having a worst math experience. This finding was almost similar to what the college norm reported, which was 93%. The American educators reported a slightly higher percentage of worst experience than preservice counselors. A reason for this difference might be that math anxiety exists regardless of the country. In other words, it is a universal experience in various countries and in a multitude of populations.

An alternative explanation might be that preservice counselors have certain personality types that are prone to having math anxiety prior to becoming preservice counselors. Based on Hadfield and McNeil’s (1994) research, one of the suggested origins of math anxiety was personality (p. 3). These authors also found that people who had an extroversion trait had scored lower on math anxiety in comparison to their opposite counterparts. Hadfield and McNeil also
found that certain personality types are attracted to the elementary school teaching profession, and in these personalities, there is a higher prevalence of math anxiety.

The same authors also found that people with the personality type of “feeling” were attracted to the school counseling profession, and these populations have a higher tendency to be math anxious. Hadfield and McNeil (1994) proposed a possible solution: employing math specialists to teach mathematics to teachers who are highly math anxious. These teachers are more “feeling” types, and this personality type has more math anxiety. They are not analytical, but they have traits that young children need in the academic environment. This research demonstrated that certain personality types are drawn to elementary school teaching while having higher levels of math anxiety.

The most plausible explanation is that math anxiety exists in many populations regardless of the country or place of origin. Bekdemir’s (2010) research found that most Turkish students reported having math anxiety throughout their academics. Kalaycioglu’s (2015) research found the highest mean level of math anxiety in Turkey based on the five countries researched. The research further stated that this math anxiety might be explained by different educational systems in the countries researched. The study also discussed that countries such as Hong Kong, Turkey, and Greece utilize high-stakes testing to allocate which academic high schools students will attend. These countries also use high-stakes testing to determine which middle schools students will attend.

With regard to the fifth research question (American v. Turkish proportion of worst math experiences), one of the reasons the proportions of American preservice counselors and Turkish educators might vary is due to American preservice counselors’ need to take higher levels of math courses later on in their academic career in comparison to Turkish educators. Turkish
educators engage in high-stakes testing, but those in the US do not. Kalaycıoğlu’s (2015) article stated, “Math anxiety levels may be explained by the different educational systems in these countries. Educational systems of developing countries such as those of Turkey, Greece, and Hong Kong are more centralized and more challenging for students. These countries’ education systems currently use high-stakes testing as a means of allocating students into academic high schools, and students are ranked depending on their test scores” (p. 1399). The US does not engage in high-stakes testing, which might explain the reason for higher proportions of math anxiety in the Turkish populations at younger grade levels. However, in the US, math anxiety may surface in the later academic years when a career choice is necessary, and math becomes a focal point for achieving that career.

Another possible explanation is that the junior colleges in the US are places where students can recover some of the academic functioning and career exploration skills if they did not do so in high school. In Turkey, students have to pick a path at younger ages while performing towards that goal, or they lose the opportunity for college completion. Students in Turkey usually begin to focus on technical programs to build task skills for employment because academic options are no longer open to them due to their performance and the established academic rules in Turkey’s educational system. In the US, students can redeem their splintered academic skills long after they graduate from high school by attending junior college. The proportion of worst math experiences mostly likely happens at higher rates at the junior college and at the 4-year college level because math becomes significant for academic and degree success, as well as career planning. The research of Jackson and Laanan (2015) found that
nearly half of the students who attend community college do so to complete preparation for STEM careers. In addition, the research of Floyd, Haley, Eddy, and Antczak (2009) shared that community colleges are an access point for students for higher learning as well as job training. When considering such a need in the US, it is important to recognize that other countries do not have community college access. Thus, math anxiety is more prevalent in earlier years when compared to a US population of students who can continue to work towards their career goals by attending community colleges and requesting transfer agreements.

In terms of the sixth research question (timing of worst math experience), three possible reasons could explain the results obtained. The first possible reason is that high-stakes testing of math performance occurs earlier in the Turkish educational system when compared to the US educational system. Kalaycıoğlu (2015) noted the following:

Educational systems of developing countries such as those of Turkey, Greece, and Hong Kong, are more centralized and more challenging for students. These countries’ education systems currently use high-stakes testing as a means of allocating students into academic high schools, and students are ranked depending on their test scores. In Hong Kong, Turkey, and Greece, students are allowed access to specific schools based on their exam score starting in middle school. (p. 1399)

Preparation of students in Turkey begins much sooner to be competitive for academic institutions. In countries like Turkey, high-stakes testing preparation begins in the primary years of education for students, and performance on these tests will determine if students will have
access to competitive high schools. It is also important to note that high-stakes performance in a
country like Turkey determines a student’s college opportunities and future success.

The second reason could be that the pay and retention consequences for poor student
performance in math occur earlier for Turkish teachers. Another reason could be that hiring
consequences and retention for poor student performance in math occur earlier for Turkish
teachers. The research of Kılınç, Watt, and Richardson (2012) stated that considerable attention
is focused on selecting math and science teachers. Kılınç et al. also stated; “In accordance with
the modernization of Turkey, there is aggressive attention to the quality, especially in
scientific/mathematical domains … There is consonant high attention to the quality of
mathematics/science teachers, as indicated by higher requisite entry scores to undertake teacher
education in those specialties” (p. 200). It can be concluded that the rigor in teacher selection
and expectation begins well before a teacher is hired to teach science and math. If teachers are
committed to the requirements to become math teachers, the same expectations are most likely
required of their students to prepare to enter high-achieving institutions.

A third reason relates to parent expectation. Perhaps Turkish parents press for greater
math performance at earlier ages than American parents. For example, the literature has
reported that it is not uncommon for Turkish parents to hire tutors to improve their child’s
performance in elementary school years (Atalmis, Yilmaz, & Saatcioglu, 2016). In the Turkish
culture, extra rigor goes into selecting math and science teachers, and parents also know that
preparation is a joint effort between these teachers and parents to ensure college entry for their
children.

Kılınç, et al.’s (2012) research stated, “As early as grade 9 (the first year of secondary
education), students are required to select science versus social science strands for their
remaining education” (p. 200). Parent involvement begins at a young age due to the rigor of performance expectations.

Among these three reasons, the most probable explanation for the results obtained is the first one because Turkish students, based upon test scores, are tracked into college and non-college pathways far earlier than American students. Atalmis, Yilmaz, and Saatcioglu (2016) stated:

Entrance exams for both high school and university are highly competitive in the Turkish educational system. The first step of this competition for Turkish students is the high school entrance exam administered by the Ministry of National Education once a year. Students are supposed to take this exam in the last year of primary education (8th grade), and they are accepted to prestigious high schools only if they obtain high scores on the test. (p. 1136)

Given that high-stakes testing begins in middle school and determines college access, it would be the strongest driver as to the timing of a worst math experience.

Limitations

When considering the results of this study, three limitations should be kept in mind. First, this study used a cross-sectional design. A known limitation with this design relevant to this study is that it is used to gather data on a specific population in a given time period. Second, the study used a convenience sample. Convenience samples cannot be used globally to generalize an outcome for additional populations. They can only be used to draw conclusions about the population that was sampled. A third limitation involved the narrow demographic
profile of the sample. The limited diversity of the sample surveyed was composed of one university with multiple campuses on the west coast of the US, and the population was predominantly Caucasian. Although this researcher sampled multiple campuses of one region on the west coast of the US, they were primarily Caucasian. A more diverse sample might yield different results.

Implications

The implications for counselors’ preparation research are fourfold. First, no research study has explored the impact that school counselors have on students, and yet school counselors have a pivotal role in assisting students with class selection, career exploration, and college requirements. Given the high percentage rate of school counselors who were previously teachers also indicates the prevalence of high math anxiety in many American preservice teachers, who also reported having a worst math experience. With limited research and the inability to answer why this is happening, effective interventions are limited for teachers, thus with similar limitations for preservice counselors. In addition, no research has been conducted to answer why preservice teachers’ experience math anxiety can also apply to school counselors, thus limiting effective treatment strategies or knowing when the intervention strategies are needed the most. This deficit perpetuates a math-stagnant and limited student population.

The second implication relates to the timing of the worst experience. The data collected recognized that math anxiety increases in later years for preservice counselors. These data are significant because counselors may have a perception that math anxiety is common through later years due to their own experiences. Thus, they dismiss the needs of the younger students they counsel, who might be expressing their concerns with math anxiety. This anxiety might be normalized versus school counselors who assist students with effective therapeutic treatment for
anxiety. In other words, school counselors might be limited by their narrow views and performance when it comes to math.

Third, if math anxiety is elevated in student populations, school counselors might compare data and state that the math anxiety is a norm, which leads to poor performance in STEM careers in the US, versus looking for possible solutions for boosting math performance.

Fourth, school counselors may not consider increasing math performance by reducing math anxiety as a needed intervention, or they may not seek further training in the area because they have dismissed the need or are limited to few, if any, interventions. This lack of awareness that the problem could be remedied exists because the research is scarce, thus enabling and perpetuating a cycle of helplessness.
References


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workplace, taking a STEM-centric view can prove helpful. *Technology and Engineer Teacher, 71*, 6-12.


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Table 1

*Grade Level of Worst Experience*

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<th>6-8</th>
<th>9-11</th>
<th>12-14</th>
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</table>

*Calculated from Turkish data reported by Bekdemir (2010).
Chapter 4: Conclusion
Math performance and success are highly critical for academic and career success for people in the US, especially in STEM careers. Regardless, math performance is expected in most professions, and a certain level of math performance for students is expected when they graduate high school, college, and graduate school. However, math performance remains an area of low performance and heightened anxiety because of limited research as to why this phenomenon is occurring in the US. Based on the 2015 Pisa results, the US dropped in rank from the 25th place in 2012 to the 35th place in 2015. This rating is of vital concern for STEM careers and potentially indicates a perpetuated cycle of poor math performance. Atkins and Mayo (2010) found that the US is falling behind rapidly in its investment in STEM innovation when compared to other countries that are privately and publically investing in their economies to be competitive.

In addition, little is known about the prevalence and cause of math anxiety. Understanding the prevalence of math anxiety can assist in the goal of increasing math performance. The hope is that such a goal can improve the poor ranking of math performance in the US. Thus, the focus of this research is to examine the prevalence of math anxiety.

This chapter will provide a summary of the two completed studies and the prevalence of math anxiety in preservice educators. It will then review the limitations and recommendations. Next, it will address and review the thematic linkages between the chapters. Subsequent to the linkages discussion, the chapter will review the general research implications. Lastly, I will present my 5-10 year plan for future research as it has been shaped by my current dissertation experience.
Summary of Findings of Manuscript #1

The two completed research studies identified the prevalence of math anxiety in educators. Regardless, research in this area remains limited, and further research is needed to discover how extensive the prevalence of math anxiety is in educators. The first study, entitled “Preservice Elementary School Teachers’ Math Anxiety and Negative Experiences as Students in Math Class,” found a prevalence of math anxiety in almost all of the preservice teachers sampled. It was based on the Worst Experience and Most Troublesome Classroom Experience Reflection Test (WMTMCERT), which looks at the number of “worst” math experiences. As collected in this data sample of preservice teachers, 96% of the sampled population reported these experiences. Although this is a small sample size from one region, it shows that an overwhelming number of educators reported a prevalence of math anxiety. This percentage is alarming, and further research would help to discover if educators in many regions experience such anxiety. It is also important to complete further research so that this area of concern can gain more awareness. Finding strategies to reduce math anxiety will be significant for educators and STEM careers. If math anxiety is addressed, American students might be more open to studying and planning careers in the STEM fields. In addition, there may be an increase in academic performance in the US, which would thus increase its educational ranking when compared to other countries. Growth in STEM careers would stimulate the US economy and allow for an increase in technology and innovation. Many of the STEM jobs are fulfilled by foreign workers and not US workers. A study that Atkins and Mayo completed in 2010 stated, “For example, almost three quarters of electrical engineering and two thirds of industrial engineering doctorates are awarded to foreign students” (p. 27). Atkins and Mayo further reported, “The gap between growth in STEM jobs and STEM degrees has been largely filled by
foreign workers” (p. 29). These gaps between growth in STEM jobs are significant, and the US must address the reasons that educators demonstrate a high prevalence of math anxiety. Hence, more research is needed.

Summary of Findings of Manuscript #2

The second research study, entitled “Preservice School Counselors’ Math Anxiety and Negative Math Experiences,” also found a high prevalence of math anxiety in almost all of the preservice counselors sampled. The Abbreviated Math Anxiety Scale (AMAS) indicated that 88% of preservice counselors who comprised the sample population surveyed noted “worst” math experiences. The sample effect was small and limited to one region; however, the results are important because a significant number of preservice counselors reported the prevalence of having a “worst” math anxiety experience. The results of preservice counselors reporting these negative experiences are significant because if foreign workers mainly fill the STEM careers, it is important to address why the number of US professionals in these jobs has declined (Atkins and Mayo, 2010). Counselors are a pivotal point of contact when students decide on a career path or want to explore class options. If preservice counselors demonstrate a high prevalence of math anxiety, how could they address this need in the population they serve? The National Survey of School Counselors, Counseling at a Crossroads (2011) found that a significant number of school counselors were teachers, thus resulting in the compounded impact of math anxiety. Therefore, one would have to ask: If counselor educators have not addressed their anxiety or are unaware of their anxiety towards math, will they encourage students less frequently to explore and select STEM careers/majors or math-based learning? In fact, they may be limited as a resource or support due to their inability to understand high levels of math to encourage STEM careers in their students.
Thematic Linkages

The research question that guided both studies to assess the prevalence of math anxiety looked at the following two significant areas. The first question in both studies collected data on the number of preservice teachers and preservice counselors who reported a level of math anxiety. Both preservice teachers and preservice counselors reported having medium to high levels of math anxiety. Approximately half of the sample of preservice teachers reported a moderate to high level of math anxiety. In the second manuscript, approximately more than half of the sample size reported moderate to high levels of anxiety.

The other significant question in both manuscripts asked how many preservice educators had a worst experience. Both survey samples produced data with high numbers of preservice educators who reported a worst experience. In the first manuscript, data collected on preservice teachers who exhibited a worst experience had a sample proportion of 97%. In the second manuscript, data collected on preservice counselors who exhibited a worst experience had a sample proportion of 88%. Both manuscripts yielded a high prevalence of math anxiety in preservice educators. This dissertation lays a potential foundation for additional important research on why such a prevalence exists. If this question can be addressed through research, better treatment options can be designed and implemented, which could possibly increase overall math performance. These research findings and treatment options can also increase the US ranking in math performance globally, thereby increasing economic success.

Regardless of the small sample size in one region, this study can be replicated in various cities, states, and globally to address math anxiety. These two research studies have indicated the need for help in preservice educators regarding math anxiety, which would be beneficial to
explore further. Additional research can shed light on how much math anxiety prevalence exits, potentially why it exits, and how it can be addressed and treated. Math anxiety research findings are significant for academic performance in the US and throughout the world. It is the hope that these manuscripts can open up dialogue and discussion for further research regarding the prevalence of math anxiety. If the root causes cannot be addressed, many teachers and counselors, if not most, will continue to perpetuate the current cycle of high math anxiety prevalence.

**Limitations**

Three aspects to this study represented threats to the external validity of this research. These aspects all center on the use of a convenience sample readily accessible to the authors. First, the participants were graduate students drawn from a single counseling program located at a public university in the Pacific Northwest. Second, the participants were predominantly Caucasian female students. Third, the participants lived in a suburban region with a high SES. As such, the extent to which this sample of preservice counselors represents all of the preservice counselors in the US is unknown.

**Researcher Perspective**

Based on the research conducted, using survey research methodology and as the writer of both manuscripts, I would be very interested in conducting this type of research in other regions and with various ethnicities. Survey research is interesting and can be time consuming; however, it provides relevant and immediate data regarding people’s experiences. The methodology is not difficult to follow, especially with established reliable and valid questionnaires such as the Abbreviated Math Anxiety Scale (AMAS) and Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT). Utilizing a printing
company is valuable for the optical mark recognition forms (i.e., Scantron) that can be easily completed when conducting survey research, and the data can easily be grouped and compiled. If these causes cannot be addressed, many teachers and counselors, if not most, will continue to perpetuate the current cycle of high math anxiety prevalence.

**Implications for Practice**

Two major implications for practice exist when addressing math anxiety in preservice teachers and preservice counselors. First, this anxiety has a significant impact on the students they teach and for whom they provide guidance counseling because these practitioners are pivotal in the lives of students as role models and professionals. Considering that both teachers and counselors impact student lives and shape them, it is imperative that they address their own individual areas of need and growth. Therefore, if preservice teachers and preservice counselors are struggling in areas that they have not sought to explore, they can negatively impact the students who look to them for guidance and exploration beyond what they may have access to in their lives. If a preservice educators are limited in what they can assist students with due to their own anxieties, they can negatively impact the growth and learning of the very students they teach. Hence, exploration becomes limited for the student.

Second, considering the facts that the US is falling behind in STEM careers, and that this research study found significant math anxiety in a convenience sample in preservice educators at a public university on the west coast of the US, it is possible that these preservice teachers and preservice counselors can negatively impact math exploration in the students they guide. Even though it is not their intent to do so, the students who they instruct are impacted at various grade levels. When considering these impacted groups, these students may also go on to impact other students as they pick their careers if they fail to confront their possible math anxiety. Thus, this
cycle will become perpetuated in education and affect STEM careers and the US economy if other convenience samples are found to have similar results. Another variable to consider is that preservice teachers might not be able to introduce new learning concepts that are math based to students. Similarly, when students turn to their counselors for support, these counselors may not know how to explore higher level academics that require the extensive math skills that the students will need, nor can they show their students how to avoid the hardships that come with high-level math classes. This type of repetitive cycle in students, generation after generation, could cause the US to further decline in math performance or remain in poor ranking. If the research is limited for larger groups of study, and the treatment options to alleviate the prevalence of math anxiety are also limited, it will become even harder to assist the US in competing in the area of math and STEM careers in the global economy. These deficits are serious on both a domestic and global level and must be considered for implications of practice.

**Future Research Plans**

Based on the research conducted, using survey research methodology and as the writer of both manuscripts, I would be very interested in conducting this type of research in other regions and with various ethnicities. Survey research is interesting and can be time consuming; however, it provides relevant and immediate data regarding people’s experiences. The methodology is not difficult to follow, especially with established reliable and valid questionnaires such as the AMAS and WMTMCERT. Utilizing a printing company is valuable for Scantron forms that can be easily completed when conducting survey research, and the data can readily be grouped and compiled.

In terms of future research in the area of math prevalence, my strong desires and interests are to continue addressing how math anxiety exists in many states. It would be enjoyable to
compare states and decipher plausible reasons as to why there are fluctuations or similarities in math anxiety prevalence. If there is a high rate of occurrence in inner cities and multiple states, it would be reasonable for ongoing research to uncover the reason(s) for it. It is important that researchers discover why math anxiety exists in educators, and what the impact is on students. I would also want to research possible treatment strategies for math anxiety to better our educational system. If the 50 states can be researched, and larger deductions about the prevalence of math anxiety can be made, we would be able to address this concern. It would also be important to complete a formal study of whether having math anxiety and or trauma from a worst math experience leads to an unconscious bias that impacts career guidance with students. In addition, studies that look at the inter-relationship between math anxiety, worst math experience, SES, gender, race/ethnicity would be beneficial. The realization and causes of math anxiety prevalence would increase awareness and stimulate other researchers to find possible solutions, a crucial requirement because math performance is significant for access of high-paying jobs, inventions, stimulation of jobs, and economic growth. All of these areas could be highly impactful.

My research agenda would continue to utilize survey research, a methodology that is useful, purposeful, and simple. Another area of research interest for me is the prevalence of burnout in law enforcement. This topic could potentially lead to research in health and disease prevalence in law enforcement. This type of research would assist the community as well as law enforcement agencies and agents.

My hopes and goals for the next 5 to 10 years center on continued research in the area of math anxiety prevalence as well as law enforcement burnout. I have been passionate about access and learning, as well as access, safety, and community awareness regarding mental health
and wellness. Both areas require much-needed and ongoing research. For example, in the realm of math anxiety, if students believe that they are not going to do better in math, and the teaching staff has similar beliefs, the cycle of math anxiety will not improve, and math performance will continue to show a decline. STEM careers and innovation in the US, as well as math performance, will continue to rank poorly. In the realm of law enforcement and mental health, with a prevalence of poor mental health in officers and those who seek mental health services, access, stigma, and poor impact on the community may continue to be issues. Researching this area and demonstrating the need could create more mental health jobs and awareness in these agencies, making individual mental health access mandatory and necessary. Research in this area may lead to many positive changes such as a decline in community violence and a merging of disciplines in the mental health field and law enforcement collaboration. In addition, this merging of disciplines can lead to better overall mental health for individual law enforcement officers. Previous research has indicated that many law enforcement providers do not have the ability to deescalate, and their mode of operating is continuously “flight or fight.” Therapists can assist in providing best practice treatment in this area, but only if further research is conducted. This area will be my strong interest and focus for the next 5-10 years of research pursuits.

When addressing my own experience conducting this research, the process has been positive. I have learned a great deal about the dissertation process including how to structure and write dissertation manuscripts. Each chapter’s organization is shaped section by section and consistent and pleasant guidance from the dissertation Chair. Although for me, this has been a stressful, humbling, and growing experience, I have gained great insight regarding academic research. My anxiety came from the arduous and long process of writing and staying on topic. I tended to wander, focusing on broad topic areas. The dissertation writing process has taught me
how to narrow and focus my research material. The process is exhausting; however, it has assisted in my growth and development in academia. That is one of the most exciting parts of dissertation writing. It has been a grueling task, and getting to the end of it has been an amazing accomplishment.

I found that pencil and paper surveys in person yielded many benefits. I was able to travel, get respite, and meet many people who showed genuine interest in the research that I was completing. Creating a balance between data gathering and respite, I had the strength and motivation to continue and persist. Seeing the importance and value of having this type of research accessible to preservice educators and individuals assisted me as it normalized others’ math anxiety and negative experiences. I also found that survey participants were more likely to complete the surveys when I went in person because a live person requested their assistance. We formed a connectedness that would not have been possible had I used an electronic means to survey preservice educators. I was able to travel to various parts of Oregon and learn about all of the various extended campuses of Oregon State University and the programs they offer to students. The settings are nestled in beautiful nature, which was much needed for such intense surveying and researching. The process of pencil and paper surveying allowed me many opportunities to explore nature while balancing my anxieties. Most of the classrooms that were solicited for research participation were more than willing to participate, and many of the students asked questions about the PhD process and the topic being researched. Students also approached me with questions about entering into a PhD program in their future. The dissertation process allowed me to give back to others on many levels, which made the research process extremely valuable.
Another part of the dissertation process I found thoroughly enjoyable was making the optical mark recognition form (i.e., Scantron) templates through a printing company and submitting them to be printed. I have never done this task before, and it was time consuming and tough initially. I spent an entire morning playing with the printing company’s software in attempts to make these survey templates that surveyors can scan for data when complete. When I completed this job, I felt highly accomplished and excited about all that I had learned. My next step was to have the survey forms formatted with the printing company, and this stage was also exciting and fun. The printing company was able to run all of my data and organize it nicely into files for the statistician. There were many unique layers of learning through this dissertation process. Looking back on it, I find it amazing that I did all of this work and learned so much. It is rather unbelievable, and the dissertation process is a significant reminder that I am this much closer to understanding and doing future research.

I continue to have doubts about my ability to organize and structure research; however, I am much more confident about conducting survey research now. I have learned how to do the following things through participating in the dissertation process: (a) search for reliable and valid questionnaires to support what I want to research, (b) create the templates using a printing company, (c) select and request a survey population, (d) design and create survey forms to be provided to a printing company for production, (e) administer in-person surveys, and (f) have the research complied and formatted to send to a statistician. I have learned survey research methodology well and am eager to replicate it in the future.

In terms of future research in the area of math prevalence, I have a strong desire and interest to continue addressing how math anxiety exists in many states. It would be enjoyable to compare states and decipher plausible reasons as to why math anxiety prevalence can either
remain similar or fluctuate given that education is uniform in the US. If there is a high rate of prevalence in inner cities and multiple states, it would be reasonable for ongoing research to be conducted to uncover the “why” of its occurrence. It is important that researchers understand the reasons that math anxiety exists in educators and the impact on students. I also want to research possible treatment strategies as to why math anxiety has existed for so long without means to decrease it. In addition, I want to research possible treatment strategies and how education can be more competitive in the US. If the 50 states can be researched, and larger deductions about the prevalence of math anxiety can be made, then the concern could be addressed. The increased awareness could stimulate other researchers to find possible solutions. I would be highly intrigued and interested in finding solutions because I believe math performance is significant to access high-paying jobs and to innovate and stimulate economic growth. These areas are highly impactful for the US economy, and they must be considered in ongoing research.
Dissertation Bibliography

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Appendices
Appendix A: IRB Approval Notice
### EXEMPT DETERMINATION

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<td>Study Team Members</td>
<td>Gurpal Gill, Kok-Mun Ng, Manivong Ratts</td>
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The above referenced study was reviewed by the OSU Institutional Review Board (IRB) and determined to be exempt from full board review.

**EXPIRATION DATE: 12/29/2020**

The exemption is valid for 5 years from the date of approval.

Annual renewals are not required. If the research extends beyond the expiration date, the Investigator must request a new exemption. Investigators should submit a final report to the IRB if the project is completed prior to the 5 year term.

Documents included in this review:

- Protocol
- Consent forms
- Assent forms
- Alternative consent
- Letters of support
- Recruiting tools
- Test instruments
- Attachment A: Radiation
- Alternative assent
- Grant/contract
- External IRB approvals
- Translated documents
- Attachment B: Human materials
- Other

**Comments:** Modified questionnaire

**Principal Investigator responsibilities:**

- Certain amendments to this study must be submitted to the IRB for review prior to initiating the change. These amendments may include, but are not limited to, changes in funding, study population, study instruments, consent documents, recruitment material, sites of research, etc. For more information about the types of changes that require submission of a project revision to the IRB, please see:
  
  [http://oregonstate.edu/research/irb/sites/default/files/website_guidancedocuments.pdf](http://oregonstate.edu/research/irb/sites/default/files/website_guidancedocuments.pdf)

- All study team members should be kept informed of the status of the research. The Principal Investigator is responsible for ensuring that all study team members have completed the online ethics training requirement, even if they do not need to be added to the study team via project revision.

- Reports of unanticipated problems involving risks to participants or others must be submitted to the IRB within three calendar days.

- The Principal Investigator is required to securely store all study related documents on the OSU campus for a minimum of three years post study termination.