PERCEPTIONS OF MATH TEACHERS WORKING WITH STUDENTS WHO SUFFER FROM MATH-ANXIETY: A COLLECTIVE CASE STUDY

by

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Liberty University

A Dissertation Presented in Partial Fulfillment Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math anxiety and what best practices are put in place to help reduce math-anxiety. This qualitative study attempted to explain the role of an effective mathematics teacher and the best practices utilized to identify successfully and teach students who suffer from math-anxiety. The focal participants in this collective case study were teachers that were identified by their district leadership team as teachers who successfully implement best practices that support students with math-anxiety in the classroom and empower them to become successful and confident math students. Data were collected through interviews of teachers and students, a focus group of teachers, and students’ writing. All data were analyzed and categorically aggregated by the researcher, and themes were identified as they emerged. This study sought to answer the following questions: how general education teachers from Virginia identify students with math-anxiety, what methods they would consider to be best practices, and what challenges they face when working with these particular students. Bandura’s social learning theory guided this study as teachers learn from observing their students’ behaviors in the classroom environment. Common themes for identifying students with math anxiety across cases were self-esteem, body language, and work avoidance. Patterns considered to be effective best practices are safe classroom environment, small group instruction, chunking content, and building confidence. Future research is recommended to include more cases and to consider the impact of high stakes testing on students with math anxiety.

Keywords: Math-anxiety, intervention, best practices
Dedication

I dedicate this study my husband Pat, my son Patrick, and my daughter Ashley, who have been the driving force behind completing this degree. Pat is my absolute rock in life. Patrick provides tough love and reality, while Ashley provides a listening ear and loving support. I am so thankful for their love, support, and encouragement throughout this entire process. I am also thankful for my parents, who instilled in me the belief in hard work. My dad, Bunk, is in heaven looking down with pride, while my mom, Louise has encouraged me along the way and always reminds me that I can accomplish anything that I set my mind to.

I am thankful to our almighty God. It is always said that with God, all things are possible. Without the power of prayer and the peace that only he can provide, this may not have come to fruition. We serve a mighty God that inspires us to believe in that things that sometimes may seem impossible.

I am also thankful to Dr. Robert Johnson and Sarah Bayer. These are the first two people that encouraged and believed in me when I entered the field of education, and it is because of them that I grew a great love of education. Sarah, my supervising teacher shared her passion and her love for education was infectious. Dr. Johnson was stern but fair and a great role model that I reflect on in my practice daily. It is because of these two people that I grew into an educator who loves working with students and fully believes that all students can learn when provided the opportunity.
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Individualized Education Plan (IEP)

Math anxiety (MA)

Response to Intervention (RTI)

Science, technology, engineering, and math (STEM)
CHAPTER ONE: INTRODUCTION

Overview

The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math-anxiety and what best practices are put in place to help reduce math-anxiety. The gap in literature that led this research is the lack of studies of effective practices and documented methods of how teachers appropriately identify and support students who demonstrate math-anxiety. The focal audience for this study is educators that may encounter students who experience any level of anxiety when encountering math or any other content subject. Bandura’s social learning theory provided the theoretical framework for this study.

This chapter provides a background of the literature and how it relates to the current study. The situation to self addresses my motivation for identification methods and for analysis of best practices that can effectively alter a student’s trajectory in math. The problem and purpose statements are presented along with the significance of the current study, research questions, definitions, and limitations.

Background

Students from elementary school through college may experience varying levels of math-anxiety which may manifest as nervousness, lack of interest, avoidance, or students that completely shut down (Artemenko, Daroczy, & Nuerk, 2015; Henslee & Klein, 2017; Skaalvik, 2018). Math-anxiety has been studied from a psychological viewpoint in an attempt to better understand neurological factors that contribute to anxiety experienced by students (Artemenko et al., 2015). Psychological factors of math-anxiety actually hinder students from being able to learn math skills and cause negative feelings toward math (Shishigu, 2018) and working memory
becomes reduced when the students feel heightened levels of anxiety and their brain’s ability to process information becomes impaired (Henslee & Klein, 2017). Emotional feelings toward math can be directly related to the student’s outcome in math courses. As students are more engaged and are able to experience positive emotions and take pride in their math coursework, their anxiety levels have been shown to decrease while success increases (Villavicencio & Bernardo, 2016).

**Historical**

Math anxiety has been studied over time in an attempt to determine what causes it and how it can be reduced. With all of the research that has been done, there is still no one definitive answer of what causes math anxiety or how it is helped (Dowker, Sarkar, & Looi, 2016; Ramirez, Shaw, & Maloney, 2018). However, some major events such as Sputnik and A Nation At Risk, increased pressure on the field of education as they shed light on the demand for increased rigor in content areas of mathematics and science for a nation to remain economically competitive, and this may contribute to math anxiety (Richerme, 2012). In response to Sputnik, the United States passed the National Defense Education Act in 1958, which provided an incentive to students to enter the mathematics and science fields (Barrett, 2005). The increased demand for students to graduate with higher-level mathematics skills to be competitive in the field of engineering also added pressure for students to perform. Standards, Accountability, and standardized testing would again increase added pressure as the nation reacted to the publication of A Nation At Risk in 1983, which pushed education through the Excellence Movement, Restructuring Movement, and the Standards Movement (Hunt, 2008). These accountability structures and excessive amounts of pressure for students to perform came full circle with the No Child Left Behind Act (NCLB) that was passed in 2002 (Heise, 2017). This act brought
accountability in education to the forefront, with standardized and high-stakes testing being the centerpiece (Gary, 2005; Jain & Dowson, 2009). Districts, schools, and students immediately felt the added pressure of testing for federal accountability as gaps and gap groups were exposed. Gap groups such as economically disadvantaged, Black students, and students receiving special education services lagged behind the other subgroups of students (Linn, Baker, & Betebenner, 2002). These gap groups identify many factors such as poverty and access that are outside of a student’s control while still adding another layer of pressure to meet those high expectations of academic performance (Tuerk, 2005).

Science, technology, engineering, and math (STEM) careers were becoming a focal point as there was a push for the United States to remain competitive in technology as they were once deemed superior and had now fallen behind (Beilock & Maloney, 2015). Some of the same groups of students who were identified as gap groups for federal accountability are also identified as underrepresented groups in the STEM field. Programs and mentorships were created to increase minority participation in STEM-related career paths (Carpi, Ronan, Falconer, & Lents, 2017). Students who suffer from math anxiety and have a negative outlook on mathematics in general and their ability to problem-solve have been shown to avoid higher-level mathematics classes as well as those career fields (Beilock & Maloney, 2015). While there may be no single, definitive answer to what causes math anxiety, these federal movements and events in education have increased the level of burden on students as they fall behind the expectations (Abramson, 2003).

**Social**

Math-anxiety can have many contributing factors and may manifest itself in many different ways. Various coping strategies have been utilized to combat the symptoms of math-
anxiety and help students experience higher levels of success (Shishigu, 2018). Some of the strategies that have been studied are student avoidance due to poor performance (Skaalvik, 2018), using brief guided imagery to improve visual working memory (Henslee & Klein, 2017), teacher motivation (Raufelder, Regner, & Wood, 2018), and student support groups that may improve self-motivation (Shishigu, 2018). When the learning environment is conducive to allowing students the opportunity to interact with other students, it has been shown to have a positive effect on student levels of anxiety (Deieso & Fraser, 2019). Students communicating about math through deep and rich conversations about math methods, ideas, and their own perceptions about problems has been known to open up opportunities for students to share mistakes which can create opportunities for better understanding which relieves anxiety as confidence builds (Andersson, Valero, & Meaney, 2015; ). Teachers have used a variety of flexible group methods to attempt to meet the needs of all learners and create learning environments that are more inclusive to all students and promotes high levels of engagement (Boyd & Ash, 2018).

**Theoretical**

Bandura’s social learning theory will guide this collective case study as we examine the students' experience in math class and how their interactions with other students and their learning environment affect their overall anxiety level (Bandura, 1977). “Schools are now considered to play a vital role in the identification and management of children’s mental health, yet little research has examined teachers’ sensitivity to their pupils’ internalizing symptoms” (Neil & Smith, 2017, p.1184). Most teachers are able to identify students who suffer from math-anxiety when they display outward physical symptoms such as crying or acting out. More experienced or seasoned teachers may be able to recognize when students mentally shut down or
begin to internalize their emotions and frustrations when they are faced with math-related activities and become frustrated (Neil & Smith, 2017). Bandura’s theory states that people learn through observation and self-regulation, and in this case, the teachers are learning about their students (Bandura, 1977). Students who experience math-anxiety must be identified before any interventions, or alternative methods can be implemented. The problem is that research is limited in terms of how teachers perceive their abilities to recognize students who have math-anxiety and identify successful best practices that are believed to improve the student’s overall anxiety level towards math. Math teachers and other core content teachers could benefit from the case study as it will investigate how math teachers’ perceptions and their experiences have helped them to identify students who suffer from math-anxiety. Identification and discussion of strategies and methods that have served as best practices that can be replicated in other math or any content-related classrooms could prove to be beneficial.

**Situation to Self**

The motivation for this case study was to gain an in-depth understanding of how these math teachers are able to identify and effectively serve students who suffer from math-anxiety. I currently serve as a math coach and have served as a classroom teacher of middle school mathematics for eight years. I have experienced and have had success helping students who suffer from math-anxiety; however, I am not an expert in this area. I was able to compare my personal experience with the experience of these teachers for the purpose of helping other teachers better understand how to identify and help students in their own classrooms who are exhibiting signs of math-anxiety.

My ontological assumptions include that I believe that this study will reveal multiple realities as people will have different perspectives on the causes of math-anxiety epistemological
assumptions include that I recognize the importance of working closely with the teachers in my case studies to better grasp what the reality is (Creswell & Poth, 2018). My axiological assumptions include that I am an advocate for all students having access to mathematics in a non-threatening or scary way. My rhetorical assumptions include that I wrote and reported the truth as the participants believe it to be their reality. I believe in equity in learning and that when students are anxious about math, it hinders their ability to have full access. Furthermore, I believe that there is a need to identify best practices in identifying and responding to students who are suffering from math anxiety (Creswell & Poth, 2018). I utilized my prior knowledge and experiences as a teacher who has worked with students who suffer from math anxiety as a guide my analysis of the data (Yin, 2009).

I applied a social constructivist approach as I sought to better understand how other teachers identify and successfully work with students who experience math anxiety in a content area that I am so interconnected with (Creswell & Poth, 2018). Furthermore, post-positivism guided the study as I used a systematic approach to link the cause-and-effect relationship within the data. The actual words and perspectives of these math teachers and other stakeholders, in this case, were used to help assemble a collective view of what allows these math teachers to effectively identify and work with students who exhibit math-anxiety (Creswell & Poth, 2018). I examined perceptions and experiences of the teachers and other stakeholders in this case study using broad questions to gain a deeper understanding of their beliefs and how the teachers’ reactions to students evolve as they work more extensively with students who they have identified that suffer from math-anxiety (Creswell & Poth, 2018).
**Problem Statement**

“Mathematics anxiety is a pervasive issue in education that requires attention from both educators and researchers to help students reach their full academic potential” (Ramirez et al., 2018). At this point, much of the research about math-anxiety has been focused around the connection of math-anxiety and math performance and has been from the student’s perspective (Beilock & Maloney, 2015, Brandenberger, Hagenauer, & Hascher, 2018) or has been quantitative in nature (Shishigu, 2018; Skaalvik, 2018; Sorvo et al., 2019) and there has been little to no qualitative research done with the teachers’ perspective and experience of identifying and working with students with math-anxiety. Student’s perceptions of teachers are quickly formed based on their communication and tone of response in the classroom and therefore define the teacher’s teaching style to the student (Lin, Durbin, & Rancer, 2017). Research shows that most teachers only recognize the most outward signs of anxiety, and further professional development or training may be needed to help teachers become more aware of students suffering from math-anxiety in their classrooms (Lukowski et al., 2019). The problem is that many students who suffer from math anxiety are not being identified by their teachers. Further research could provide the teacher’s perspective on what characteristics are present and how they identify students who they suspect are suffering from math anxiety. This could provide an in-depth understanding of best practices to identify and reduce math anxiety among students.

**Purpose Statement**

The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math-anxiety and what best practices are put in place to help reduce math-anxiety. These collective case study participants were identified by the district-level math
leadership team, have a minimum of three years of teaching experience, and have demonstrated success in helping students who exhibit math-anxiety. At this stage of the research, math-anxiety is generally defined as “feelings of nervousness and tension interfering with manipulating numbers and solving mathematical problems” (Sorvo et al., 2019, p.173). Perception is defined as personal beliefs, ideas, and understandings gained through personal experience (Benson, 2017). The theory that guided this study is Bandura’s social learning theory as it relates to explaining a connection between human behavior and environmental influences. Through direct experience, teachers observe behaviors and adapt lessons and environments to meet the needs of the students in their classrooms that are suffering from math-anxiety (Bandura, 1977). This directly relates to strategies and best practices that are put into place to decrease the anxiety of students who are experiencing math-anxiety. As teachers gain more experience successfully working with students who exhibit signs of math-anxiety, they will learn through their own experiences, interactions, and modeling behaviors with the students on how to best serve those students (Grusec, 1992).

**Significance of the Study**

The study potentially has empirical significance to math teachers and educational leadership as this study builds on current research. It adds the perspective of math teachers as well as identify the best practices that have been documented to be effective for those teachers. It provided insights into how math teachers may identify students that have math-anxiety (Neil & Smith, 2017). Furthermore, the study explored the teacher’s perception of how students that experience math anxiety are identified and how best practices are utilized to combat math-anxiety (Sharp, Bonjour, & Cox, 2018) in order to improve student attitudes toward math (Lukowski et al., 2019) and implement tools or strategies to help students overcome or lessen
their anxiety level (LaGue, Eakin, & Dykeman, 2019). Coping strategies were scrutinized to determine which strategies, such as self-protective or self-coping, proved to be most successful in reducing math-anxiety (Skaalvik, 2018). The research fills a gap in the literature and give a voice to math teachers who work with students who suffer from math-anxiety.

The theoretical significance of this study may help educators, and educational leadership better understand the importance of the perception of the math teacher and the impact of their role as first contact or responder to this display of anxiety by the student (Neil & Smith, 2017). Teachers may benefit from drawing on their personal experiences for the purpose of better understanding their roles and their overall impact when working with students that suffer from math-anxiety (Bandura, 1977). Teacher self-efficacy and the ability to model a positive approach to mathematics are necessary for teachers to convey confidence to their students (Lotter et al., 2018). “Personality of educators and teachers is one of the most important factor influencing the process of social learning in school and preschool age” (Marić et al., 2017, p.238). The ability to have a better sense of and recognize the needs of students who suffer from math anxiety and the competence to self-regulate their own behaviors, responses and offer different teaching models to meet the needs at the moment will increase their power and value as math teachers (Grusec, 1992).

This study may have practical significance for current, and future educators as the findings may be used to help other teachers better serve students that suffer from math-anxiety. Looking at students and math-anxiety through the lens of a math teacher may help new and veteran teachers be able to better identify students who are experiencing math anxiety and provide the teacher the opportunity to implement best practices. Educational leadership may be
able to utilize the information gained through this study to provide professional development and tools to classroom teachers to help students (Ramirez et al., 2018).

**Research Questions**

The following questions were used to guide the study to better understand the perception of the math teacher and their experiences working with students who suffer from math-anxiety.

**RQ1:** How does a general education secondary math teacher from Virginia identify students with math-anxiety? A case study will allow for an in-depth understanding of how multiple teachers recognize signs or symptoms of math-anxiety within their own natural setting of the classroom (Yin, 2009). This question seeks to investigate how teachers would identify and what specific symptoms they may look for in students that are exhibiting math-anxiety (Neil & Smith, 2017).

**RQ2:** What are some methods and techniques that teachers utilize to improve the students’ experience with math to decrease their level of math-anxiety? It is necessary to implement some form of intervention to aid the student in overcoming math-anxiety (Brandenberger et al., 2018). It is important for teachers to realize the extreme number of interventions that are available as students with math-anxiety are not a one size fits all situation, and multiple methods may be needed (Boyd & Ash, 2018; LaGue et al., 2019; Shishigu, 2018).

**RQ3:** What are some challenges that teachers experience when working with students who suffer from math-anxiety? A broad question will prompt teachers to reflect on their own practices and gain knowledge through their personal experiences. This question seeks to gain insight into what teachers perceive their weaknesses to be and to better understand what they believe to be effective and true (Neil & Smith, 2017).
Definitions

1. **Math-anxiety** - “Math-anxiety is commonly defined as a feeling of tension, apprehension, or fear related to working with mathematical problems or manipulation of numbers” (Skaalvik, 2018, p.712). It is also associated with negative feelings and emotions toward the subject of math which causes avoidance (Shishigu, 2018).

2. **Case Study** – “A social science research method, generally used to investigate a contemporary phenomenon in-depth and in its real-world content” (Yin, 2018, p.286).

3. **Math attitude** – A student’s emotions and beliefs about their ability in math (Chen et al., 2018; Lisciandro, Jones, & Geerlings, 2018).

4. **Adaptive Coping Strategy** – Strategies “that may increase learning and improve a child’s chances of doing better at the task in subsequent attempts” (Skaalvik, 2018, p.713).

Summary

This chapter provided the background for this collective case study. Math teachers are faced with the challenge of working with some students who experience and exhibit varying degrees of anxiety related to math. The problem is that students who suffer from math-anxiety need to be examined from the teacher’s perspective because there is limited, if any, research to give a voice to the teachers that are directly impacting these students. The purpose of this collective case study was to develop an in-depth understanding of how general education secondary school math teachers effectively identify students who suffer from math-anxiety and what best practices are implemented to reduce levels of anxiety. The theory guiding this study was Bandura’s social learning theory, as it connects human behavior, environmental influences, and how teachers learn from and expand their knowledge through their own experiences.
(Bandura, 1977). This study fills a gap in the literature because there is currently no focused research on the teachers’ perspective and methods of identifying students with math-anxiety.
CHAPTER TWO: LITERATURE REVIEW

Overview

The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math-anxiety and what best practices are put in place to help reduce math-anxiety. An analysis of the current literature was completed in this chapter. The literature reveals that math-anxiety has been studied from many views (Artenenko et al., 2015; Recber, Isiksal, & Koc, 2017; Skaalvik, 2018) but little if any have addressed the perspective of the math teacher and how they identify students that suffer from math-anxiety (Neil & Smith, 2017). Most of the research focused on working memory (Caviola, Carey, Mammarella, & Szucs, 2017) and processing speeds (Beilock & Maloney, 2015) as specific deficits that occur when a student is anxious about math-related tasks. Psychological testing such as personal rating scales and aptitude tests have also been used but may not be effective for young students or may not be readily available to classroom teachers (Suárez-Pellicioni, Núñez-Peña, & Colomé, 2016). Teachers have been identified as the most likely persons to identify students with math-anxiety because, according to Neil and Smith (2017), “They may be ideally placed to pick up on social anxiety, for example, because of their opportunity to observe peer interactions and children’s behavior during social and academic challenges such as speaking in front of the class or tests” (p. 1178). The ability of teachers to identify students who are suffering from math anxiety and understand the best practices for intentional, targeted intervention may prove to be most beneficial for students, and research at the middle-grade levels is limited.
Theoretical Framework

Bandura’s social learning theory guided this intrinsic case study. This collective case study examined teachers’ perceptions as they relate to teaching students who exhibit symptoms of math-related anxiety or students that they have identified as having some level of math anxiety. Bandura theorized that learning actually occurs through observation, self-evaluation, and self-regulation (Bandura, 1977). When teachers model specific strategies and behavior and then reflect and respond with adjustments based on their experience and observation in the moment, they may gain a better perception of which interventions or methods are effective versus which are not (Bandura, 1978). Teachers with higher self-efficacy are better able to bring a positive approach with a level of open-mindedness that all students can learn math when given the right instructional strategies along with scaffolding (Bandura, 1993). Teaching and learning are both considered social in nature (Kim & Baylor, 2006), and the relationship between the student and teacher can be compared to other leadership models as the students look to the teacher as a role model (Mayer, Kuenzi, Greenbaum, Bardes, & Salvador, 2009).

A student’s perception of their relationship with the math teacher may impact their overall ability to perform mathematics as well as shape their confidence with which they approach problem-solving. Whether a positive or negative relationship exists may influence the manner that students interact with math content (Zee & de Bree, 2017). Teachers model behavior and set goals for students; however, the learning in this study is within the pedagogical process as the teacher is the learner as they strive to increase their instructional skills (Lotter et al., 2018). When teachers set high expectations for their students, it demonstrates high levels of belief and confidence that the teacher has in their students (Gershenson, Holt, & Papageorge, 2016). When students struggle with math, teachers that change their methods or intervention strategies rather
than lower their expectations make more positive gains in their relationships with their students because their belief in the student’s ability is kept intact (Lisciandro et al., 2018). A teacher’s belief in their student’s ability to learn is as important to the learning process as the student’s belief about their own ability (Ardasheva, Carbonneau, Roo, & Wang, 2018). When students’ or teachers' self-efficacy declines, their performance tends to decline as well (Bandura, 1993). As teachers make adjustments to intervention strategies while maintaining their belief in the student’s ability, they are modeling the growth mindset by continuing to help the student believe that they can, in fact, learn anything with the appropriate tools (Collie, Martin, Bobis, Way, & Anderson, 2019).

Bandura’s social learning theory states that learning occurs as a response to experience (Bandura, 1978), and classroom teachers are the most likely people to identify students who are experiencing math related anxiety (Neil & Smith, 2017). Although all students with math anxiety are not identified in the classroom, Neil and Smith’s study revealed some common themes. “The six themes they identified were impact on learning, atypical child behavior, repeated difficulties without improvement, a poor response to strategies, teachers’ need for support, and information from parents and careers” (Neil & Smith, 2017, p. 1178). Teachers who work with students who suffer from math anxiety are learning by direct experience when their students encounter situations that may positively or negatively impact their overall experience with math (MariĆ et al., 2017). How a teacher chooses to respond to a situation, whether negatively or positively, may determine the level of anxiety that a student will experience toward math (Caviola et al., 2017). When teachers react with judgment when a student answers incorrectly or does not perform to their expectations, the student may begin to feel hopeless in their ability as social pressure mounts. They may begin to believe that they are incapable of ever being successful academically.
and develop negative emotions toward math specifically (Heyder & Brunner, 2018). Supportive responses are needed for students to feel capable and not helpless. Teachers learn which supportive responses may work in relation to math anxiety as they increase their familiarity with their students and better understand what they believe to be the underlying cause of anxiety (Neil & Smith, 2017). Students who receive negative feedback routinely or even once that cause them increased anxiousness or feelings of being incapable, may become overwhelmed with negativity and move forward with hopelessness in regard to math or any content that they feel is difficult or above their ability level (Lisciandro et al., 2018). In response to these types of actions or reactions from students, teachers may put supports in place that empower their students to become more confident learners of math content (Lin et al., 2017).

The classroom teacher is also a learner and is motivated by the challenge of helping students who suffer from math anxiety experience new found success (Passolunghi, Caviola, De Agostini, Perin, & Mamarella, 2016). Motivation is a cognitive process, and increases as goals are met, new levels of success are attained, or positive emotions are felt (Bandura, 1993). Teachers can only effectively help students when they are confident in their ability to provide scaffolded layers of instruction or intervention that allow them to successfully help their students (Lotter et al., 2018). When teachers are working with students, they are learning from their personal experiences at the moment with those students, and then the learning continues after by the teacher using self-reflection (Martin & Martin, 2016). The practice of using inquiry in the classroom has been shown to improve thinking and learning in math as students are able to share their own experiences and collaborate with the teacher and their peers about how those experiences have shaped their thinking (Lotter et al., 2018).
Self-efficacy is a powerful influence on the cognitive process and may influence learning and decision-making. When teachers are reflective in their practice and can determine what drives their success, they become more strategic and sometimes even competitive with themselves to become masters of their teaching methods (Bandura, 1993). Weak self-efficacy has been shown to have negative effects on the classroom environment as the teacher lacks the self-confidence and belief that they can help all students be successful (Lavasani, Hejazi, & Varzaneh, 2011). Bandura states that when people learn from the consequences of their actions and their reactions that true learning occurs (Bandura, 1978). Teachers who are experienced with working with students who exhibit signs of math anxiety may use self-regulation in response to what they have gleaned as part of the self-reflection process to introduce or reinforce what they deem to be useful methods of instruction. Methods and interventions that have been previously identified as successful may become their bag of tricks when working with other students who may be suffering from math anxiety (Martin & Martin, 2016). Teachers may feel social pressure to perform at a certain level or have their students perform at a high academic level that will set the teacher apart from other teachers, therefore, allowing them to gain social recognition or rise within the social hierarchy of a school community (MariĆ et al., 2017).

Related Literature

Math-anxiety has been studied from many viewpoints. Psychologically, math-anxiety has been studied to determine what happens in the brain when math-anxiety occurs (Caviola et al., 2017; Skaalvik, 2018). Working memory and its reduced capacity to access and operate have been identified as a prominent reason for math-anxiety (Caviola et al., 2017; Herts & Beilock, 2017). Timed tests and added pressure are often experienced when students are attempting math tasks (Caviola et al., 2017; Stoehr, 2017), and this contributes to the level of anxiety and negative
attitude that surrounds math (Lisciandro et al., 2018). Research has also been completed that shows a connection of math-anxiety to math performance and how these may be considered bidirectional as performance impacts math anxiety, but math anxiety may also impact performance (Recber et al., 2017; Zee & de Bree, 2017). Parental attitude and their own ability to perform mathematics tasks have also been identified as a contributing factor to some students who suffer from math anxiety and maintain negative attitudes toward math as they are mirroring their parents' beliefs (Soni & Kumari, 2017). Social pressures to perform well and be academically competent among their peers have also been recognized to contribute to math anxiety. In a reaction to these pressures felt by students, they may use coping strategies such as acting out, work avoidance, or other behaviors which will remove attention from the failure that they may be experiencing academically in the classroom (Skaalvik, 2018).

Causes of Math-Anxiety

Mathematics anxiety has been reported to have many causes without any specific definitive answer that fits all cases. Working memory and reduced capacity of working memory get much of the attention for causing math anxiety. Research has shown that there is a connection between working memory and math anxiety (Herts & Beilock, 2017, Namkung, Peng, & Lin, 2019, Passolunghi et al., 2016, Suárez-Pellicioni et al., 2016). “Working memory, the system that organizes and stores information for short periods of time, has been found to moderate the relationship between anxiety and performance” (Herts & Beilock, 2017, p.719). Math anxiety has been shown to have a large impact on the working memory (Namkung et al., 2019) because computation and basic math recall can require a large capacity of working memory to be available and access to prior knowledge in order for students to complete a math task (Caviola et al., 2017, Ng & Lee, 2010). Working memory has been tested using various
working memory tasks, including short and long-term memory skills, recalling information that is necessary when performing basic math skills, and more complex problem solving (Passolunghi et al., 2016). When anxiety is present, the capacity for working memory becomes reduced, thus making the process of math more difficult for students with math anxiety as they also have limited recall (Passolunghi et al., 2016).

Students who lack effective problem-solving skills or efficient strategies and the tools necessary to chunk problems into what they can reasonably work through often experience heightened levels of anxiety. As students begin to feel math-related anxiety and their working memory and processing becomes diminished, it has been said to be metacognitive blindness as they are so limited in what they can actually see or have access to in their memory (Faradiba, Sa’dijah, Parta, & Rahardjo, 2019). Although much of the research has focused on students in lower grade levels who experience math anxiety, it has been shown that students in all grade levels dealing with more complex math versus basic math computations skills demonstrate higher levels of anxiety (Namkung et al., 2019). As a student’s anxiety level is heightened when charged with tasks that are perceived difficult for them or require problem-solving and multiple steps, their working memory is significantly decreased, and cognitive function has been shown to suffer, resulting in poor academic performance (Herts & Beilock, 2017; Passolunghi et al., 2016). It may be necessary for students to learn coping skills that allow them to access math on a different trajectory to lessen the level of anxiety experienced so that they may remain focused to complete the problems. Strategies may need to be individualized based on student need and their ability to break apart math tasks into smaller tasks that they are able to work with (Caviola et al., 2017).
Social pressure and general expectations of student ability may also be associated with math anxiety (Caviola et al., 2017). When students feel pressure from their friends or classmates to meet certain academic standards and fall short, math anxiety can be experienced (Passolunghi et al., 2016). High-stakes testing and the pressure to achieve higher proficiency levels in order to access advanced classes or gifted programs may cause higher levels of anxiety among students who seek to enter those programs or have those expectations from their parents (Foley et al., 2017a). People are often associated with either being good or bad at math, which translates to being a math person or not being a math person (Andersson et al., 2015). When students feel social pressure, not only do they experience cognitive limitations, but their overall level of motivation and desire changes (Caviola et al., 2017). Students sometimes find themselves in a competitive situation in the classroom which also can cause anxiety if they are not confident in their ability (Shishigu, 2018). Students who suffer from math anxiety may choose not to participate in higher-level math courses based on their fear of failure rather than their overall ability to perform academically (Pizzie & Kraemer, 2017). Math anxiety experienced in school that affects the overall desire for students to engage in higher-level math content has been shown to translate to adulthood and the overall avoidance of careers that require math skills or specific levels of math background (Huang, Zhang, & Hudson, 2019). The overall structure of the classroom can contribute to the competitive feel in the room as well as the goal structure and how students perceive their teacher’s expectations which ultimately may determine the level of math related anxiety that some students may experience (Skaalvik, Federici, Wigfield, & Tangen, 2017).

Classroom environments have been shown to have an impact on student participation, engagement, and attitude toward the class (Deieso & Fraser, 2019). How safe and welcoming a
classroom environment is and the expectations in which a teacher sets for their students may determine the tone for how students react toward math and their future effort in that class (Heyder & Brunner, 2018). If a teacher responds negatively or provides harsh feedback to a student, or allows other students to make negative comments when the student is attempting to participate in math, this increases anxiety levels and results in an unpleasant environment for that student (Suárez-Pellicioni et al., 2016). Research has shown that there is a decline in students' attitudes toward learning environments from the primary years to the secondary years and is attributed to the change in the physical classroom environment as well as teachers not being as warm and nurturing (Deieso & Fraser, 2019). The teacher’s beliefs about the student’s capabilities and level of encouragement or discouragement can directly impact how the students view math and their level of math anxiety. When teachers do not believe that their students can perform, students will also accept the same belief in many cases (Gershenson et al., 2016). Teacher’s beliefs in their student’s abilities and attitude toward math, in general, may stem from their own personal negative experiences in math when they were in school and their own inability to successfully problem solve and make sense of math (Faradiba et al., 2019).

Secondary level math classes tend to be more goal structured and oriented than some other content classes; therefore, the added structure and expectations may also contribute to heightened levels of anxiety (Skaalvik et al., 2017).

In relation to some math anxiety, Cropp (2017) stated, “This anxiety arises from cultural beliefs such as ‘only clever people can do mathematics,’ which can lead to math phobia” (Cropp, 2017, p.483). This is an example of how social pressure to be smart and successful can contribute to a student’s overall self-reflection, self-worth, and how they view their own capabilities in relation to math (Caviola et al., 2017). The age-old thought that boys are good at
math and girls are not still may be a lingering mental thought due to it being a trend for such a
significant amount of time and although there has been significant focus and intentionality in
trying to highlight girl’s abilities in math, the shift may be less than expected (Huang et al., 2019;
Rubinsten, Marciano, Eidlin Levy, & Daches Cohen, 2018). Gender differences in math have
been shown to be more related to self-esteem than biological gender (Xie, Xin, Chen, & Zhang,
2019). Teachers are often the frontline of identifying students who are suffering from any level
of math anxiety and are instrumental in putting interventions in place to help alleviate anxiety;
therefore, learning environments and classroom teachers have a large impact on student

Math anxiety has also been shown to have a strong correlation with academic
performance levels in math (Schillinger, Vogel, Diedrich, & Grabner, 2018). Emotional and
physiological changes happen when students are faced with math anxiety that is often out of their
control (Foley et al., 2017a). Anxiety causes students to self-doubt, feel defeated, and become
disengaged in the learning process to the point that their performance in math falls well below
success, and this can become cyclic as anxiety drives poor performance and performance drives
anxiety (Namkung et al., 2019). Research indicates that students who routinely experience low
performance on math tasks and assessments often suffer from some level of math anxiety
(Gershenson, Holt, & Papageorge, 2016, Sorvo et al., 2019). Another reason for poor
performance can be a result of students that have fallen behind in the curriculum or have gaps in
their knowledge (Namkung et al., 2019). Gaps in math content can be more punitive than other
subject areas due to the manner in which math scaffolds and builds upon each concept. Students
who have missing chunks of knowledge may have experienced a bad year, or they may be
among some of the subgroups that are often identified as missing prior knowledge, experience,
and exposure (Gershenson et al., 2016). Significant gaps in content knowledge may prove to be an unsurmountable hurdle in math as teachers do not have time to go back and reteach skills that are missing, and students fall further behind and often become even more frustrated and anxious (Caviola et al., 2017). Students who struggle with content and are unable to perform in math class are often the students who experience higher levels of math related anxiety (Henslee & Klein, 2017). Students who are missing gaps of information and experience math anxiety may struggle to experience success unless they are identified early and receive appropriate intervention to address both the math skills that are needed as well as coping strategies for their anxiety (Caviola et al., 2017).

Math performance and math anxiety have been said to be bidirectional as they have a reciprocating effect on each other (Martin & Martin, 2016). As students become increasingly frustrated when trying to solve a math problem that may seem impossible, their level of anxiety rises. Conversely, when students who typically perform well in math are faced with an assessment that causes higher levels of anxiety, their performance may suffer (Herts & Beilock, 2017). Students that are academically strong and suffer only on math tests may suffer from test anxiety versus math anxiety due to the high stakes feel of testing. Teachers will have to recognize the difference between test anxiety and math related anxiety considering if students are struggling in the classroom on all math related content only when facing an assessment (Lukowski et al., 2019). Students at all academic achievement levels may suffer from math anxiety, but for many different reasons. Students who are generally low performing experience anxiety due to inability to do the math, while students who are higher performing experience anxiety as a result of the pressure to meet higher expectations from themselves, parents, and teachers (Luttenberger, Wimmer, & Paechter, 2018).
An indicator for poor math performance and negative emotions towards math may be the rooted in the students' past academic performance in math (Lukowski et al., 2019). When students have had negative experiences in math, they often have negative feelings about completing any tasks that are math-related and may encounter feelings of anxiety toward math (Beilock & Maloney, 2015). A student's self-motivation and confidence level are often determined by the level of math anxiety that the student has experienced in math (Brandenberger et al., 2018). A student's level of motivation often affects how they approach any task in math, and the outcome is sometimes set in their mind before they ever fully engage with the task (Luttenberger et al., 2018). Students who are chronic low achievers in math are more likely to experience negative emotional thoughts, feelings of low self-worth, lack of motivation, and increased levels of math related anxiety (Heyder & Brunner, 2018). Students who experience higher levels of motivation tend to be more invested and willing to put in more time and effort when working with problems that require more focus and experience lower levels of anxiety (Luttenberger et al., 2018). Students who have a fixed mindset rather than a growth mindset are more likely to experience anxiety related to math as their fixed mindset does not allow them to fully recognize the possibilities of academic growth in mathematics (Huang et al., 2019).

Timed tests and high-stakes testing have also been to blame for some students who suffer from math anxiety (Nortvedt & Buchholtz, 2018). There is a direct correlation between timed tests and math anxiety in students who experience slower processing speeds (Namkung et al., 2019). The test being timed adds another layer of added pressure for the student, which increases their overall anxiety level and diminishes their working memory capacity preventing them from being able to access prior knowledge and the problem-solving skills needed (Soltanlou et al., 2019)(Caviola et al., 2017). Even when students are known to be good math students, they may
experience much higher levels of anxiety during a timed test (Suárez-Pellicioni et al., 2016). Students may take alternate paths and make different decisions based on time constraints, and their inability to chunk information and determine the best strategy could affect the ability to problem solve (Caviola et al., 2017). Standardized tests are required at some state and district levels to evaluate student academic performance in relation to other peers of their age; however, these tests do not take into consideration that students have individual learning styles and needs and that a one size fits all test can cause high levels of anxiety (Stoehr, 2017). The formatting of high stakes testing tends to be very different than the open-ended, inquiry, or project-based learning that occurs in math classrooms on a daily basis, and the increased level of vocabulary beyond what many students are exposed to can have a large effect on how students feel and engage with the test (Caviola et al., 2017). Although students may be well versed in the content being tested, high-stakes testing has been shown to contribute to an overall negative attitude toward math (Pizzie, 2018). It has also caused increased levels of anxiety toward math due to the excessive pressure that is placed on students and teachers for one cumulative test (Larkin & Jorgensen, 2016).

Math anxiety may even be considered to be a hereditary trait (Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015). Students have repeatedly told teachers that they are not math people because their parents were not good at math, and surprisingly this could have some truth to it, but it is not that simple. Parents can pass on to students general anxiety, negative attitude toward math, and general dislike for the subject, which may contribute to the overall inability to perform well in math (Soni & Kumari, 2017). Parenting style and parent’s beliefs about their child’s ability to do math can have an impact (Macmull & Ashkenazi, 2019). The research has not revealed a genetic connection between a parents’ ability to do math and
students, nor has it demonstrated a direct connection of genetically passed down specific math-related anxiety (Lukowski et al., 2019). Generalized anxiety is more likely to be a hereditary trait versus anxiety that is specifically math-related in nature (Luttenberger et al., 2018). When parents share their experiences and struggle with math with their children, it may cause the child to have negative emotions and decreased confidence in being successful themselves (Maloney et al., 2015). While there are no genetic predispositions (Dowker et al., 2016) for students to be bad at math or suffer from math anxiety, the trait is often shared as parents exhibit their own anxiety when talking about math or when trying to help their children with math homework (Maloney et al., 2015). In the same manner, in which children learn habits from parents, they may develop learned helplessness in math as they deem themselves to be unable to do math because they are associating their own ability with that of their parents. When children sometimes share their parent’s negative attitude and feeling of helplessness in relation to math, it will often result in the child experiencing math-related anxiety (Mammarella, Caviola, Giofrè, & Borella, 2017). Their perception of their own inability becomes a reality as their attitude affects their ability to be successful in math (Soni & Kumari, 2017).

**Identifying Math-Anxiety**

Researchers have used neuropsychological testing, and a variety of math anxiety rating scales to identify students who suffer from math anxiety based on reading comprehension, reasoning skills, and working memory capacity (Chen et al., 2018). Psychological responses to behavior and interactions with the environment have been studied to determine if students are experiencing any signs of math-related anxiety (Kelly, Rice, Wyatt, Ducking, & Denton, 2015). Additional physiological testing may include intelligence testing, personal rating scales, and IQ testing along with full MRI scans of the brain with imaging to help further evaluate the level of
math-related anxiety and how the brain responds to math-related stimuli (LaGue et al., 2019, Pizzie & Kraemer, 2017). Electroencephalograph (EEG) has also been used to measure brain wave activity when students are competing in math tasks, and those results were then compared to self-reported rating scales (Choi-Koh & Ryoo, 2019).

Rating scales have often been used to identify students who are suffering from math anxiety. Some of the rating scales that have been used in an attempt to identify and measure levels of math anxiety include the Math Anxiety Rating Scale (MARS) (Shishigu, 2018), the Math Anxiety Scale for Students (MASS) (Ko & Yi, 2011), and the Abbreviated Math Anxiety Scale (AMAS) (Hopko, Mahadevan, Bare, & Hunt, 2003). The MARS was the first formal instrument developed to measure math anxiety based on the participants' response to 98 questions that determined their level of anxiousness in relation to math-related problem solving (Pizzie & Kraemer, 2017, Suárez-Pellicioni et al., 2016). The AMAS was developed specifically for students and has been shown to be effective with middle school students (Choi-Koh & Ryoo, 2019). The AMAS is a short, adapted version that has been shown to be effective with children (Hopko et al., 2003). School psychologists may be a resource when trying to identify students who are experiencing math anxiety or psychological stress, which may lead to health and self-esteem issues if support is not put into place to meet the needs of the individual student (Raufelder et al., 2018). Psychological symptoms may include outward displays of nervousness, shame, worry, or helplessness, while physical symptoms may include sweating, rapid heartbeat, and upset stomach (Kelly et al., 2015).

What math anxiety looks like could vary from student to student, and there is not a guidebook or teaching tool that specifically states how to identify students with math anxiety. Teachers are in a role where they have the opportunity to compare students of the same age and
with similar experience levels (Neil & Smith, 2017). “A limited number of studies have investigated teachers’ abilities in recognizing anxiety symptoms in their pupils, by comparing children’s self-reported anxiety levels with teachers’ nominations of the three most anxious children in their class” (Neil & Smith, 2017, p. 1177). Outward emotions and signs of stress such as shutting down or refusal to work are the most obvious clues that a teacher may recognize relating to students who may possibly suffer from math anxiety (Vorensky, 2018). Sometimes teachers may struggle to determine if the behaviors they are witnessing are related to math anxiety or if they are just typical behaviors of students who are acting out to gain attention (Neil & Smith, 2017). Students may also exhibit performance avoidance or off-task behavior as a way to avoid an uncomfortable situation that may result in embarrassment due to their own inability to complete a task (Skaalvik, 2018). Teachers’ perceptions of student behavior and their sensitivity to the actions may also impact their ability to correctly identify when students are in fact suffering from math anxiety (Neil & Smith, 2017). Physical behaviors such as noticeable frustration, anger, shutting down, avoiding a task, or refusal to work may be the quickest way that teachers identify a student that may be suffering from math-related anxiety (Skaalvik, 2018). Students who display disruptive or distracting behaviors may also be acting out as a coping mechanism to mask their feelings of math-related anxiety or their inability to perform well academically in the math class and save face in front of their friends and classmates (Neil & Smith, 2017).

Teachers may also consider past academic performance in math to identify students who may suffer from math anxiety. Math anxiety and math performance have been studied for interconnectedness and to consider contributing factors such as emotion and attitudes toward math that have been shown to be linked to both (Namkung et al., 2019). Students who have
limited or weak basic math skills and have demonstrated low performance levels may be identified as students who suffer from some level of math anxiety (Foley et al., 2017). The root of the performance issue must be addressed in order to better understand when performance is related to math anxiety. When students have fallen behind and have large gaps in their knowledge and basic mathematics skills, low performance may be just an indication of missing content (Namkung et al., 2019). However, it has been shown that when students are missing significant gaps of knowledge and unable to perform at the expected level, they experience anxiety related to their inability to be successful in math (Foley et al., 2017). As students struggle, learned helplessness is a trait that some students may use to avoid actively engaging in a task when they feel that failure is almost certain (Dossel, 2016).

Low performance may also be a result of slow processing speeds and limited working memory that causes the inability to recall information that is needed to perform multi-step or more complex math problems. This demonstrates another connection between performance and math anxiety, but in this case, the anxiety is hindering the ability to perform, creating even higher levels of math anxiety (Henslee & Klein, 2017). When students are successful in classwork activities but lack the ability to perform well on quizzes, unit tests, and activities that have specific time restraints or added pressure, this may also be an indicator that the student suffers from some level of anxiety related to math (Gershenson et al., 2016). Student’s academic performance and level of math related anxiety have been shown to be bidirectional (Foley et al., 2017). A student’s ability to perform in math class may be a cause for math anxiety; however, math anxiety can also be the cause of a student who has an underachieving performance, and this affects students at all academic levels, including below grade level, on grade level, and advanced students (Namkung et al., 2019).
Parents may sometimes express concerns about their child’s academic performance in math which may eventually lead to further consideration for math anxiety, but this is not the first thought. Often at first, parents take on the attitude of they were never good at math, and therefore, their child is not capable of being good at math either. They may not consider math anxiety being a factor as they may not fully understand what math anxiety looks like and if it even exists (Beilock & Maloney, 2015). If the child is demonstrating outward signs of shutting down, being emotional or even acting out, some parents may reach out to their pediatrician for help. This usually only comes after the situation has been going on for an extended amount of time. It is the doctor that may recommend psychological testing or further medical testing depending on the severity and the child’s overall medical history. The doctor or psychologist may also provide a self-reflective questionnaire or scale to help parents and students evaluate and reflect where the negative thoughts and feelings are coming from (Luttenberger et al., 2018).

While parents may not be the most obvious source of identification, they do know their children the best and are often the ones to get the ball rolling by bringing the attention to the teacher (Neil & Smith, 2017).

The ability to identify students who are experiencing math anxiety may be a necessary skill for classroom teachers who teach math; otherwise, those students may not ever be identified. Students may first be identified through the response to intervention (RTI) process as students that are struggling academically in math or reading and are falling behind due to gaps in knowledge are considered to be at risk students and in danger of failing (Bouck, Park, Bouck, Alspaugh, & Spitzley, 2019). The RTI process and the RTI team can be a valuable asset in helping schools and teachers identify students who are experiencing levels of anxiety that are associated with academics, and the overall process sheds light on where academic struggles exist.
When a teacher can identify the signs and symptoms of math anxiety, they may be more likely to address the students’ individual needs and provide the needed support or scaffolding that is necessary for the student to be successful in math (Neil & Smith, 2017). It is only when a teacher has the capacity to identify a student with math anxiety that they can support the student by setting goals and putting coping strategies in place that are needed to reduce the anxiety level (Skaalvik, 2018). Once teachers identify the underlying cause of math anxiety, they may be able to implement a targeted intervention or instructional strategies that may set the student in a positive direction that will enhance their experience and engagement level in math, causing their academic performance to increase while math anxiety lessens (Foley et al., 2017).

When teachers are able to recognize that a student’s negative attitude toward math is associated with their ability or past performance, it creates an opportunity for the teacher to create a positive experience in math for that student (Larkin & Jorgensen, 2016).

**Interventions for Math-Anxiety**

Methods of effective intervention for math anxiety that are considered to be best practices could prove to be valuable to practicing teachers in today’s classrooms. Something as simple as motivation may seem expected, but research shows that self-determined motivation decreases as students transition from elementary to secondary school (Brandenberger et al., 2018). A student’s perceptions of their own ability to perform math tasks tend to have a large impact on the student’s motivation, confidence, and how determined they are to succeed (Zee & de Bree, 2017). Students who have experienced low levels of achievement often lack motivation or the confidence needed to experience any gains in their performance levels in relation to how they have performed in the past (Pekrun, Lichtenfeld, Marsh, Murayama, & Goetz, 2017). Student engagement is a factor in motivating students because when students are bored and disengaged,
they are not motivated to learn (Andersson et al., 2015). When students experience enjoyment and positive emotions, they encounter increased confidence, higher levels of engagement, and lower levels of math related anxiety (Villavicencio & Bernardo, 2016). Movement and interaction with their peers using hands-on learning is a large part of what keeps students in elementary school so actively engaged (Have et al., 2018).

Increasing student motivation may prove to be a viable method of intervention. “Encouraging students to make connections between what they are learning in the educational context and their own lives has been found to help them find meaning in their schooling, which, in turn, enhances their interest and motivation” (Brandenberger et al., 2018, p.298). When students have an intrinsic motivation to learn math, they often experience a decrease in their level of math-related anxiety because they have a vested interest and are taking ownership of their own learning (Wang et al., 2015). Student motivation may also be affected positively or negatively by the teacher-student relationship and is greatly affected by the level of respect and value the student feels from the teacher (Zee & de Bree, 2017). When students were given the opportunity to explore their own emotions and their connections to mathematics through using an iPad diary system, students were able to reflect on what prompted positive and negative emotions. They found that when they were presented with more engaging activities that included collaboration and real-world-related content, they experienced more positive emotions (Larkin & Jorgensen, 2016).

When teachers use flexibility in their teaching methods, they may be more likely to reach all learners by examining the conceptual understanding that is occurring and analyzing how students are learning math (Ramirez et al., 2018). When teachers can begin to shift from ask and answer, rote algorithms, and include more inquiry while reaching more for the why, they will
help develop their students into mathematical thinkers who can problem solve at much deeper levels (White & Sullivan, 2018). Old practices such as forcing students to produce an answer quickly when being timed and putting them on the spot or having them come to the board and work out problems in front of the class when they are not ready results in negative emotions and attitudes toward math and may cause great levels of anxiety (Deieso & Fraser, 2019). Students learn in many different ways, and the approach of everyone needs to do the same thing to be successful is no longer a valid approach to mathematics. Teachers often have to meet students where they are and provide multiple opportunities for students to access the same skill to ensure that all students have equal opportunities to be successful in math with the least amount of anxiety (Schillinger et al., 2018).

Teacher expectations have been shown to have a direct impact on how a student perceives their ability to perform math (Heyder & Brunner, 2018). When teachers set low expectations, there is a trend for students to perform at lower levels. Teacher biases may have a large impact on what expectations they set for their students, thus creating opportunities for students to fall short of their true ability (Gershenson et al., 2016). Teacher goals for their students and individual student goals that they set for themselves often create or contribute to the level of anxiety that students feel toward math (Martínez-sierra & García-gonzález, 2017). Building relationships and knowing their students is paramount for teachers to create the best opportunities for growth and deeper learning by understanding what background knowledge and experiences students bring to the classroom (Lisciandro et al., 2018). When teachers stereotype students or group students based on what they believe to be true versus the reality of knowing their students, expectations are set based on false knowledge (Gershenson et al., 2016). Different levels of teacher expectations have been shown to result in significant differences in how
students view themselves as math students and often affect their overall ability to perform math-related tasks (Heyder & Brunner, 2018). When teachers set expectations based on their own biases and negative beliefs about students and their backgrounds, socio-demographic gaps may occur. These low expectations, stereotypes, and the inability of teachers to believe in some students may contribute to negative emotions towards math, resulting in underperformance and math anxiety in specific groups of students as a result of teacher bias (Gershenson et al., 2016). Students who have experienced negative emotions and experiences in math often approach the subject as the most difficult and actually experience fear resulting in added layers of math anxiety (Peixoto, Sanches, Mata, & Monteiro, 2017).

Mindfulness-based cognitive therapy has also been shown to improve math performance and lessen math anxiety (LaGue et al., 2019). By definition, “A growth mindset is a belief that the harder you work, the smarter you get” (Boyd & Ash, 2018, p.216). Mindfulness training has been shown to be a possible intervention that may be worthy of consideration as it may encourage students and teach them how to have a growth mindset (Heyder & Brunner, 2018). Students who demonstrate a fixed mindset have accepted to live with the belief that they are not capable of doing mathematics and tend to experience higher levels of math anxiety when faced with possible failure (Boyd & Ash, 2018). Students that are able to develop a growth mindset may begin to realize their potential as successful math students, gain more positive emotions toward math, and set aside some of their anxiety related to math tasks (Lisciandro et al., 2018). Emotions have been shown to play a large role in how students perceive their relationship with math, and any method of increasing a student’s confidence level may decrease their anxiety related to math (Klein et al., 2019). When attitudes are improved, performance and anxiety levels are also likely to improve (Verkijika & De Wet, 2015).
Exposure to more math related tasks and skills on a more repetitive basis has been shown to alleviate anxiety and build more stamina for the student emotionally, which may increase their ability to be more successful in math (Supekar, Iuculano, Chen, & Menon, 2015). When students are encouraged to have more of a growth mindset, they may be more likely to demonstrate higher levels of success as they begin to understand that mistakes and failure are part of the learning process (Heyder & Brunner, 2018). As students receive mindfulness training, their ability to work through math-related situations may improve as they understand that there is not only one way to solve problems, and accepting the mistakes and making adjustments may be the path to the correct solution (Boyd & Ash, 2018).

Peer mentoring may be another viable strategy to work with students who suffer from math anxiety. Peer mentoring aligns with the ideas of peer tutoring as students are teaching and learning from one another, but peer mentoring seems to be more well received (Nicholson, Rodriguez-Cuadrado, & Woolhouse, 2018). Some students that suffer from math anxiety may shut down or put up a barrier when tasked with difficult problems that they are unable to solve on their own or even in some cases with the teacher, but may find some relief in having a student partner to work with (Vaughan, Clampitt, & Park, 2016). When teachers provide students support by partnering students up or allowing them to work in small groups, it may create a more community feel to the classroom and result in a safer feeling learning environment that encourages communication about math (Lin et al., 2017). Students often have questions or need clarification but are unwilling to ask the teacher due to either interruption of the class, drawing attention, or the possibility of a negative response from the teacher that will cause further negative emotions or heightened levels of math anxiety (Wilson & Grigorian, 2019). Students are often much more comfortable asking another student for help, and this process to them may seem
less intrusive to the class and lower the possibility of embarrassment or unwanted attention for something they are already feeling anxious about (Nicholson et al., 2018). When students are able to communicate about math, using math language and problem-solving, they are creating an interactive environment for learning and reflection. The classroom community becomes a safe place for students to speak freely about their beliefs and their own understanding of the problems, as well as what strategies they used. When students are encouraged to utilize different methods and paths for solving, it creates more opportunities for students to share their thought process and learn from one another (Saylor & Walton, 2018).

Peer mentoring happens in many classrooms, but unless it is purposeful, it may not be in its most effective form. Peer mentors can help students who routinely find math concepts difficult but with some added support and collaboration with another student may be able to work through the process and experience success (Cropp, 2017). When teachers decide to use peer mentoring in the classroom, it does not require formal training but may require some purposeful partnerships to ensure that the peer mentor relationship will be positive. All students are not created equal, and partnerships may need to change often based on content, student needs, and the culture of the classroom. Communication about math and using different problem-solving strategies as a pair of students work through a problem could prove beneficial to both students. It is not only valuable to the math anxious or lower-level student but also proves valuable to the higher achieving and more confident math student as communication about math enriches their learning process (Nicholson et al., 2018). As they build a partnership, the student who has been identified as math anxious may become more confident as they realize that their contribution to the conversation is important (Cropp, 2017). A study performed by Supekar, Luculano, and Chen revealed that there was a decrease in overall math anxiety in the case of
students who received eight weeks of one on one tutoring, which bolstered their confidence in
the content as they were exposed to different methods and strategies to work math problems
(Supekar et al., 2015). These peer mentoring relationships are important because it allows
students to understand that there is more than one way to solve a problem and that each student
has valuable input and brings different life experience to the table (Dutko & Putney, 2015).

Small groups or workstations in math classrooms are proving to be very valuable in
allowing students to access content in a different way using flexible groupings that are fluid and
ever changing. Static groups may prove to be beneficial to some students, but for maximum
growth, grouping should be flexible to allow change to differentiated, leveled, student choice, or
other groups based on teacher experience and needs for the students (Boyd & Ash, 2018). When
students have the opportunity to work and learn in small groups, students begin to learn and
grow as a classroom community rather than individual students being lost in the content, and
their anxiety level toward math may begin to decrease (Deieso & Fraser, 2019). Students may
become more comfortable with their environment as math talks, and open communication about
making mistakes becomes a daily practice in these purposeful math groups that are designed to
support weaker students while allowing stronger students to flourish (Lin et al., 2017). Small
group settings allow students to work with other students and pull from a group of knowledge
versus just that of the individual students (Thuneberg, Salmi, & Fenyvesi, 2017). Lived
experiences and exposure to real world connections to math have been shown to improve overall
attitudes toward math as students are more interested because they see a purpose in what they are
learning (Dutko & Putney, 2015). Small group instruction also allows students to receive teacher
feedback in a less intimidating way and therefore gives the student a much more positive
experience in math with the opportunity to ask questions without the pressure of the whole class environment (Passolunghi et al., 2016).

Workstations, also known as a workshop, have become increasingly important in math classes giving students an alternate way to do the math. According to Sharp, Bonjour, and Cox, “The math workshop approach, is a rigorous, student-centered way to teach mathematics that fosters inquiry among the community of learners” (Sharp et al., 2018, p.69). The math workshop approach helps math anxiety as it gives students multiple representations of the same content and provides the opportunity for hands-on engagement, math communication with their group, and usually a small group opportunity with the teacher for reassurance (Sharp et al., 2018). The workshop model allows the teacher to remain the content expert while students have an opportunity to use their critical thinking skills to solve problems and work within their groups using hands-on manipulatives to make sense of math (Boyd & Ash, 2018). When the teacher sits and works in small groups with students, they feel more comfortable opening up to the teacher and share their own thinking. The community environment creates a positive and safe work space that students feel like making mistakes and growing from them is an acceptable practice that may reduce their level of apprehension and anxiety toward math (Stoehr, 2017). Math instruction in the workshop model breaks the traditional role of drill and kill while lessening the stress of standardized learning and just remote memorization but rather encourages higher levels and deeper understanding of math by encouraging powerful discourse about math and how it works (Sharp et al., 2018). Teachers are becoming more aware that grouping, rather than independent work, may be a better option for higher levels of learning to occur, and the math workshop model fully supports this idea while also decreasing the anxiety level of students as they grow into much more confident math students (Boyd & Ash, 2018).
The intentionality of how student groups are formed has been shown to have an impact on student learning. Flexible grouping strategies should be used based on the needs of the students. Groups with different level learners give students the opportunity to experience peer tutoring in the small group format, while leveled groups may give the teacher more time to work with a lower level group (Boyd & Ash, 2018). Student motivation and level of anxiety may be improved when teachers offer students choice for grouping; however, this may not be appropriate for daily use if students are productive in their math process. Student’s attitudes toward math may be improved when they are able to share the experience with their friends because they may be more comfortable engaging in open conversation, although they are not always truthful about their full level of understanding (Larkin & Jorgensen, 2016). Many types of grouping strategies are used by teachers when developing small group models or learning stations. A teacher’s expertise about the content and how well they know their students, along with formative assessment data, should drive how small group instruction should occur, with the result being targeted instruction with lower levels of math anxiety (Sharp et al., 2018).

Positive learning environments and relationship building may be an important part of building classroom community and reducing math anxiety for students who are experiencing it. Students need to feel comfortable with their teacher and feel that the teacher believes in them and their ability to be successful in the content (Deieso & Fraser, 2019). Students that outwardly dislike or hate math typically have had some bad experience in math that has caused them high levels of anxiety and the desire to push back when the math gets difficult (Larkin & Jorgensen, 2016). The classroom environment should be conducive to all students having equal access and opportunity to experience math and gain a deeper understanding (Recber et al., 2017). Learning environments are gauged by what they look like and how they feel. Characteristics of a positive
learning environment consist of student cohesiveness, teachers cooperatively working with students providing instructional support, and encouragement for student thinking (Deieso & Fraser, 2019). The overall structure and set up of the actual classroom may have a large impact on how students perceive math and their overall experience, including their anxiety level toward math (Lavasani et al., 2011). There is a growing need for more student-centered learning environments that complement the shift from straight rows and independent work to group seating and collaboration that increases overall student engagement and success. When students have access to a student-centered learning environment, they may take more ownership of their own learning because the responsibility for discovery and understanding takes a shift toward the student versus the teacher (Collie, Martin, Bobis, Way, & Anderson, 2019).

Many of the strategies that have been identified in research occur more naturally at the elementary level. Elementary grade level teachers typically offer more collaborative learning opportunities and have learning environments that are more nurturing and appealing to students (Sharp et al., 2018). Physical classrooms and instructional practices are more conducive to student interaction, engagement, and inquiry which may prove to be part of the reason that math-related anxiety tends to increase when students move from the elementary level to secondary (Klee & Miller, 2019). The teachers are not the only difference between elementary and secondary, and the students are much more willing to engage with the process and have a much larger desire to please their teachers at the lower grade levels (O’Leary, Fitzpatrick, & Hallett, 2017). Teachers may also know more about their students in elementary grades, as they are responsible for the same group of students all day versus the multiple classes of students in secondary. By being the only teacher for all core content for that student, the teacher may more easily recognize when a student is a lower reader, which may result in the student also struggling
with word problems, multi-step problems, or more complex problem solving (Zee & de Bree, 2017). Although math anxiety exists at the elementary level, research has shown that it increases as students move into secondary, and some of these basic structures and instructional strategies may prove to be the best place to start when addressing math anxiety at the secondary level (Sharp et al., 2018).

**Summary**

This review of the literature covers math-anxiety from many viewpoints. The gap in the literature will be addressed by this study, which will seek to better understand the teachers’ perspective of working with students who suffer from math-anxiety at the secondary level. Math-anxiety has been shown to greatly affect working memory (Caviola et al., 2017) by reducing the brains capacity to process arithmetic tasks (Artemenko et al., 2015), cause poor performance (Beilock & Maloney, 2015), and contribute to an overall bad outlook and attitude toward math (Shishigu, 2018). Math performance and math anxiety have been identified as being bidirectional as they can effectively cause one another (Foley et al., 2017). The causes of math anxiety cannot be narrowed to one specific cause but rather many factors that come into play over the course of the student’s entire academic career, beginning in elementary school and often still being present in college-age students and adults (Beilock & Maloney, 2015; Caviola et al., 2017).

While genetics may not be directly responsible for math anxiety, parental influence may, in fact, be partially to blame. Students may share anxiety through hearing about and reliving negative experiences that happened to their parents. Math anxiety is not passed down, but anxiety related to negative emotions may be (Beilock & Maloney, 2015, Maloney et al., 2015). Social expectations of how well students should perform in the classroom have been shown to contribute to math anxiety as students fall short of the expectation and experience the added
pressure from their peers, thus creating heightened levels of math related anxiety (Klee & Miller, 2019). Environment, culture, relationships, and experiences also may contribute to a student’s level of math anxiety (Stoehr, 2017). If students do not feel part of a community and able to express their opinions and ideas, they may not grow into their best selves as math students, but rather experience great levels of anxiety about not being adequate (Deieso & Fraser, 2019). Social pressure and added environmental stress from the standardized and timed test may also be to blame (Dutko & Putney, 2015).

Identifying students may be the most difficult challenge that is faced when dealing with math anxiety. There have been limited studies performed to determine if teachers are able to properly identify students who suffer from math anxiety (Neil & Smith, 2017). Teachers tend to identify students only after they have failed or are academically struggling in the classroom. When students are experiencing high levels of math anxiety, they may not be able to perform, and this could be a sign to the teacher (Foley et al., 2017). Teachers often look for themes and patterns but sometimes fail to identify students who are suffering from math anxiety as they attribute their behavior to typical behavior for students of that age group (Sharp et al., 2018). Students can be identified from self-assessment-type rating scales, which is a method that teachers could also use to confirm if their identification is current (Caviola et al., 2017). Math anxiety may also be identified by more extensive psychological testing. There is a variety of behaviors such as avoidance, acting out, and even showing signs of being physically ill that could also help identify students who are suffering from math related anxiety (Neil & Smith, 2017).

Research reveals a number of interventions that are being used that are proving to be beneficial for students who suffer from math anxiety, but teachers are still in need of
documented, best practice strategies that can be implemented to minimize math anxiety (Boyd & Ash, 2018; Deieso & Fraser, 2019; Vorensky, 2018). Some of the more common interventions include building relationships with students (Dowker et al., 2016), adding small group instruction, supporting students with peer mentors, and introducing the workshop model in the classroom (Deieso & Fraser, 2019, Sharp et al., 2018). All of these interventions have some best practices included, which may help students become better math students and reduce the level of math anxiety that they experience (Boyd & Ash, 2018). When students are given the opportunity to dive deeper into mathematics and spend time with inquiry versus rote memorization, students take more pride in the content they are learning; thus, it is more meaningful (White & Sullivan, 2018). The focus on deeper understanding in math and moving away from the rote memorization may help some students experience higher levels of success in the math classroom, and this may alleviate math-related stress as their confidence builds (Lotter et al., 2018).

By studying math-anxiety from the teacher’s perspective, it is hoped that the insight and knowledge gained will help other teachers be able to recognize the signs of students (Shishigu, 2018) who are suffering from math anxiety and implement documented strategies that work. At this point of the process, there is limited information on the practices that have been identified as improving math anxiety for students (Sharp et al., 2018). The United States is currently facing a shortage of graduates in the science, technology, engineering, and math (STEM) field, and research has linked it to math-related anxiety (Artemenko et al., 2015, Beilock & Maloney, 2015). Society has emphasized the need for graduates to focus on STEM-related fields, and this places a greater focus on math and the need for students to be better prepared for math related careers (LaGue et al., 2019). When students experience math anxiety throughout their academic
journey, it carries over into their adult life at it is far-reaching and has a great impact on student success over time (LaGue et al., 2019).
CHAPTER THREE: METHODS

Overview

This intrinsic collective case study allowed the researcher to investigate the perception of math teachers and their ability to identify students who struggle with math-related anxiety and the types of interventions they implement to address it. Students who teachers have identified as students who they believe in suffer from some level of math anxiety will complete a rating scale that measures math anxiety. The instrument that was used for the cases in this case study was the Abbreviated Math Anxiety Scale (AMAS) (Hopko et al., 2003). The teacher’s perception of their own self-efficacy of identifying students with math anxiety will be confirmed or negated by the students' completed survey results. The case study method allowed the researcher to gain an in-depth understanding of the phenomena and gain insight through practical application in the natural setting of the classroom (Yin, 2009). The collective case was conducted by interviewing secondary math teachers who have been identified by the math curriculum coordinator and math coach as teachers who have demonstrated success working with students who suffer from math-anxiety. Interviews also included the students who volunteered to participate or were identified by their math teacher as students who they suspect are experiencing math anxiety. A focus group was formed consisting of the three math teachers in the study. Multiple sources were used for data collection, including interviews, focus groups, student anxiety scale rating, and letters to future math teachers from the students. The researcher transcribed all interviews for the case study and analyzed them for themes or patterns. This chapter provides the design, participants, and methods for this collective case study.

Design

A qualitative intrinsic collective case study was used for the purpose of gaining a better
understanding of the perspectives of math teachers who work with students who suffer from math-anxiety. Qualitative research was chosen so the researcher could “study things in their natural settings, attempting to make sense of” (Creswell & Poth, 2018, p.7). How teachers perceived their ability to identify and effectively work with students who are suffering from math anxiety. Creswell and Poth (2018) explained how qualitative research uses multiple methods of data collection to get a deep, rich understanding of a phenomenon, which in this study will be the cases. The case study method granted the researcher the opportunity to take a deep dive into a particular situation to better understand the “how” and the “why” when the connection is not always obvious or clear (Yin, 2018). A collective case study was used to gain deeper insight into multiple cases of general education math teachers who have demonstrated success in identifying and successfully implementing interventions with students who suffer from math-anxiety (Yin, 2018, p.50). Each case in the case study consisted of the teacher and three students who self-identified or have been teacher identified as students who possibly suffer from math anxiety. The researcher used multiple cases to better understand if commonalities or patterns existed in the method in which teachers are able to identify students who suffer from math-anxiety and why their interventions work (Stake, 1995, p.3).

**Research Questions**

**RQ1:** How would math teachers describe their methods for identifying students with math-anxiety?

**RQ2:** What are some methods and techniques that teachers utilize to improve the students’ experience with math to decrease their level of math-anxiety?

**RQ3:** Why do you think that some students who suffer from math anxiety respond to certain interventions while others do not?
Setting

This collective case study examined the perceptions of three math teachers in a suburban school district in the Commonwealth of Virginia. This is a Virginia county school district that is located in southeast Virginia and does have a significant military presence with an Air Force Base nearby. In 2018, this County had an approximate population of 67,846 according to the US Census Bureau. Demographic breakdown is 76% White, 13.7% Black, 5.8% Asian, 0.5% Indian, and 10.2% other. The schools are mostly representative of the county. The county has a very low poverty rate at only 5%. The educational background of the residents is impressive, with over 94% having a minimum of a high school diploma while 43.6% have earned at least a bachelor’s degree. This level of education is evident in the overall success of students in the county schools. The majority of the population is located within the southern part of the county.

Three cases were selected from the eight secondary schools located in this school district. This is a public school district that serves approximately 12,000 students where all schools are accredited in mathematics. General education mathematics teachers who had documented success for working with students with math anxiety were the target participants. The teachers for this collective case study were identified by math curriculum coordinators and the district math coach who have personal knowledge of the teachers’ success working with students who suffer from math-anxiety and have witnessed the improvement in the student’s performance or level of anxiety. The focus was the teachers’ ability to identify students who suffer from math anxiety as well as implement strategies that are proven to work.

Participants

The participants for this case study were selected through purposeful sampling. Teachers were chosen based on their successful experience with identifying and successfully teaching
students who suffer from math anxiety. The selected teachers had a minimum of three years of teaching experience and have demonstrated success identifying and implementing interventions with students who suffer anxiety when dealing with math-related tasks. Each case was the selected teacher and the students who they have identified as math anxious or students who self-identified as math anxious. There were three cases in this study to gain a deeper understanding of the causes of math anxiety while searching for patterns (Creswell & Poth, 2018). The district math coordinator and math coach utilized previous data and personal knowledge of the general education math teacher’s positive experiences with working with students who suffer from math-anxiety to identify the cases. School-level administration also confirmed teacher participants as who they also believe in having positive experiences with students overall. Once all cases were identified, pseudonyms were assigned to protect their identity and privacy. Ms. Palmer is an advanced Geometry teacher at the middle school level and teachers eighth-grade students. This class is considered to be two years advanced and includes the most advanced students at the middle school level. Ms. James is a Pre-Algebra 7 teacher who teachers Pre-Algebra to seventh-grade students. This class is considered to be one year advanced. Ms. Clayton teaches Pre-Algebra 8, which is an eighth-grade class with all on or below grade level students. The students who the selected teachers identify as having math anxiety became part of each of the cases with that teacher, as well as any students who self-identified as anxious about math. The study revealed what methods teachers use to identify or recognize students that they suspect to suffer from math anxiety. The student’s level of math anxiety was measured using the Abbreviated Math Anxiety Scale (AMAS). The AMAS is appropriate for children and has only nine questions, and has visual indicators for emotions (Hopko et al., 2003). There was a minimum of 12 participants utilized to collect data to meet data saturation (Creswell & Poth, 2018).
Procedures

The researcher received approval from the Virginia County School District to conduct the study in the secondary schools (see Appendix B). The researcher received IRB approval from Liberty University (see Appendix A). The research met with the math coordinator to discuss which teachers she would recommend based on past data and experience with those teachers. The researcher then met with the school-level administration for further consideration and discussion. Upon selecting teachers for the study, teacher recruitment letters were emailed to the teachers (see Appendix C). Upon receipt of the teacher consent forms (see Appendix E). The researcher contacted the teachers to schedule interviews at a time that was convenient to them to discuss which classes they would choose as part of the study. Teachers identify students who they believed to suffer from math anxiety. The researcher met with each class during a regularly scheduled class on Microsoft Teams and explained the study. The teacher then emailed the students the student recruitment letter (see Appendix D) and the parental consent form (see Appendix F). Students were encouraged to submit parent consent forms if they wanted to participate in the study. Upon receipt of consent forms from students, the researcher reached out by email to the student and parent to schedule the interview. As part of the pandemic guidelines and schools operating in a hybrid setting, all interviews were held using Microsoft Teams. Teachers were interviewed from their classrooms using Microsoft Teams as they were back working in person while still teaching virtually. Students were interviewed from their homes using Microsoft Teams as all of the seventh and eighth-grade students were still learning virtually from home at the time of the interviews.

Following interviews, a focus group was formed with the teachers, and this was held on a Microsoft Teams meeting. All teachers were provided a copy of the questions (see Appendix I)
for clarity and to help facilitate conversation. The researcher participated only to ask questions and clarify answers. Students were asked to complete the AMAS (see Appendix K) and a piece of student writing. They were provided a writing prompt that included instructions, and some question stems to help write a letter to a future math teacher (see Appendix L). The AMAS forms and student writing were collected by email directly from the students or parents.

**The Researcher's Role**

For this study, I served as the human instrument to collect data and analyze data to gain a deeper understanding of how teachers are able to identify and help students who exhibit signs of math-anxiety. I took on the role of the advocate, evaluator, and interpreter to evaluate, interpret and connect meaning to how teachers are successfully working with students who have math-anxiety (Stake, 1995). I am a district math coach and the secondary level in this Virginia county school district. I have taught middle school math, grades 6-8, for nine years. I have personal experience working with students that suffer from math-anxiety and have witnessed firsthand how debilitating it can be. I have also experienced success working with students with math-anxiety and have been able to alleviate or lessen the overall level of anxiety toward math. Through this experience, I have enjoyed sharing their new joy of learning math with a positive attitude and outlook. I currently work with all of these teachers in my role as the math coach, which is a support position. This allows me the opportunity to spend time in their rooms, observe their students, and witness the work that they do with their students. My position affords me the opportunity to see in-depth how these teachers potentially impact their students in terms of anxiety and attitudes toward math. I have no supervisory role for any of the selected participants.
Data Collection

No data were collected until approval has been granted from Liberty University’s IRB (see Appendix A). Upon identification of all participants, consent forms were signed and received. According to Yin (2009), “The use of multiple sources of evidence in case studies allows an investigator to address a broader range of historical and behavioral issues” (p.115). Multiple data collection tools were used to collect a variety of data that provide a better and more in-depth understanding of the teacher’s perception about working with and supporting students with math-anxiety. Stake (1995) states, “The experience of the qualitative researcher is one of knowing that leads to significant understanding, recognizing good sources of data, and consciously testing out the veracity of their eyes and the robustness of their interpretations” (pp.49-50). The three primary methods of gathering data for this study was by interviews, a focus group, and student writings. Additionally, demographic information and AMAS results were obtained (Creswell & Poth, 2018; Yin, 2009). To remain focused during the data collection stage, the researcher followed a schedule and used memoing to record thoughts and reflection before and after interviews (Creswell & Poth, 2018).

Interviews

Interviews are essential to case studies by providing a guide to a conversation through open-ended, non-threatening questions (Yin, 2009). Open-ended questions are used to encourage richer in-depth conversations. Interviews were semi-structured to maintain focus while allowing for participants to elaborate on their experiences. Interviews are the most commonly used method of collecting data in case studies. Interviews are most specific to the case and directly address the research questions (Yin, 2018). Interviews target participants that should be able to provide greater depth into the cases. Interviews were conducted using Microsoft Teams in the
participants’ natural setting and were untimed. Interviews in-depth and focused and were recorded and transcribed at the conclusion of the interview. Interviews in this collective case study will include all participants in each case. The researcher transcribed the interviews. Member checking was used to ensure participant responses were reflected correctly.

For interviews, teachers, and students each had a specific set of interview questions. Confidentiality was achieved by ensuring that pseudonyms were used for all participants. Complete confidentiality will be practiced throughout the study.

Each teacher participant answered this list of questions from their own perspective.

1. Please introduce yourself to me
2. Please tell me about your collegial background and training.
3. Please tell me about your path in education thus far and what prompted you to teach math.
4. Tell me how many years you have been teaching and what types of schools you have taught at.
5. How often do you experience students in your class that you feel suffer from some level of math-related anxiety?
6. How would you describe a student that has math-anxiety?
7. How would you describe students’ mannerisms or outward displays that alert you to math-anxiety?
8. Describe any specific characteristics that you look for when determining if a student has math-anxiety.
9. How does your perception of students’ anxiety level impact your method of teaching?
10. Describe best practices that you routinely use with students?
11. Describe your perception of well you respond to your students’ needs when they are experience math-anxiety?

12. Tell me about the struggles you’ve experienced when working with students who have math-anxiety.

13. Why do you think interventions work with some students and not others?

14. Describe a situation, if any, when a student had math-anxiety, and you were not able to reduce the anxiety or support them adequately?

Interview questions one through four will allowed me to learn about the teacher’s background and how they became math teachers. It is often that math teachers do not begin as math teachers. Question five is specifically to evaluate how the teacher perceives their own level of math anxiety and their overall attitude toward math. A teacher’s attitude and belief in their own efficacy have been shown to impact the quality of their teaching as well as negativity and self-doubt transferring to their own students (Gershenson et al., 2016; Stoehr, 2017). Questions six through eight required teachers to be reflective in their practice and discuss the methods in which they use to identify students who they believe are suffering from math anxiety. Studies have shown some positive relationships between how teachers identify students and how students identify themselves in terms of math-related anxiety (Neil & Smith, 2017). Questions nine through 14 address the types of interventions that the teachers believe to be effective in working with students with math-related anxiety (Brandenberger et al., 2018; LaGue et al., 2019; Wang et al., 2015). Many methods and types of interventions have been utilized when working with students, and these questions seek to understand which specifically have been the most effective and could be considered best practices for working with middle school-aged students who are experiencing math anxiety.
Student participants answered the following set of questions from their perspective.

1. Please introduce yourself to me.
2. How do you feel about school in general?
3. What is your favorite subject in school and why you like it?
4. What is your least favorite subject in school and why?
5. How do you describe your feelings about math?
6. Have you always been anxious about math?
7. Why do you think you have anxiety about math?
8. How is your performance in math?
9. How would you describe your attitude about learning math?
10. How does your attitude affect your performance in math?
11. What does your teacher do that helps you with your anxiety?
12. How does your teacher have an impact on how you learn math?

Using open-ended questions with the students allowed us to have more of a conversation than just a question-and-answer session. The questions were used as probes to open discussion and encourage a conversation. Questions one through four helped me to learn basic information about the students. Questions five and six will allow the students to explain how they see themselves in terms of being anxious about math (Kelly et al., 2015). Questions seven and eight will give the students the opportunities to tell why they feel that they are anxious about math and where it stems from (Recber et al., 2017). Questions nine through twelve required the student to reflect on their overall attitude and the impact that it and their teacher have on their success in math (Chen et al., 2018).
**Focus Groups**

A focus group was formed with the teachers from each case in the study. “Focus groups are used for generating information on collective views, and the meanings that lie behind those views” (Gill, Stewart, Treasure, & Chadwick, 2008, p.293). The focus group allowed for teachers to compare and contrast their ideas about how they each identify students who they believe are suffering from math anxiety. It also provided teachers an opportunity to collaborate and brainstorm about what each of them perceives to be best practices when working with students who are experiencing math-related anxiety. Using prompts, the researcher guided the discussion in the focus group. This method afforded the participants an opportunity to discuss and expand on each other’s views. Having shared experiences allowed the group to be comfortable enough to provide rich and meaningful discussion (Gill et al., 2008). Confidentiality was be achieved by ensuring that any identifiable information was removed, and complete confidentiality will be practiced throughout the study. Questions to help facilitate and guide discussion were the following:

1. What characteristics does a productive learning environment have for students to learn math?
2. What practices do you have in place to ensure that students feel safe to make mistakes in your classroom?
3. What is considered the first sign for you that a student is experiencing some level of math anxiety?
4. Are there common characteristics that you look for within students to identify who you believe suffers from math anxiety?
5. What structures do you put in place in your classroom to ensure that students with
math anxiety can be successful?

6. What strategies do you use that specifically address the needs of students who suffer from math anxiety?

7. What is the relationship between math anxiety and math performance?

Focus groups used open-ended questions to promote deep discussion for teachers to collaborate and allow themes to develop. Questions one and two addressed the learning environment and for teachers to discuss how students perceive their fit within it and their ability to experience success (Deieso & Fraser, 2019). Questions three and four encouraged deep discussion on how teachers identify students who are possibly experiencing math related anxiety (Neil & Smith, 2017). Questions five and six allowed teachers to identify sound instructional strategies and best practices and collaborate on similarities and differences within (Sharp et al., 2018). Question seven highlighted how the teachers felt about any possible connections between performance and anxiety (Foley et al., 2017).

**Student Writing**

Student writing was collected as data. Students were asked to compose a letter to a future math teacher. They were to assume that this person is a brand-new teacher with no prior experience with students. The students write a letter explaining how math makes them anxious. The students were provided with some sentence stems to stimulate their thoughts about this letter. They were asked to tell the teacher how long they feel they have experienced anxiety related to math. They were asked to tell the teacher what would make math better or easier for them and possibly alleviate some of their anxiety. They were left open to choose to tell about a teacher that has helped them and what they looked like. The hope was that this writing would provide the researcher a more in-depth view of how the student perceives their own anxiety and
how the teacher can or has helped. This student writing was similar to journaling which allows students to put down their thoughts in their own words without the pressure of time or answering specific questions, giving a more authentic view of how they perceive their math experience (Creswell & Poth, 2018). Confidentiality was achieved by ensuring that pseudonyms were used for all participants. Complete confidentiality was practiced throughout the study.

Data Analysis

For this case study, the researcher transcribed all interviews and focus group discussions. Member checking was completed with the teacher participants as part of the process, along with summarizing and clarification during the interviews, discussion, and follow-up as necessary (Creswell & Poth, 2018). The first step was to put the data into groups using excel spreadsheet data tables and mapping by hand into Venn diagrams (Yin, 2018, p. 175). The researcher read each interview transcript read multiple times to ensure that the entire case was considered and used tables to organize data into “causal conditions (what factors caused the core phenomenon), strategies (actions are taken in response to the core phenomenon), contextual and intervening conditions (broad and specific situational factors that influence those strategies), and consequences (outcomes from using the strategies)” (Creswell & Poth, 2018, p. 85). A Venn diagram was used to visually look at data throughout the reading process to help the researcher better understand where commonalities were occurring. I used memoing to record my observational comments so that I could fully engage in the raw data (Creswell & Poth, 2018). Using this process granted the opportunity for themes and patterns to emerge.

Data were sifted into two categories that included how teachers identify students with math anxiety and the interventions in which they use to address the anxiety. Initial pattern matching in this collective case study was performed by splitting the data into two groups of the
“how’s” and the “whys” as subgroups (Yin, 2018, p. 175). Logic models for analysis are sometimes used in cases where the researcher is looking for the cause and effect, which is a consideration in this study as the identification has to occur before the intervention can be implemented and then the effect known (Yin, 2018, p. 186). Once themes were identified, data were organized according to the theme for further analysis (Creswell & Poth, 2018). Data analysis may be the most important part of the case study as it will allow the researcher to tell the story and connect the “how” to the “why.” Using multiple cases allowed the researcher the opportunity to identify patterns between the cases as well as differences. Cross-case synthesis and analysis were used to provide additional strength for the findings. Multiple cases and methods of data collection allowed for the triangulation of data (Stake, 1995). Differences between the site populations may need to be considered in comparison (Yin, 2018). For security and privacy, all data is maintained in a secure database.

Trustworthiness

Qualitative research relies on trustworthy data rather than numbers and figures. The data measures trends and themes. Data was collected through multiple methods. There are four primary tests for trustworthiness, which include credibility, transferability, dependability, and confirmability.

Credibility

Researcher bias will need to be clarified. Two researchers who read and analyze the material and trade documents, reread material and recheck the data can establish credibility. By doing this to all methods of data collection and reaching the same conclusion, the results of the research are more credible (Creswell & Poth, 2018). Member checking by study participants will verify “the credibility” of the researcher’s “findings and interpretations” (Creswell & Poth, 2018,
p. 252). The researcher does this by taking the transcriptions of the interviews, field notes, and the researcher’s “analyses, interpretations, and conclusions” of this data “back to the participants so that they can judge the accuracy and credibility of the account” (p. 252). Member checking and allowing participants to review transcriptions improves the validity of the research findings and description of the phenomenon.

**Dependability and Confirmability**

Triangulation of data through multiple methods and resources confirmed patterns and themes. By locating “evidence to document a code or theme in different sources of data,” the researcher was able to triangulate the data and provide “validity to their findings” (Creswell & Poth, 2018, p. 251). Using multiple sources of data and multiple cases, the evidence provides various measures of the same phenomenon. Member checks provide external checks of the study to increase reliability. Dependability and confirmability are ensured through audit trails, which included the documents, data, and applications used.

**Transferability**

Transferability is increased through “thick, rich descriptions” that the reader can “transfer information to other settings” (Creswell & Poth, 2018, p. 263) to replicate the study. By using multiple case studies, the researcher will determine if methods of identification or strategies of intervention are valid across different classrooms and teachers. Some application from the results may be utilized for teachers through professional development to improve their ability to identify and work with students who suffer from math anxiety.

**Ethical Considerations**

IRB approval was obtained from Liberty University. To maintain confidentiality and privacy, all participants, schools, and the school district was assigned pseudonyms for
anonymity. Findings from the study will be shared with the participating teachers and district so that the information gained through the study could prove to be valuable in future professional developments. All information that is collected was kept in a locked filing cabinet, and electronic records will be password protected and will be destroyed after three years. As the researcher and a guest at the site, the utmost respect and discrepancy were used in terms of ethics and professionalism. All interview responses were reported verbatim, so they accurately reflect the participants’ experience (Creswell & Poth, 2018).

Summary

This chapter discussed the methods and design of this collective case study and provided the setting and the participants. This chapter also provided an overview of the methods of data collection for this study, which included interviews, document analysis, and observations. The way in which the researcher will analyze the data is also included. The conclusion of this chapter describes how trustworthiness and ethical considerations were handled.
CHAPTER FOUR: FINDINGS

Overview

The increasing anxiety in children across mathematics classrooms has generated the need for teachers to improve upon their ability to identify and work with students who are experiencing anxiousness related to mathematics. The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math-anxiety and what best practices are put in place to help reduce math-anxiety and their best practices for working with those students. Through teacher and student interviews, teacher focus group discussions, and student writing, this study examined three cases at the middle school level. Each case consisted of a teacher and three students. The cases were across three different levels of mathematics taught in the middle school. The cases were reviewed as individual cases based on their specific level of content and then cross analyzed to identify themes and patterns.

The research questions guiding this collective case study were: (a) How does a general education secondary math teacher from Virginia identify students with math-anxiety? (b) What are some methods and techniques that teachers utilize to improve the students’ experience with math to decrease their level of math-anxiety? (c) What are some challenges that teachers experience when working with students who suffer from math-anxiety? This chapter provides demographics of the participants, data obtained from the interviews, focus group, and student writing, themes and patterns generated from the data, and a summary of the findings.

Participants

The participants in this study consisted of three middle school math teachers and nine middle school math students from Virginia County School Division. The study was comprised of
a total of 12 participants. The teacher participants ranged in age from 38 to 53, two were White, and the other was Native American and White. They were all female, and their mathematics teaching experience ranged from 12 to 30 years teaching middle school math courses. The content level ranged from grade level students in the eighth-grade who were learning pre-algebra, students in seventh-grade who are considered one year advanced and learning pre-algebra, to the most advanced middle school students who were learning geometry. Student participants were all seventh and eighth-grade students whose ages ranged from 12 to 14 years old. Four of the students were male, and five of the students were female. Ethnicity information was not collected on the students. Pseudonyms were used to protect the identity of the school division and participants.

Table 4.1

<table>
<thead>
<tr>
<th>Case</th>
<th>Teacher</th>
<th>Content Level</th>
<th>Students</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Ms. James</td>
<td>Pre-algebra 7</td>
<td>Johnathan</td>
</tr>
<tr>
<td></td>
<td>12 years teaching experience</td>
<td>Seventh-grade</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Jamie</td>
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<td></td>
<td></td>
<td></td>
<td>Jaxon</td>
</tr>
<tr>
<td>2</td>
<td>Ms. Clayton</td>
<td>Pre-algebra 8</td>
<td>Christine</td>
</tr>
<tr>
<td></td>
<td>18 years teaching experience</td>
<td>Eighth-grade</td>
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<td>Caleb</td>
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<td></td>
<td></td>
<td>Cara</td>
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<tr>
<td>3</td>
<td>Ms. Palmer</td>
<td>Geometry</td>
<td>Pamela</td>
</tr>
<tr>
<td></td>
<td>30 years teaching experience</td>
<td>Eighth-grade</td>
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<td>Patrice</td>
</tr>
</tbody>
</table>
Ms. James

Ms. James is a 42-year-old Native American and White mathematics teacher in the Virginia County School Division. She is a career switcher who moved from a career as a computer programmer to teaching. She has experience teaching middle school grade level seventh-grade content through high school Geometry. She changed careers when she decided she was no longer satisfied with her career choice. Although she believed the income to be lucrative, the joy was no longer there.

Ms. James started out in a neighboring division that provided a career switcher program where she taught for four years at the middle school math level. She then moved to a gifted school nearby where she taught Algebra and Geometry to middle school students. She has now been at the Virginia County School Division for four years and has 12 total years of teaching experience. Currently, Ms. James teaches one grade level content seventh-grade class and two seventh-grade pre-algebra classes. Pre-algebra in the seventh-grade is considered to be one level advanced for this division.

Ms. James’s undergraduate degree was in math and computer science, which led her to choose math as the subject area that she would teach. She chose the teaching profession based on her belief that it was something that she would enjoy and would be good at and that the schedule would complement motherhood. She already had one child and planned to have another. She also knew that because of her undergraduate degree in mathematics that should be able to pass the praxis. Ms. James also has endorsements in computer science and gifted. She chose middle school math because she believes that this is when students learn to love or hate math and feels that it is directly related to their experience and success.
In our interview, Ms. James's excitement and passion for teaching were evident. She feels that she has students in every class, every day, that are experiencing some level of math anxiety. She most often recognizes anxiety through what she describes as student negative self-talk, which is when students express things like “I can’t do this, I’m not good at math, I hate math,” students acting out, or students shutting down. She considers changing the way students feel about math to be one of her biggest personal work goals. Her goal is for all students to at least like math before they leave her class.

Ms. James plans engaging lessons with the intent to make math as fun as possible. She uses best practices daily for all her students, which included chunking notes and lessons into more management pieces. She thrives on simplifying the process to ensure that all her students are able to get the concept. The most important thing to Ms. James is giving students some level of success. She strongly believes that when students experience even a small bit of success, it will build their confidence, and they can continue to grow and draw from that positive math experience to become better math students. She admits that she tends to encourage the girls in class more than the boys to combat the stereotype that girls are typically not good at math. The difficulty at this point is the virtual environment. When students are in class, she can read their faces, their body language and pick up on the struggles, but with most students refusing to turn their cameras on and just the nature of virtual teaching and learning, it has been hard.

Ms. James views herself as a math teacher that works well with all students. She believes that she does a good job identifying students with math anxiety in most cases. There have been a few times when she has been contacted by a parent about a student who is experiencing anxiety, and she had no idea. The student had put on a good act of being calm and clued in a while in
class. The middle school environment is where she believes that students' experience with math is pivotal on what path they continue down in their educational career.

**Johnathan** (student)

Johnathan is a seventh-grade pre-algebra student. He likes school for the most part, but he does feel anxious about school in general sometimes. His favorite subject in school is math. He thinks that people find this surprising because he struggles sometimes. His least favorite subject is science because he feels like it is hard for him to understand. Overall, he feels like he is a good student, but must work hard to get good grades; they do not come easy for him.

When asked about math and his general feelings toward math, Johnathan responded that he mostly likes math and enjoys learning it. He believes that he is good at math until there are too many new concepts and then his brain feels scattered, and he begins to get fidgety, and that is when he begins to feel anxious. He has always felt anxious about math. Johnathan blames his math related anxiety on past math teachers who did not support or work with him when he struggled to learn new concepts. He considered that they just gave up on him and did not feel like he was worth their time.

Johnathan thinks his performance in math is good. He did admit that it could be better and that it changes sometimes daily depending on the actual skill being taught. Currently, he is enjoying learning math and feels like his teacher is helping him get better at math. He believes that he always tries his best and is willing to ask questions when he needs help. His willingness to ask for help and advocate for himself makes him a better math student. His overall attitude is positive, and he is really enjoying learning math this year because his teacher has helped him gain so much confidence. When he makes mistakes or may be feeling anxious, she takes him aside and talks to him to make light of his mistakes and teaches him how to work through the
mistake. Her positive attitude and support make him want to do better for her; he wants to make her proud.

**Jamie** (student)

Jamie is a seventh-grade pre-algebra student. She has a positive attitude about school. She has rather enjoyed the switch to virtual learning during the pandemic because even though she has a positive attitude, she admits that school does stress her out. She misses her friends, but does not miss the drama that is typical in middle school. Her favorite subject in school is English. She is good at it, and she finds it very relaxing. Science and Spanish are her least favorite subjects. In science, she struggles to learn the new content, and in Spanish, she does not get it and finds it irritating. Her favorite thing about school is sports.

When asked about math and her general feelings toward math, Jamie responded that she likes math, but it does depend on the math teacher. She has mixed emotions about math because, in her opinion, the teacher makes make fun and easy or hard and boring. She believes that she can be good at math when given the opportunity for help when she needs it. She does often feel anxious about math. Jamie stresses out about new concepts and the number of new things that she expected to learn at one time. The pace may often be more of a problem than the material, which she feels comes with advanced math.

Jamie thinks her performance in math is good most of the time. She does struggle when too many new things are covered in one class. She considers herself a hard worker who always wants to do well. Her attitude about math changes, but it is mostly positive. Good grades are important to her, and this drives her to do whatever she can to learn the material. Jamie considers a teacher a good teacher when she/he is willing to go over the concepts until she understands it. This sometimes requires the math to be broken down into smaller parts, and she likes when the
teacher is willing to do that because it eases her anxiety. A good teacher believes in her and helps boost her confidence and builds her self-esteem. When she has good math teachers, she is always able to meet her goals.

**Jaxon** (student)

Jaxon is a seventh-grade student taking Pre-Algebra 7. He has always lived in this area, so he has many longtime friends in his classes. Overall, he enjoys school and does not feel overly anxious about school. His favorite subject is science, because he easily understands it and does very well. He is very interested in science. His least favorite subject is English. He finds it boring and does not do very well. He feels like no matter how hard he tries in English, he just does not get any better. Jaxon feels like his grades are better in classes that he is more interested in.

When asked about math and his general feelings toward math, Jaxon describes his feeling as pretty good most of the time. He may feel some anxiety toward math but not a lot or not consistently. He believes that he is good at math. He struggles every now and then but not all the time. His struggles stem from too much work at one time more than the concepts. Jaxon likes math and feels like he better understands math when teachers break it down into small pieces. Even being in an advanced math class, he feels like he still must work hard to learn some skills because it does not always come easy to him.

Jaxon thinks his performance in math is good. He is willing to put in the work to get the grades. His attitude toward math is positive. He enjoys the challenge of math. It makes sense, and he often views it as a puzzle. Jaxon believes that the teacher can really make math fun and engaging. He loves when the teacher plays games or does things like scavenger hunts to help the students learn math. He believes that teachers highly impact his attitude. Although his success or failure is on him, the teacher really affects how anxious he is when it comes to learning math.
Ms. Clayton

Ms. Clayton is a 38-year-old White mathematics teacher in the Virginia County School Division. She began college with plans of medical school but then later changed to education. She just came to realize that she really enjoyed math and teaching and changed her degree path to education. She had two teachers in high school that impacted her love for math. Her calculus teacher is the one that was able to make her believe that she could do it even when she felt like she could not, while another teacher drove her crazy but in a way that had a positive impact. This influence has helped her to become the math teacher that she is.

Ms. Clayton started her teaching career in a very small rural county school in North Carolina and taught there for two years. She then moved to a very large, diverse school division, where she taught for seven years. In this division, she served a very transient and diverse group of students with many military families moving in and out. She also had students from both ends of the socioeconomic spectrum as the school’s zone included very wealthy households as well as trailer park communities and neighborhoods known to have street gangs. She then joined the Virginia County School Division and has been there for now for nine years. During her 18 years of teaching middle school math, she has taught mostly seventh and eighth-grade level content.

Ms. Clayton feels that she has students every day that suffer from some level of math anxiety. Being a grade level content teacher at the eighth-grade level, the students tend to struggle with math. She believes that sometimes the anxiety is from the amount of work, but more often, it is from missing something in the teaching at the beginning of class and not being able to get caught up. She described it as riding a bike. The students are peddling as hard as they can, but the peddles on their bike won’t move fast enough, and they are being left behind. This, in turn, can cause the student to shut down as they become frustrated.
Ms. Clayton identifies students that are suffering from math anxiety as those who are often avoiding work by asking to leave the room for random requests such as water or the restroom. She also identifies students who act out or possibly shut down as students who are anxious and unable to perform. When a student acts out, she sees it as a coping mechanism to avoid embarrassment for not knowing how to do the math or wanting to ask a question. Virtual teaching during the pandemic has made it much more challenging. The cues that she is able to pick up on in class are no longer there as students are not required to turn their cameras on, so therefore, they do not. Virtually she identifies kids that are not getting work done, not attending class meetings, or have gone completely dark.

Ms. Clayton has a passion for building relationships and working with students. Because she teaches students who are on grade level, and many of them struggle with math, she has many built-in practices for all of her students. She considers best practices to be working with students one on one, small group instruction and helping students achieve success. Ms. Clayton believes that creating a positive experience when a student makes a mistake allows others to see that mistakes are acceptable and they are safe. She tries to build them up with what they do well so that when they fall short, they still have something to build and grow from. Her classroom and students become a family and really gain a sense of community, and she has expectations for how they are to treat one another and work together.

Ms. Clayton feels that she does well identifying and working with a student who has math related anxiety. She admittedly has missed identifying some students and then later stumbled upon it when a specific skill or concept makes it more obvious, and she realized that there were signs that she missed along the way. Ms. Clayton believes that if she makes her room a safe place and builds relationships with her students right away, she is able to recognize when
students struggle better. The virtual environment has been difficult because she has been unable to establish the same warm environment that she is used to providing. The students do not turn their cameras on, and she is unable to read faces or body language. She has also experienced students who have refused help, and that has been her most frustrating experience as it is not always a struggle with math but a struggle with life. Ms. Clayton’s goal is to provide the best experience for students in her math class so they will grow to learn and love math as much as she does.

Christina (student)

Christina is an eighth-grade student in Pre-Algebra 8. She is part of a military family and moved many times during her school career. She feels that she adjusts well. Overall, she is enjoying school but admits that sometimes it does stress her out. Her favorite class in school is Chorus because she likes to sing and have fun with her friends. Her least favorite class is English. Christina feels like the passages are too long, and there is too much work assigned each day. She dreads the long passages and writing; it is just not something that she enjoys.

When asked about math and her general feelings toward math, Christina responded that she mostly likes math, but it depends on the skill being taught because sometimes she struggles more than other times. She doesn’t feel like she is anxious about math all the time but again, it depends on the skill because it can be tricky, and when she struggles, she becomes anxious. When new material is being introduced, she feels much more anxiety until she determines if it is going to be something that she understands or something that is going to take more work. If it takes more work or time to understand, that is when she begins to feel behind and gets anxious.

Christina feels her performance in math is fairly good but knows that she has to work hard to keep her grades up. Math does not come easy for her, and she has struggled from time to
time. Her overall attitude toward math is positive unless she falls into a place where she severely struggles, and things just do not work out. She believes that a good math teacher is someone with who you can ask for help without fear of being embarrassed or called out about not knowing how to do something. She believes that teacher is able to recognize when she feels anxious because she seems to always come to her rescue when she is having a hard time. Her teachers are available at times outside of class time to get help, and that makes her more confident because it relieves the sense of having to get it right now. It is the support of her teacher that helps her to believe that she can do it.

Caleb (student)

Caleb is an eighth-grade student in Pre-Algebra 8. He comes from a military family and does have to move whenever his dad gets new orders. He does not feel like he moves around often but does move some. He is generally anxious about school and often dreads going. His favorite subject in school is math. He really enjoys working with numbers and would like to have a job in space engineering. His least favorite subject is history and English. He feels like history is very hard for him. English is not necessarily hard for him, but he finds it annoying with all of the reading and writing.

When asked about math and his general feelings toward math, Caleb responded that it makes him happy. He really loves math and enjoys working with numbers and figuring out problems. He does get anxious in math sometimes when new skills are being taught, and he is scared that he will not understand it. Caleb really works hard because he wants to do his best, and although he loves math, it is not easy for him. He feels anxious and stressed when he struggles with a concept. He believes that his overall performance in math is good but feels that
it could be better. His test scores tend to be lower, and he attributes that to being anxious when taking tests.

Caleb has a great attitude about math, and he believes that his attitude does impact his performance. He recognizes that when he gets anxious about math, his performance or grade is typically affected. He feels this more in testing than in everyday class work. He believes that his teacher is very important in how he feels about math because their willingness to help him and walk him through more difficult work helps his confidence. He believes a good teacher is able to notice when he is struggling, although he is willing to ask questions when he gets stuck. His goal is to have a job where he gets to work with numbers and uses math.

Cara (student)

Cara is an eighth-grade student in Pre-Algebra 8. Without prompt or question, she disclosed that she has an IEP and gets small group instruction and extra help through an additional class. Cara is part of a military family and feels like they have moved around a lot. Generally, she feels that school is okay, but with moving so often, she does not always feel good about going because it is hard to get settled into so many new places. She enjoys band the most. She plays the flute and really likes playing music, and this is the class that she feels like she has the most friends. Her least favorite subject is math because it is the hardest for her.

When asked about math and her general feelings toward math, she responded that she hates it and feels like she should not have to do it. She does not see the purpose of it or how it helps her in life in any way and believes that she should not have to learn math. Cara feels like she has extreme anxiety toward math because she does not understand it, and it is so difficult for her. She believes that she has always felt this way about math. She cannot remember a time when she did not struggle with math. Cara’s performance in math is low. She struggles to get the
concepts. She believes that her attitude does impact her ability to learn, but she cannot get past believing that she is horrible at math.

Cara believes a good teacher is someone who makes it fun and can help her to understand math. Her current teacher is fun, but she still struggles with math. The resource class that she is in just frustrates her more because it is more math, and she does not like it. The constant struggle and feeling of behind making her extremely anxious about math. She knows that she does not perform as well as others in her class, and this makes her feel inadequate and results in her not doing her work in most instances. Cara believes that her attitude does impact her performance but does not believe it will ever change because she does not believe that she will ever be able to do the math.

**Ms. Palmer**

Ms. Palmer is a 53-year-old White mathematics teacher in the Virginia County School Division. She decided to go to college for mathematics because she experienced a terrible math teacher that just made them memorize facts, and she felt that she could do a better job. She was a good math student and did not struggle, but she also does not consider herself a mental math person. In college, she completed a secondary mathematics program and student taught in third, fifth, and eighth-grades. She considered switching to elementary education at one point before she decided that the younger students were too touchy. She decided that she liked the middle grades as that is where she felt could be most impactful.

Ms. Palmer was a late hire, after the first quarter, at Virginia County School Division. She is currently in year 30 at the same middle school where she began teaching. She has taught every math content at the middle school level other than grade level sixth grade math. She has taught seventh and eighth-grade level math as well as Algebra I and Geometry. For the past few
years, she has only taught Algebra I and Geometry, which are both considered advanced courses at the middle school level. Ms. Palmer really enjoys working with the advanced students and loves that they challenge her and keep her excited about teaching.

Even after 30 years, Ms. Palmer’s excitement for teaching students and her love for math is evident. She believes that she has students in the classroom every day that experience some level of math anxiety. Most advanced students constantly seek perfection and feel pressure from their peers to be the best. Discussion of test scores is not about passing as much as who has the highest score. She believes that building their confidence is important to help them understand that they are smart and capable. Many of her students not only deal with self-induced pressure but also experience pressure from their parents to be exceptional students.

Ms. Palmer identifies a student who is experiencing math related anxiety in her classroom by their body language and facial expressions. She believes that by reading their faces, she knows when they understand a concept, like when they get it versus when they are lost and frustrated. When students are struggling, they tend to fidget or check out, or you can see that their wheels are turning but just not quite getting there. When she notices a student in class that seems to be festering, she can talk them down and provide immediate help and feedback to get them on the right track. There have been times when Ms. Palmer has not identified a student as having math related anxiety and has been contacted by a parent that their child is really stressed out. She believes that students at this level experience anxiety not only based on ability, but also about the amount of work. In the virtual setting, it has been extremely difficult to identify students who have math anxiety. They are not turning their cameras on, so she cannot see their body language and facial expressions.
Ms. Palmer has a real dedication and excitement for working with these advanced students. She feels like she is able to push and challenge them to be their best in math. She creates a safe environment for her students where they know that it is okay to make mistakes. Reassuring students and building confidence are very important to her as she feels that it affects the student’s overall performance in her class. She puts scaffolding into place to catch students who may struggle or may experience math related anxiety. Even students who are advanced will struggle from time to time, and it really shakes their confidence. Ms. Palmer is very experienced at reading her students and knowing when she needs to break things down into more manageable chunks. She circulates the room continually, monitoring the students' work and asking questions, but when she comes upon a student who may be struggling, she immediately starts chunking and repeating instructions to the whole group as not to embarrass or call attention to that one student. This also helps others that may be struggling that she has not reached yet. She also sets study groups on a routine basis so students have an opportunity to get help in a less threatening way than with all of their peers. Although she notes that many of her students that routinely attend the study sessions come in pairs with their friends whether the other student needs help or not.

Ms. Palmer feels that she is good at working with students with math anxiety when she recognizes it. She does believe that in the advanced courses, it is harder to identify as students work harder to put on a façade in front of their peers. Even at the middle school level, advanced students are competitive with their scores and gauging who is the best. She believes that many of her students hide anxiety well and then explode when they get home. They feel a lot of pressure from parents in many cases to be the best or to be advanced. Ms. Palmer has large class sizes due to the nature of the advanced course and feels that this may impact her ability to identify all students who are suffering from math related anxiety.
Pamela (student)

Pamela is an eighth-grade student in Advanced Geometry. Ms. Palmer did not identify Pamela as a student who she believed to suffer from math related anxiety. Pamela generally likes school and feels that overall, she does well. Her grades are good, and she is in advanced classes. Her favorite subject in school is English because she likes the ability to be creative and to learn to become a better writer. She enjoys reading and loves learning new words and reading about new things and places. Science is her least favorite subject because she feels that it is difficult for her to understand. Even when she feels that she understands things in science, she doesn’t always agree with it.

When asked about math during the interview, Pamela expressed that she feels confident about math most of the time and enjoys it because it does challenge her. She does not feel apprehensive about math routinely but does sometimes experience anxiety. Her anxiety mostly occurs when she feels as if she is falling behind or struggling to understand a specific concept. Although she is a very good math student, there are times that she does not catch on right away, and it quickly becomes overwhelming for her. Her overall performance in math is very good; she always achieves pass advanced on state standardized exams. Pamela believes that her attitude toward math has a significant impact on her performance in math. She has had times when she felt that the work was monotonous, and it was those times that her grade would fall and because she is academically driven, she would self-correct.

Pamela believes that a good teacher is someone who understands the struggles that students may experience in math. She believes that when a teacher can relate to what students are going through, they are better at explaining it and reteaching in a way that she can understand it. Pamela appreciates teachers who provide out-of-class opportunities such as study groups or help
sessions so she can reach out on a more individual basis for help when needed. She believes a good teacher is supportive and does not always expect perfection but rather accepts mistakes and helps her grow from them.

**Patrick (student)**

Patrick is an eighth-grade student in Advanced Geometry. He feels good about school overall. He really enjoys being in all advanced classes. His favorite subject is science because he feels like it challenges him the most and is the field of study that he wants to pursue. His least favorite subject is English, not that it is difficult, but he thinks it is boring and does not like the long writing assignments. His grades are good in school, although he does sometimes feel anxiety but mostly when taking exams. Patrick admits to feeling the need to be perfect and does feel pressure from his parents to excel academically.

When asked about math and his general feelings toward math, he responded that he felt it was exciting and really enjoys it. He likes the challenge of learning new skills. He plans to go into a field in science and believes that math will always be part of his work. Patrick does not typically struggle with math, and most concepts come rather naturally to him. He does experience some level of anxiety when it comes time to take an assessment. He also stresses out when the work piles up, and he feels that his teacher loads them up with work since they are advanced students. The amount of work is more than double any other class he has ever taken, with homework often requiring an hour or more per night. The class meets every other day so he thinks this is why the amount of homework is so much.

Patrick feels like his performance is in math is very good. His scores passed advanced on the state standardized assessments. He scores high marks on most assessments in class. His attitude is positive, but occasionally he lets anxiety get the best of him at test time and may fall
short of his goal. He is a hard worker and always attends help sessions when he is feeling anxious. His parents put a lot of pressure on him to score pass advanced on state testing, and this also adds to his anxiety. A good teacher to him is someone that is willing to break down the material into small and manageable pieces. He also likes when the teacher provides opportunities outside of class for help. He would like a teacher that would reduce the amount of work based on mastery versus requiring excessive practice on skills that he has already mastered.

**Pria (student)**

Pria is an eighth-grade student in Advanced Geometry. She likes school overall and has no negative feelings toward school. She enjoys the challenge of being in all advanced classes. His favorite subject is math because she feels likes that it is continually building on itself. Her least favorite subject is civics because she does not like all the memorizing and hates politics. Her grades are good in school are typically straight A’s. She feels like she struggles with exams because she lets the pressure get the best of her. She does feel pressure from home as her parents both have what she considers to be great jobs, so they expect her to do well.

When asked about math and her general feelings toward math, she responded that she felt happy about math. She enjoys the challenge and often views math content as puzzle pieces that she is trying to put together. She likes the fast pace of advanced math, although when she struggles with a concept, she immediately feels nerves set in because she is afraid that she won’t be able to catch up. When she becomes overwhelmed, she experiences a level of anxiety as well as when she is testing. Pria does not experience high anxiety for every test, just high stakes testing such as state standardized testing or when she feels that she is really not ready for it. Even with the anxiety, she still really enjoys math and hopes to find a career that will include using math.
Pria feels like her performance is in math is very good. Her scores passed advanced on the state standardized assessments. She does well on classwork and assessments and usually has an A average. Her attitude is positive because even when she struggles, she still enjoys the challenge of figuring it out and becoming a better math student. She is a hard worker and will seek out help if needed. With the information on the internet, she feels like she can also find help. A good teacher to her is someone that is able to break skills down so she can understand them. She likes for them to be available or offer some time outside of normal class time to get help one on one. Pria really appreciates that her current math teacher offers scheduled help sessions a couple of days per week, so that is like a safety net for her. This helps ease her anxiety about being left behind. Even with the virtual environment, she has felt successful because of these extra help sessions and personalized help.

Results

This section will include detail of theme development, responses to research questions, and an overview of the findings of this study. Patterns and themes were identified across cases all cases. Themes evolved of how teachers across the three cases were able to best identify students who suffer from math anxiety. Patterns emerged of what teachers believed to be best practices to effectively respond to math anxiety.

Theme Development

The purpose of this collective case study was to determine how middle school math teachers identify students who suffer from math anxiety and what they considered to be effective best practices to reduce anxiety and allow students to experience success. Data were collected through interviews, focus groups, and student writing. Data were recorded, transcribed, organized, and analyzed. According to Yin (2009), the strategy of pattern matching is “one of the
most desirable techniques” (p. 136) when analyzing case studies. Patterns and themes were identified for each case. Cross-case synthesis was used to compare the cases (see Tables 4.2 and 4.3). The “technique treats each individual case as a separate case study” (Yin, 2009, p. 156). Patterns and themes across cases were identified using aggregation (Stake, 1995). I identified three patterns across all three cases that teachers used to describe students who they believe suffer from some level of math anxiety: self-esteem, body language, and work avoidance. I also identified four patterns across all three cases that teachers consider to be effective best practices: safe classroom environment (accepting and teaching from mistakes, being supportive), small group (one to one, help sessions), chunking content (breaking it down), and building confidence (positive feedback, building students up).

Table 4.2

Comparisons of Identifying Characteristics of Math Anxiety among Mathematics Teachers

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<thead>
<tr>
<th>Case 1 - James</th>
<th>Case 2 - Clayton</th>
<th>Case 3 - Palmer</th>
<th>Common Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Self-esteem</td>
<td>• Overwhelmed</td>
<td>• Facial cues</td>
<td>• Self-esteem / lack of confidence</td>
</tr>
<tr>
<td>• Negative self-talk</td>
<td>• Work avoidance</td>
<td>• Body language</td>
<td>• Body language</td>
</tr>
<tr>
<td>• Body language</td>
<td>• Not doing work</td>
<td>• Shut down</td>
<td>• Shutting down</td>
</tr>
<tr>
<td>• Shut down</td>
<td>• Shut down</td>
<td>• Fidgeting</td>
<td>• Acting act</td>
</tr>
<tr>
<td>• Acting out</td>
<td>• Acting out</td>
<td>• Perfection</td>
<td>• Incomplete work / avoidance</td>
</tr>
<tr>
<td>• Work avoidance</td>
<td>• Struggling</td>
<td>• Pressure</td>
<td>• Confused</td>
</tr>
<tr>
<td>• Confidence</td>
<td>• Push away</td>
<td>• Competitive</td>
<td>• Confused</td>
</tr>
<tr>
<td>• Not doing work</td>
<td>• Avoid contact</td>
<td>• Embarrassed</td>
<td>• Lack of confidence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.3

Comparisons of Best Practices among Mathematics Teachers

<table>
<thead>
<tr>
<th>Case 1 - James</th>
<th>Case 2 - Clayton</th>
<th>Case 3 - Palmer</th>
<th>Common Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Showing work</td>
<td>• Chunking</td>
<td>• One on one</td>
<td>• Teaching from mistakes</td>
</tr>
<tr>
<td>• Approachable</td>
<td>• Sense of classroom family</td>
<td>• Breaking it down</td>
<td>• One on one or small group instruction</td>
</tr>
<tr>
<td>• Mistakes are acceptable</td>
<td>• One on one</td>
<td>• Using mistakes to teach</td>
<td>• Chunking / breaking it down</td>
</tr>
<tr>
<td>• Not scary</td>
<td>• Positive reinforcement</td>
<td>• Building confidence</td>
<td>• Positive feedback / building confidence</td>
</tr>
<tr>
<td>• Classroom community</td>
<td>• Accepting mistakes</td>
<td>• Positive feedback</td>
<td>• Help sessions</td>
</tr>
<tr>
<td>• Breaking it down</td>
<td>• Flexibility in methods</td>
<td>• Safe classroom</td>
<td>• Supportive</td>
</tr>
<tr>
<td>• Positive feedback</td>
<td>• Positive reinforcement</td>
<td>• Study sessions</td>
<td>• Positive / safe classroom environment</td>
</tr>
<tr>
<td>• Help sessions</td>
<td>• Small group</td>
<td>• Reassurance</td>
<td></td>
</tr>
<tr>
<td>• Building confidence</td>
<td>• Help sessions</td>
<td>• Challenging them to be better</td>
<td></td>
</tr>
<tr>
<td>• Success</td>
<td>• Supportive</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Interviews.** I conducted 12 interviews for this collective case study. Each teacher and group of three students per case were interviewed via Microsoft Teams. Teachers were all interviewed from their school locations, in their classrooms where they felt comfortable and safe to speak openly (see Appendices H). Teachers were selected by the division math coordinator based on the following criteria: (a) had been teaching math for more than three years and (b) has a history of working well with all students. Teachers were purposefully selected from the three different paths students can take in middle school, including on grade level, one year advanced, or two years advanced. Selected teachers were then emailed recruitment letters (see Appendix C). Teacher interviews were scheduled at their convenience and, upon receipt, signed consent form (see Appendix E). Each teacher selected one class of students to invite to participate in the study. All students were provided with the student recruitment letter (see Appendix D). Upon
return of parental consent forms (see Appendix F), student interviews were scheduled at a time that was convenient for them. Student interviews were conducted via Microsoft teams. Students were interviewed from their homes, where they felt comfortable and safe to openly participate in the interview (see Appendix J).

**Focus Group.** A focus group was formed to include the three teachers in the study and the researcher. The focus group was conducted and recording using Microsoft Teams at a time when all teachers could be present and not distracted. The conversation was recorded and then transcribed. Common themes and patterns were identified (see Table 4.4). The participants were provided a copy of the focus group questions (see Appendix I). When asked about the characteristics of a productive learning environment, the conversation centered around a clean, comfortable, and safe environment for students to engage in learning math. Ms. Clayton stated that she really wanted students to know that they matter. Ms. Palmer felt that “a non-judgmental environment was key to students taking risk.” Ms. James agreed that “students should be comfortable to make mistakes.” All three teachers talked about the importance of students having fun and being engaged.

The participants openly discussed the practices that they each have in place to help students feel safe to make mistakes in the classroom. Ms. James pointed out that she “often makes mistakes and thanks to students for correcting her.” She believes that this sets the example that mistakes are accepted and that we learn from them. Ms. Clayton interjected that she sometimes makes mistakes on purpose to create the opportunity to learn from the mistake. The group really emphasized how important it is to be non-judgmental and to focus on building self-confidence.
The first signs of a student that is experiencing anxiety varied, but the theme was common with students disengaging from class through either work avoidance, acting out, using excuses to leave the room, or negative self-talk. The teachers agreed that the easiest signs were the physical cues that are observed through body language, facial expressions, and negative comments about math. There was also agreement that not all students present the same. Ms. James indicated that she often uses past scores to survey her class prior to the year starting and often depends on parents for input. All the teachers agreed that relationship building is key to getting to know your students, which may help you recognize some of the behaviors that coincide with math anxiety. Ms. Palmer, who teaches the most advanced students, admits that she struggles to identify students that struggle with math anxiety because she believes that due to their competitive nature that they tend to hide it very well to save face with their peers.

The response to the structures that teachers have in place was the most robust part of the conversation. All three teachers focus on relationship building and encouraging their students. They all focus on building self-esteem and instilling in students that they have the ability to accomplish anything that they set their minds to. Ms. Palmer stated, “even though my kids are advanced, they are really hard on themselves when they struggle, and I continually tell them that they are super-duper smart and that they can do this.” All three teachers provide students the opportunity for one-to-one help, small group instruction, re-teaching when needed, routine checks for understanding, and flexibility in methods of teaching and assignments. Ms. James added that she likes to provide choice assignments for students. Peer tutoring or strategic grouping is also something that is commonly used to help students learn from one another. Ms. Clayton believes that “pairing stronger students with weaker students during classwork benefits them both.” Ms. Palmer added that “when a student can teach it, they really understand it.”
When asked about the relationship between math anxiety and performance, Ms. James stated, “for some, anxiety is what fuels success, and for others, it can be paralyzing.” As a group, the teachers discussed this statement. They all believe it to be a true and accurate statement about many of the students who they teach. Ms. Palmer spoke about her advanced students and how the pressures from home and their parents are often what is creating anxiety. Ms. Clayton believes that “there is a strong relationship between math anxiety and math performance.” They all agreed that the inability to perform could cause some level of math anxiety; however, there are often other factors that contribute. Ms. James stated, “anxiety does not dictate performance because it is all in how the student deals with their anxiety.” Ms. Palmer added that many of her student’s anxiety comes from the need for perfection more than their inability to perform. The group did agree that anxiety can affect performance, but performance can also affect their anxiety level. Ms. Clayton described it as a “double-edged sword”. The final thought of the group was that as educators, it is our responsibility to provide opportunities for students to explore, experience success, experience failure, and learn to grow from it.
Table 4.4

Focus Group themes of Best Practices among Mathematics Teachers

<table>
<thead>
<tr>
<th>Productive Classroom Environment</th>
<th>Common Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case 1 - James</strong></td>
<td><strong>Case 2 - Clayton</strong></td>
</tr>
<tr>
<td>• Clean environment</td>
<td>• Warm atmosphere</td>
</tr>
<tr>
<td>• Comfortable space to work</td>
<td>• Community environment</td>
</tr>
<tr>
<td>• Open communication</td>
<td>• Classroom family</td>
</tr>
<tr>
<td></td>
<td>• Students feel</td>
</tr>
<tr>
<td></td>
<td>like they matter</td>
</tr>
<tr>
<td><strong>Common Themes</strong></td>
<td><strong>Common Themes</strong></td>
</tr>
<tr>
<td>• Clean environment</td>
<td>• Friendly</td>
</tr>
<tr>
<td>• Comfortable space to work</td>
<td>• Encouraging</td>
</tr>
<tr>
<td>• Open communication</td>
<td>• Safe to ask questions</td>
</tr>
<tr>
<td></td>
<td>• Non-judgmental</td>
</tr>
<tr>
<td><strong>Practices for students to feel safe to make mistakes</strong></td>
<td><strong>Practices for students to feel safe to make mistakes</strong></td>
</tr>
<tr>
<td>• Learning from mistakes</td>
<td>• Positive reinforcement</td>
</tr>
<tr>
<td>• Help students fix mistakes</td>
<td>• Accepting mistakes</td>
</tr>
<tr>
<td>• Struggle through mistakes</td>
<td>• Embrace mistakes</td>
</tr>
<tr>
<td>• Good mistakes</td>
<td>• Use mistakes for teaching</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>The first sign of math anxiety and common characteristics</strong></td>
<td><strong>The first sign of math anxiety and common characteristics</strong></td>
</tr>
<tr>
<td>• Acting out</td>
<td>• Excuses</td>
</tr>
<tr>
<td>• Talking</td>
<td>• Work avoidance</td>
</tr>
<tr>
<td>• Work avoidance</td>
<td>• Negative behavior</td>
</tr>
<tr>
<td>• Quiet</td>
<td>• Shutdown</td>
</tr>
<tr>
<td>• Withdrawn</td>
<td>• Rushing just to finish</td>
</tr>
<tr>
<td>• Negative self-talk</td>
<td>• Leaving class</td>
</tr>
<tr>
<td>• Physically frustrated</td>
<td></td>
</tr>
<tr>
<td>• Fidgeting</td>
<td></td>
</tr>
<tr>
<td><strong>Built-in classroom structures and best practices</strong></td>
<td><strong>Built-in classroom structures and best practices</strong></td>
</tr>
<tr>
<td>• Flexibility</td>
<td>• Small group</td>
</tr>
<tr>
<td>• Accept late work</td>
<td>• One to one</td>
</tr>
<tr>
<td>• Support</td>
<td>• Peer tutoring</td>
</tr>
<tr>
<td>• One on one</td>
<td>• Flexible grouping</td>
</tr>
<tr>
<td>• Small group</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Student Writing. Students were asked to write a letter to a new, future math teacher. The letter was to help the new teacher understand from a student’s view what a good math teacher looks like. Students were provided with a writing prompt with sentence stem ideas to help their thinking (see Appendix L). Three of the students’ responses are included (see Figures 4.1, 4.2, and 4.3). The samples provided are a good representation of what characteristics that most students consider to be important in a math teacher. Students are looking for fun, engaging math classes where they can be comfortable making mistakes and learn from them. One student stated, “I learn best by using hands-on activities, working in groups, and using fun educational activities” (Student 1, personal communication, 2/8/21). They do not want to feel embarrassed in front of the class, and they need positive feedback and guidance. Students want teachers who can recognize when they are anxious or struggling and come to their rescue. They also need a teacher that they are comfortable enough with to ask questions as confirmed by another student who stated, “I think that if you show that you are a fun-loving person and can joke around, students feel comfortable to come to you and ask questions” (Student 2, personal communication, 2/23/21). All students seem to dread when new math content is being taught unless it is something that they are already familiar with. Students enjoy working in small groups, and many think it is important to have study sessions outside of class.
Dear Ms. New Math Teacher,

I’m so excited for you to be our new math teacher. I absolutely love math, but sometimes math can intimidate me. Math makes me feel anxious at times because I don’t understand the material, I’ve gotten a question I felt sure I knew the answer to wrong, or I feel like my classmates are way too far ahead of me. I do enjoy math and find it rather challenging sometimes. I find that the more challenging math is, the more of a chance to grow I have. I feel anxious when being called on in class sometimes because I don’t like speaking in front of people and I’m nervous that I may get the question wrong. I feel anxious when I walk through the door of math class sometimes because I worry that my clothes look weird, I should have brushed my hair, that the math concept we’re learning in class will be hard to understand, or that I may fail my test, even though I studied for it. I feel unprepared for math class sometimes because my older sister likes to explain math concepts to me and sometimes makes them seem waaaaaay more difficult than they are. I also struggle because my teacher can sometimes be a little bit boring. I have a book I want to sneak a peck in, and I find it hard to pay attention. I also feel anxious sometimes in math when other students are showing off their math scores because I often get labeled “Nerd” because my score is higher than their score that they were so proud of, or my score is lower than their score and I get labeled as “dumb, stupid, not smart, or idiotic”. It can also be hard not to second guess myself. I enjoy being in math class when we are learning something that I already know because I feel prepared, ready, and confident. Students will be more comfortable in your classroom if you have a relationship with them, you include fun activities in the school year, or if you use fun mnemonics, use engaging videos, and explain, explain, explain. I feel valued by my teacher if, they compliment me for solving the math problem correctly, ask me to help other students, or tell me that they think I am doing a good job. I learn best by using hand-on activities, working in groups, and using fun educational activities. You can help your students by offering help sessions for them when they need it and by using engaging activities. I hope this advice and bits of personal experience can help you be the best math teacher you could possibly be. Have a great day.

Sincerely,
Figure 4.2 Student writing sample #2

Dear New Math teacher,

Math is very hard for me and it gets me very anxious. I know that you can tell by the look on my face that I am lost. Sometimes I am scared to ask for help, cause a teacher might get frustrated that I didn’t understand right away. So, I usually just sit there in silence. I am getting much better though at asking questions. My teacher tells me that she is proud of me for always asking and not being nervous anymore. I do need to work on when I get called on a question, I feel that if I answer it wrong that other kids will laugh or make fun of me. I wish that things didn’t move so quickly in math class and that they could take another week to go over lessons that may be harder to understand. I wish that every teacher was positive and upbeat and would always tell kids if you don’t understand just ask and always remind kids of that. It took me a long time to start asking and I think that since I did, I have learned a lot more and it has made me a little less anxious.

I think that new teachers should be aware of things to look for when a kid is anxious. My brother has a tic when he gets nervous where he tilts his neck to the side multiple times. He had a teacher that would just ignore him so now he doesn’t really speak to teachers at all unless he absolutely has to. I just use to just sit there, and wish that a teacher would say hey buddy you need some help. Sometimes I felt hopeless cause teachers would just walk past. Kids with [paint] really need a little extra help. I came to Virginia from a really small school in New Jersey and the teachers kinda just ignored me and would send me off to the resource room for some else to deal with me. I was never really in my actual classroom for grades 2-6. I just want that feeling that a teacher does care. I never got that feeling till I moved to Virginia and the teachers and the resource teachers actually showed that they care about helping me. I love being in smaller groups so that if I don’t get something, I feel more comfortable asking, or the teacher will notice me sooner and that I’m struggling. I think that smaller groups should be all the time. I think that if you show that you are a fun loving person and can joke around to make kids feel comfortable to come to you and ask questions or say I’m really not getting this, it would make learning and teaching the kid easier. The last 2 years my teachers and support teachers have been so much help and have never made me feel like I can’t ask for help. I don’t think I would be where I am today if it wasn’t for them.

Thank you
Figure 4.3 Student writing sample #3

I get anxious when being called on in class because I get worried that if I say the wrong thing, kids will judge. Another reason why is I don’t like being the only kid that doesn’t understand what’s going on, so the teacher does something just for me in front of the whole class and embarrasses me. I enjoy being in math when the teachers make it fun and I can pick up on the material quickly and easily.

**Abbreviated Math Anxiety Scale.** After completing interviews, all students were asked to complete the student writing and the AMAS. The students were to read nine sentences about common situations related to math and score them based on the level of anxiety they experience using a Likert scale. Student scores ranged from 17 to 34, with a mean average of 27.66 and a standard deviation of 6.42 (see Figure 4.4).

**Figure 4.4 Student scores AMAS**

<table>
<thead>
<tr>
<th>Student</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caleb</td>
<td>34</td>
</tr>
<tr>
<td>Clara</td>
<td>26</td>
</tr>
<tr>
<td>Christina</td>
<td>32</td>
</tr>
<tr>
<td>Pamela</td>
<td>17</td>
</tr>
<tr>
<td>Patrice</td>
<td>23</td>
</tr>
<tr>
<td>Patrick</td>
<td>33</td>
</tr>
<tr>
<td>Jamie</td>
<td>30</td>
</tr>
<tr>
<td>Jaxon</td>
<td>34</td>
</tr>
<tr>
<td>Johnathan</td>
<td>20</td>
</tr>
<tr>
<td>Mean</td>
<td>27.66666667</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>6.422616289</td>
</tr>
</tbody>
</table>
Students experience the highest levels of anxiety according to the AMAS results when they are given large amounts of homework with difficult questions or unexpected tests. Eight of nine students scored test anxiety on a level of moderate anxiety or higher when taking a math test, finding out about a surprise quiz, or being assigned homework with difficult problems that were due the next day. Most students scored an action such as watching a student or the teacher work problems out on the board as low to some anxiety (see Figure 4.5 and 4.6).

Figure 4.5 Frequency Table

<table>
<thead>
<tr>
<th></th>
<th>Low anxiety</th>
<th>Some anxiety</th>
<th>Moderate anxiety</th>
<th>Quite a bit of anxiety</th>
<th>High anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having to complete a worksheet by yourself.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking about a maths test the day before you take it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watching the teacher work out a maths problem on the board.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taking a maths test.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being given maths homework with lots of difficult questions that you have to hand in the next day.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listening to the teacher talk for a long time in maths.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listening to another child in your class explain a maths problem.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding out you are going to have a surprise maths quiz when you start your maths lesson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staring a new topic in maths</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Research Question Responses

Interview questions for math teachers provided an in-depth view of what teachers believed to be the most effective way to identify students who suffer from math anxiety and best practices for working with those students. The focus group allowed the conversation to gain more depth as teachers added to each other’s answers and realized that they were doing most of the same practices. Student interviews provided insights on why they believe they are anxious about math, and their follow-up AMAS surveys affirmed that all of the students included in the case study suffer from some level of math anxiety. The student writing provided a really in-depth view of what students need teachers to provide to help with math anxiety. The multiple methods of data collection were used as a means to triangulate data to increase the validity and reliability of the study (Yin, 2009).

Research Question 1: How does a general education secondary math teacher from Virginia identify students with math-anxiety?
All three teachers rely primarily on observing physical cues such as body language and facial expressions to identify students with math anxiety. Three common themes developed regarding how teachers were able to identify students who they suspected were suffering from math anxiety and those themes were self-esteem, body language, and work avoidance. Ms. James said, “Physically, students will shut down by staring off into space, erasing or scratching out mistakes in a more forceful or frustrated manner.” Students who show shut down may display various body language such as head down, asking to leave class or overall work avoidance. Ms. Clayton confirms that, “This may look like avoidance, negative behavior, or even just a complete shutdown.” Negative self-talk, negative behaviors, and students joking around about not understanding math is another major clue that they may be struggling with math and are anxious about it, and they are coping. This is an example of students who may be experiencing low self-esteem and have limited self-efficacy. Ms. Palmer looks for fidgeting, facial expressions, and outward frustration, but stated, “In advanced students, I think it is harder to see because they cover it up and show frustration outside of the classroom.” All three teachers feel like they are good at identifying students who are suffering from math anxiety; however, all three also admit that they know that there are students that they miss.

Research Question 2: What are some methods and techniques that teachers utilize to improve the students’ experience with math to decrease their level of math-anxiety?

Four themes that they consider to be best practices to decrease students’ math anxiety are safe classroom environment, small group, chunking content, and building confidence. Building student confidence and helping them have a positive experience was identified by all three teachers as a method that they consider best to be best practice.

According to Ms. James,
I think that the best way that I found to curb math anxiety is to give students success, even it is the smallest little piece that we can hold on to and build on that is actually the best intervention is to make them feel good about themselves with math then they are more likely to fall back on that and that resiliency and know what it felt like to get something right an so I can hold on to that and make that my goal again.

She believes that once a student experiences some level of success, they can then remember that they were able to do it at one time, and this helps build their self-esteem. Ms. Palmer also spoke a lot about building math confidence and stated that advanced students are so hard on themselves when they do not immediately understand. She believes that it is important to “reassure them that they are smart and that they can do this.” Ms. Clayton echoed the importance of confidence,

I try to build confidence because my students are the ones that are in the eighth-grade and are in grade level math. Most of them do not like math by this point and I tell them they will like it by the end of the year, and I do everything I can to make sure they have a positive experience and love coming to math class.

Positive classroom environments where students are comfortable with making mistakes, have fun learning and enjoy math is what all three teachers believe to be the route to building math confidence. The more positive the experience, the more likely the student is to open up and get the help they need. Other specific interventions such as small group instruction, one-to-one tutoring, peer tutoring, study groups, breaking down content, and re-teaching of skills are all important, but students need to have enough confidence to engage in those activities for them to work. In reality, each of these remediation-type activities is what helps build self-esteem in math. The teachers felt it was important to point out how these best practices are all interwoven with building confidence.
Research Question 3: What are some challenges that teachers experience when working with students who suffer from math-anxiety?

All three teachers feel that the major challenge may be identifying the students who suffer from math anxiety. Subthemes that were identified such as accepting and teaching from mistakes and being supportive must become general practices within the classroom because the teachers feel that they are not identifying all students who suffer from math anxiety. While all of them feel like they are good at working with students with math anxiety, they each believe that they have missed students. Ms. Palmer said, “if I catch it, I’m all over it. So, I think I do a good job when I’m aware”. Sometimes she only finds out about a student after a parent has contacted her because “some put on a great front or they are the one that say I understand what you are saying, and they really don’t but they don’t want to look dumb” in front of their peers. Ms. Clayton added,

I’ve had struggles with students not accepting my help, being very angry that I want to help. They don’t like being called out that they need help so they will push you away and they will kind of climb into a hole so it’s hard to get them out. So that’s where you have to step in and try and get them to gain your trust.

Students must want help before you can help them. Middle school is a grade level where students are sometimes very resistant to help because of how they look to their peers. This is where relationship building is so important. Ms. James said that

Another intervention is to put positive self-talk in their brain. So, in my room they are not going to talk down to each other, you’re not going to call each other dumb even if you’re trying to be funny because if you get home and you repeat that to yourself it’s not funny
anymore and we don’t want to put word into someone’s brain even as a joke that they may not find funny.

A classroom environment that is safe for learning is paramount to all of these teachers. The main challenge that all teachers face is their need to make sure that they are identifying all students. In order to address all themes identified that teachers consider to be effective best practices to decrease students’ levels of math anxiety which are a safe classroom environment, small group, chunking content, and building confidence, these teachers consciously make an effort to establish routines and procedures that are inclusive of all students in their classes. They all worry that they have students that are hiding in plain sight and they continue to try to build relationships to help improve their ability to know their students and that students are comfortable enough to either reach out or show their true level of knowledge.

**Summary**

Chapter four provides the results of the data analysis. This chapter includes detailed demographic information on all participants. Participants included in this collective case study were three teachers and nine students. Each individual case consisted of a teacher and three students. Data collected included interviews for all 12 participants, a focus group among the teachers, student writing for the students, and the completion of the Abbreviated Math Anxiety Scale for the students. Each interview provided an in-depth view of demographic information and core beliefs of teachers and students. The focus group allowed teachers to speak collaboratively while expressing their personal views. This group was rich in conversation and afforded the teachers the opportunity to learn and grow as a group. They realized that many of their practices were the same; however, it was evident that they were all learning new bits as well. The student writing was very informative of what a student who suffers from a level of
anxiety needs from a math teacher. This was an accurate perspective into the students' minds and what they think about teachers. While not surprising, it reassured what these teachers believe to be important as well. The student’s completion of the AMAS confirmed that eight of the nine students experience moderate to high anxiety.
CHAPTER FIVE: CONCLUSION

Overview

The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math-anxiety and what best practices are put in place to help reduce math-anxiety. Chapter five consists of a summary of findings, a discussion of implications, and the delimitations and limitations of the study. Furthermore, this chapter includes how this study and the results fit into existing research and suggestions for future research.

Summary of Findings

This collective case study investigated the perception of secondary mathematics teachers about how they identify students who suffer from math anxiety and the best practices that they put into place to help those students. When teachers are identifying students, who are suffering from math anxiety, the study revealed three main themes across all three cases: (a) self-esteem (lack of confidence), (b) body language (head down, staring off, fidgeting), and (c) work avoidance (acting out, excessive talking, leaving class). When teachers are identifying best practices that work well with students who suffer from math anxiety, the study revealed four main themes across all three cases that teachers consider to be effective best practices: safe classroom environment (accepting and teaching from mistakes, being supportive), small group (one to one, help sessions), chunking content (breaking it down), and building confidence (positive feedback, building students up). The content of these themes answered each research question for the study.

RQ1: How does a general education secondary math teacher from Virginia identify students with math-anxiety?
The research question was answered by the common themes across all three cases. Teachers are able to identify students primarily by body language when in the classroom. They watch for facial expressions, frustration, or fidgeting. They rely on building relationships and knowing their students, and this adds another layer of identification as teachers quickly learn when students lack self-confidence about math or have a negative attitude. The third theme is work avoidance which festers in many different ways. In one class, it may be the constant request to leave class for water, the nurse, or just a break, while in another, it may be completely acting out, putting their head down, or just refusal to work. In all three cases, the characteristics that teachers look for to help identify students who are experiencing anxiety related to math were consistent.

**RQ2: What are some methods and techniques that teachers utilize to improve the students’ experience with math to decrease their level of math-anxiety?**

The research question was answered by the common themes across all three cases. All three teachers believe that building self-confidence and improving student’s attitudes toward math is the most important intervention. Making math enjoyable and creating an environment where students feel safe to make mistakes foster this growth mindset goes hand in hand with helping students to a better understanding that trying is not failing. Although the teachers in the study were focused on three different levels of students, the need for chunking content into smaller assignments and breaking it down so students can better understand it was another common theme. Even the most advanced students need some skills broken down and taught in pieces. Small group and one-to-one help sessions were another intervention that all three teachers identified as being very important when working with students with anxiety. No matter the level of the student, it provides the students a safety net because they know that they can get help later...
and in a more personal way if needed. They are able to ask questions and get extra help without being put in the spotlight during class. Students confirmed all of these best practices as characteristics of good math teachers. They crave teachers that care about them and help them become successful. They believe these interventions are what helps them to become better math students.

**RQ3: What are some challenges that teachers experience when working with students who suffer from math-anxiety?**

All three teachers overall believe that they are good at identifying students who suffer from some level of math anxiety and feel like they have been successful working with them. Challenges the teachers have faced have been with students who refused help or would not allow the teacher in. The teachers believe that students are sometimes already self-defeated about math by the time they reach middle school. The more advanced students are better at hiding their anxiety, and the teachers worry about missing students who are not showing the typical outward signs and sometimes even find out from the parents. Each of the teachers believes that relationship building is the best way to improve upon identification and working with students with anxiety because the better you know the student, the better chance you have to help them.

**Discussion**

This section explains how the study findings align with the empirical and theoretical literature relating to the perceptions of how math teachers identify students who suffer from math related anxiety and effective best practices and interventions they have implemented. Themes developed across cases to identify how teachers are able to identify students who they suspect suffer from math anxiety. Literature supports the case findings that there are multiple characteristics that teachers use to identify math related anxiety.
Empirical Literature Discussion

This study on how secondary math teachers identify math students who suffer from math anxiety and best practices implemented to treat math anxiety aligns with much of the empirical literature relating to this topic. Teachers rely heavily on body language to help them identify when students are suffering from some level of math anxiety. The literature and cross case analysis confirm that there is not one definitive method for identifying when a student is experiencing math anxiety. Themes developed across cases on methods used to identify students who suffer from math anxiety and patterns emerged of what teachers considered to be best practices.

Self-confidence. According to the literature, confidence can have a large impact on how students perform in mathematics (Stoehr, 2017). When students have prior achievement and success, they are more likely to have the perseverance to push through their struggles because they believe that success is possible again (Dutki & Putney, 2015). Positive attitudes have been shown to have a positive impact on learning (Chen et al., 2018). This study confirms these findings. All teachers believe that self-confidence and a positive attitude toward math are critical in students who are struggling or experiencing any level of anxiety. The study also confirmed that once students experience success, they are more likely to believe that they are capable of achieving it again.

Body Language. According to the literature, body language has long been an indicator for recognizing when students are experiencing math related anxiety (Neil & Smith, 2017). Body language such as expressions, tone of voice, fidgeting, and loss of eye contact are all signs that a student may be experiencing some level of anxiety (Foley et al., 2017). This study confirms these findings. Body language is the teachers’ first indicator that the student may be experiencing math
anxiety. Outward, physical displays tend to be the easiest characteristics for teachers to recognize.

**Work Avoidance.** According to the literature, anxiety is often directly related to students avoiding math (Hager, 2018). When students have negative attitudes toward math and feelings of anxiety, work avoidance often follows. Their inability to successfully complete works manifests into work avoidance (Dowker et al., 2016). Work avoidance most often occurs when students feel helpless and unmotivated to do any better (Beilock & Maloney, 2015). This study confirms these findings. Students who are experiencing math anxiety and are low-performing react by avoiding work. Teachers use work avoidance as an indicator that a student is unable to perform and may be experiencing some level of anxiety that is affecting their work. Work avoidance is common in students when they feel helpless.

**Classroom Environment.** According to the literature, learning environments in elementary school are often perceived to be much more positive than those at the secondary level, and the transition from elementary to secondary may cause some anxiety based solely on the environment (Deieso & Fraser, 2019). Learning environments, including a student feeling safe, teacher support, and opportunities for social peer interaction, are noted for lessening levels of anxiety related to math (Rubinsten et al., 2018). A positive classroom culture may nurture students and help prevent feelings of anxiety (Luttenberger, Wimmer, & Paechter, 2018). This study confirms these findings. The teacher believes that when students feel like part of a group or part of a classroom community, they are more comfortable sharing ideas and take risks. Teachers create environments that allow for mistakes and teach students that mistakes are acceptable and that learning can come from them. The teachers in the study all strive to provide a sense of community in a fun and engaging way that all students will embrace.
Small Group. According to the literature, student grouping should be fluid. Always grouping by ability or using the same groups may hinder progress and imply social injustice by continually classifying students (Boyd & Ash, 2018). Utilizing flexible grouping allows students to be continually paired with different students, thus building their confidence as they learn from their peers and teach others (Hager, 2018). One-to-one tutoring and targeted intervention have been shown to improve a student’s skill set in math and therefore lessens their level of anxiety. There is a direct correlation between improved performance and lower anxiety levels (Supekar, Iuculano, Chen, & Menon, 2015). This study confirms these findings. Teachers believe that they reduce anxiety by providing extra opportunities for students to receive additional help outside of the normal class. Students have the opportunity to get a small group or one-to-one support in a way that caters to their personal style of learning. The teacher is able to focus on exactly what that student needs and instruct them according to their learning style. Although this is a goal within the class, the small group time allows teachers to answer questions or re-teach skills that the student may have missed. Students appreciate having study sessions built in ahead of time so that when they feel as though they may be falling behind in class, they can prevent the immediate panic because there is an option already built-in.

Chunking Content. According to the literature, chunking content into small pieces for students to digest at a slower pace is considered a good instructional strategy (Hager, 2018). Scaffolding content is often necessary for students to learn concepts that are hard for them or that may require multiple steps (Ramirez, Shaw, & Maloney, 2018). Chunking content can help with pace for students who struggle and may need skills really broken down. The speed at which content is delivered is often to blame for the level of anxiety experienced (Dossel, 2016). Students who tend to be anxious often process at a slower speed and need scaffolding
This study confirms these findings. Students feel very anxious when teachers are teaching at a pace that they feel is unattainable. Students rely on the teacher to chunk skills into manageable pieces and to reteach content that they miss. Teachers also see the need for this because they lose many students and can immediately sense the anxiety level of some students when the content seems too much. All three teachers are able to draw on their teaching experience and know which skills and concepts will need to be chunked into small pieces. When students feel comfortable with the first step before the teacher moves on, the confidence level is higher, and the anxiety is lower. Teachers and students consider this a successful intervention.

**Positive feedback.** According to the literature, positive self-esteem related to math and a student’s belief in their math abilities often begins in elementary school. Positive feedback and reassurance from the teacher help students become more confident in their ability to do math (Vorensky, 2018). Students who outwardly display negative behaviors in math class are often craving feedback and reassurance from the teacher that they computing the assignment correctly or they are doing a good job (Neil & Smith, 2017). Math workshops or other small group settings have been shown to reduce anxiety as they allow the student to receive more reassurance, support, and positive feedback from their learning community and teacher (Sharp et al., 2018). Positive feedback from the teacher provides the support that students need to believe in themselves and their ability to be successful (Cropp, 2017). This study confirms these findings. Teachers and students believe that positive feedback allows students to gain confidence. The teachers all believe that many students at the middle school level need to have their math confidence level raised. Some of them have struggled, and their performance has not been as good as they would like, while others have performed well but still strives to do better. Advanced
students are often seeking approval because they are reaching for perfection or working under unnecessary pressure. All three teachers agree that when students receive positive feedback, it impacts their attitude and that impacts their performance, and that impacts their anxiety level.

**Theoretical Literature Discussion**

This study utilized the theoretical framework of Bandura’s social learning theory based on the practice of teachers observing behaviors and learning from their experience (Bandura, 1977). Literature indicated that learning occurs through self-reflection, evaluation, and regulation and that the power of social learning should not be underestimated (Lotter et al., 2018, MariĆ et al., 2017). Teachers are continually learning and growing from the experiences with their students as they realize and understand that a one size fits all approach does not meet the needs of all learners (Lisciandro et al., 2018, Stoehr, 2017). This study confirmed these suppositions. Within the classrooms, the teachers are continually observing students and learning how to better identify students with math anxiety by looking for physical cues such as body language and facial expressions.

Bandura’s learning theory states that learning occurs through social interaction and watching behavior (Bandura, 1977). Students who suffer from math anxiety are able to observe their teachers actively model positive emotional responses to problem solving and provide positive feedback to students who are experiencing productive struggle in the classroom. Teachers are observing students in the learning environment where they feel safe and then modeling behaviors and practices that can improve the overall experience for the students. According to Bandura, most human behavior is learned observationally through modeled behavior. As teachers make a decision about how they identify students and what best practices
they use, they are continually monitoring and adjusting as they feel necessary. When discussing how to best help students, Ms. Clayton expressed the following:

Some students are crying out for attention and some students just want to stay in a hole. So that’s when you have to change your interventions per student. You can’t think that every method is going to work with every student. You have to be ready to put a different pair of shoes on each day, put a different pair of shoes on for each kid. You’ve got to be ready to dance and sing for one kid and color and paint art for another.

All of the teachers expressed how much they learn from their own experience every year. They are all reflective teachers that continually reflect on their practice and grow from the paths they’ve previously taken. Self-reflection and self-efficacy influence personal goal setting and have a high impact on personal motivation and performance (Bandura, 1993). Classrooms have changed over the years, but the social aspect of the classroom remains intact. Bandura’s social learning theory supports collaborative and active learning. Safe learning environments with respect and positivity are essential as Bandura’s theory states that environment can determine one’s behavior (Bandura, 1979). All three of these teachers care deeply for children and their success. They continually try new interventions and instructional practices to improve the experience for their students.

**Implications**

The implications of this research study supported and expanded upon the theoretical literature. Previous research has been mostly from a psychological point of view and from the elementary setting. This study attempted to fill the gap by exploring middle school math teachers, and their perceptions about identify students who suffer from math anxiety and the
interventions they consider to be best practices. This section describes the theoretical and practical implications of this study.

**Theoretical Implications**

This study applied Bandura’s social learning theory as a theoretical framework. Bandura’s theory provides that there is a connection between human behavior and environmental influences (Bandura, 1977). In this study, teachers demonstrate how they are learning through direct observation. They are observing behaviors and then adapting lessons and environments to meet the individualized needs of their students. All of the teachers in the study understand the impact that their attitude and belief in the students have on student success. They recognize the need to continually learn and grow as there is no one definitive way to identify math anxiety or to counteract it.

**Empirical Implications**

This study adds to the literature regarding identifying students who suffer from math anxiety and best practice strategies that are used to work with these students. The participants in this study verified many of the characteristics that are considered things to look for when attempting to identify students who are suffering from math anxiety (Luttenberger, Wimmer, & Paechter, 2018). This study showed that teachers are competent in terms of being able to identify students who are suffering from some level of math anxiety. Their struggle to not identify all students corresponds with previous research as there are no definitive set of rules when it comes to identifying students who are experiencing anxiety related to math (Dowker, Sarkar, & Looi, 2016; Stoehr, 2017). This study further showed that teachers are competent about what strategies and interventions work well when working with students who are experiencing math anxiety.
The teachers identified interventions that are considered best practices throughout the literature (Lotter et al., 2018; Ramirez, Shaw, & Maloney, 2018).

**Practical Implications**

The themes and patterns identified in this study were also found throughout the related literature. However, studies in the literature did not specifically address perceptions from the view of the teacher and did not consider middle school students. Teachers need to understand that math anxiety is not the same for every student (Dowker, Sarkar, & Looi, 2016; Stoehr, 2017). The signs and manifestation of math-related anxiety come in many forms, and this is what makes it so incredibly difficult to identify. This study showed that experienced teachers are capable of identifying students who are suffering from math anxiety. However, this study also showed that it is not only students that struggle with performance but also students who struggle to be perfect. All of the students in the study, from grade level math through the most advanced, were experiencing some level of math anxiety. Teachers need to know that anxiety is reduced with adequate support structures built in. It is recommended that all teachers have ongoing discussions about what makes students anxious about math and other subjects, including the fact that anxiety is not always connected to performance.

**Delimitations and Limitations**

Delimitations are purposeful decisions the researcher makes to limit or define the boundaries of the study. The potential weakness of this study is the small number of cases and including only one school division. The decision was made based on the location of the division in relation to the researcher and the gap in the literature at the middle school level. The researcher did not control for gender, race, or age. The criteria for a teacher recommendation for
the study were: (a) teachers must have a minimum of three years teaching mathematics at the secondary level, and (b) teachers must have demonstrated success working with all students.

A limitation of this study is that there were only three cases within the study, and each case only included three students. Another limitation of the study may be that the researcher was a general education math teacher. My experience helped with data collection and analysis as I have expert knowledge of the lived experiences of these teachers (Creswell & Poth, 2018). During data collection, I used journaling as a method to bracket out any personal influences (Creswell & Poth, 2018). I utilized member checking for documentation checks of all teacher transcripts (Yin, 2009).

A final limitation of this study is that the data was collected during a pandemic. The teachers were able to differentiate between the time before the pandemic and during the pandemic. The teachers noted that there are struggles present during the pandemic that are not an issue during a normal year. Virtual learning has brought about a whole new group of challenges that teachers were not yet prepared to accept.

**Recommendations for Future Research**

In consideration of the study findings, limitations, and delimitations placed on the study, there some recommendations for further research. This research was focused on a single school division. It is recommended that the researchers use multiple case studies across divisions with a more diverse group of learners to confirm results and increase transferability. This study only surveyed students who the teacher identified or self-identified; therefore, a broader group of
students could be surveyed utilizing the AMAS to confirm teacher ability to identify math anxiety.

Future research could also focus on standardized testing and the impact that federal and state required high stakes testing has on students who may already be suffering from math related anxiety. Furthermore, more work on specific subgroups such as race, socioeconomics, and students with disabilities could provide insight on how math related anxiety impacts their ability to perform in comparison to other students. Math anxiety is an ever-growing concern and there is much still to learn about why students experience anxiety related to math and how educators can have a positive impact.

**Summary**

The purpose of this intrinsic collective case study was to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math-anxiety and what best practices are put in place to help reduce math-anxiety. Additionally, the study was to determine best practices for helping students who are suffering from math anxiety. The study utilized Bandura’s (1977) social learning theory to provide a lens for how teachers learn from their own experiences. The study included three cases which were comprised of a total of 12 participants. Each case included a teacher and three students. The case study research was used to give teachers a voice in an in-depth understanding of a phenomenon in their natural setting (Yin, 2009). Data analysis revealed three themes for characteristics of identifying students, which were: (a) body language, (b) self-esteem or attitude, and (c) work avoidance. Four themes were identified as best practices: (a) classroom environment, (b) small group, (c) chunking content, and (d) positive feedback.
Profound and worthwhile takeaways from this study include that teachers are able to identify students who suffer from math anxiety and that they do not directly relate performance to anxiety. This is important because math anxiety was shown to exist in all three of the classrooms, which included an on-grade level class and two advanced classes (one class one year advanced, the other two years advanced). Building relationships is one of the best ways to better understand students. There were no surprises of best practices, but just confirmation that there is not one size fits all when it comes to math anxiety.
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APPENDIX A

IRB-FY20-21-197 - Initial: Initial - Expedited

irb@liberty.edu <irb@liberty.edu>
Thu 11/19/2020 2:08 PM

November 19, 2020

Wanda Calhoun
Veronica Sims


Dear Wanda Calhoun, Veronica Sims:

We are pleased to inform you that your study has been approved by the Liberty University Institutional Review Board (IRB). This approval is extended to you for one year from the date of the IRB meeting at which the protocol was approved: November 19, 2020. If data collection proceeds past one year, or if you make modifications in the methodology as it pertains to human subjects, you must submit an appropriate update submission to the IRB. These submissions can be completed through your Cayuse IRB account.

Your study falls under the expedited review category (45 CFR 46.110), which is applicable to specific, minimal risk studies and minor changes to approved studies for the following reason(s):

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your stamped consent form can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. This form should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document should be made available without alteration.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
October 19, 2020

Dear Wanda Calhoun:

Re: Request to Conduct Research

This letter authorizes you to proceed with your research regarding Student Math Anxiety. While the division does not facilitate contact with employees or students, you are authorized to proceed with your research in coordination with the building administrator. Please share this letter when you contact staff for verification of approval.

Please note that participation by any YCSD employee and/or student in an outside study is completely voluntary. Please keep a copy of this letter on file while you conduct the research.

Sincerely,

Katherine Goff
Public Relations and Communications Officer

Via email to wcalhoun@ycsd.york.va.us
APPENDIX C

Teacher Recruitment Letter

Dear Math Teacher:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of my research is to understand how teachers identify students who they believe to suffer from math anxiety and strategies used in the classroom to improve the student’s experience. I am writing to invite eligible participants to join my study.

Participants must be a secondary mathematics teacher with a minimum of three years of experience teaching mathematics. Participants, if willing, will be asked to participate in a personal interview and a small focus group. Participants will also be asked to assist with student participation by sending out recruitment letters, assent/consent documents, and administering a survey. It should take approximately three hours to complete the procedures listed. Names and other identifying information will be requested as part of this study, but the information will remain confidential.

In order to participate, please contact me at [wcalhoun1@liberty.edu] for more information or to schedule an interview.

A consent document is attached to this email. The consent document contains additional information about my research. Please sign the consent document and return it to me prior to the time of the interview via email.

Sincerely,

Wanda Calhoun
Graduate Student

[redacted]
APPENDIX D

Student Recruitment Form

Dear Parent/Student:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of my research is to understand how teachers identify students who they believe to suffer from math anxiety and strategies used in the classroom to improve the student’s experience. I am writing to invite eligible participants to join my study.

Participants will be secondary math students of a teacher that is participating in the study. Participants, if willing, will be asked to take a survey to assess their anxiety related to mathematics. Participants who are identified by their math teacher as suffering from math anxiety or self-identify by the survey will then be asked to participate in a personal interview and complete a letter to a future math teacher.

It should take approximately one hour to complete the procedures listed. Names and other identifying information will be requested as part of this study, but the information will remain confidential.

In order to participate, sign and return the attached parental consent document to your child’s teacher/school. If your child is 13 years of age or older, they will need to sign the parental consent form. If your child is under the age of 13, please have them complete the assent form also attached.

A consent document is attached to this email. The consent document contains additional information about my research. Please sign the consent document and return it to your child’s teacher.

Sincerely,

Wanda Calhoun
Graduate Student

[Contact Information Redacted]
APPENDIX E

Consent

Title of the Project: Perceptions of Math Teachers Working with Students Who Suffer From Math Anxiety: A Collective Case Study
Principal Investigator: Wanda Calhoun, Graduate Student, Liberty University

Invitation to be Part of a Research Study
You are invited to participate in a research study. In order to participate, you must be a secondary math teacher who has been teaching mathematics for a minimum of three years. Taking part in this research project is voluntary. Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

What is the study about and why is it being done?
The purpose of the study is to develop an in-depth understanding of how general education secondary math teachers in Virginia effectively identify students who suffer from math anxiety and what best practices are in place to help reduce math anxiety.

What will happen if you take part in this study?
If you agree to be in this study, I would ask you to do the following things:
1. Participate in an interview via Microsoft Teams that will be recorded for the purpose of transcription (30 minutes).
2. Participate in a small focus group (3 teachers total) via Teams that will be recorded for the purpose of transcription (30-60 minutes).
3. Be willing to assist with student survey administration, and collection of parent consent and student assent forms (60-90 minutes).

How could you or others benefit from this study?
The direct benefits participants should expect to receive from taking part in this study are gaining a better understanding of how well they identify students who are suffering from math anxiety. The focus group may help teachers to better understand methods that other teachers use to identify math related anxiety and the best practices that help students feel more confident and successful in math.

What risks might you experience from being in this study?
The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

How will personal information be protected?
The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records. Data collected from you may be shared for use in future research studies or with other researchers. If data collected from you is shared, any information that could identify you, if applicable, will be removed before the data is shared.
• Participant responses and study location will be kept confidential through the use of pseudonyms. Interviews will be conducted via Microsoft Teams and will be private.
• Data will be stored on a password-locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
Interviews and focus groups will be recorded and transcribed. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher[s] will have access to these recordings.

Confidentiality cannot be guaranteed in focus group settings. While discouraged, other members of the focus group may share what was discussed with persons outside of the group.

### Is study participation voluntary?

Participation in this study is voluntary. Your decision whether to participate will not affect your current or future relations with Liberty University or your school district. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

### What should you do if you decide to withdraw from the study?

If you choose to withdraw from the study, please contact the researcher at the email address/phone number included in the next paragraph. Should you choose to withdraw, data collected from you, apart from focus group data, will be destroyed immediately and will not be included in this study. Focus group data will not be destroyed, but your contributions to the focus group will not be included in the study if you choose to withdraw.

### Whom do you contact if you have questions or concerns about the study?

The researcher conducting this Wanda Calhoun. You may ask any questions you have now. If you have questions later, you are encouraged to contact her at [email protected] or [phone number]. You may also contact the researcher’s faculty sponsor, [name].

### Whom do you contact if you have questions about your rights as a research participant?

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher[s], you are encouraged to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at irb@liberty.edu

### Your Consent

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

☐ The researcher has my permission to video-record me as part of my participation in this study.

_________ Printed Subject Name __________________________ Signature & Date

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Liberty University
IRB-FY20-21-197
Approved on 11-19-2020
APPENDIX F

Parental Consent

Title of the Project: Perceptions of Math Teachers Working with Students Who Suffer From Math Anxiety: A Collective Case Study
Principal Investigator: Wanda Calhoun, Graduate Student, Liberty University

Invitation to be Part of a Research Study
Your child is invited to participate in a research study. Participants must be a secondary (6-12) math student and the student’s teacher must be a participant in the study. Taking part in this research project is voluntary.

Please take time to read this entire form and ask questions before deciding whether to allow your child to take part in this research project.

What is the study about and why are we doing it?
The purpose of the study is to determine how teachers are able to identify students that suffer from math anxiety. The study will also aim to identify best strategies to improve the overall math experience for students and how they are implemented.

What will participants be asked to do in this study?
If you agree to allow your child be in this study, I would ask him or her to do the following things:
1. Students would complete a brief survey rating nine questions about math from low anxiety to high anxiety (15 minutes).
2. Participate in an interview via Microsoft Teams. Interviews would be recorded for transcription purposes (30 minutes)
3. Students would be asked to write a letter to a future math teacher. Within the letter, they would be asked to explain why math makes them anxious and how teachers can improve the experience for them (30 minutes)

How could participants or others benefit from this study?
Participants should not expect to receive a direct benefit from participating in this study. A benefit to teacher education may be increased knowledge in methods of identifying students who experience math related anxiety and best practices that may help students feel more confident in the math classroom.

What risks might participants experience from being in this study?
The risks involved in this study are minimal, which means they are equal to the risks your child would encounter in everyday life.

How will personal information be protected?
The records of this study will be kept private. Published reports will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records.
- Participant responses and study sites will be kept confidential through the use of pseudonyms. Interviews will be conducted via Microsoft Teams.
• Data will be stored on a password-locked computer and may be used in future presentations. After three years, all electronic records will be deleted.
• Interviews will be recorded and transcribed. Recordings will be stored on a password locked computer for three years and then erased. Only the researcher will have access to these recordings.

<table>
<thead>
<tr>
<th>Is study participation voluntary?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not affect your or his or her current or future relations with Liberty University or your school district. If you decide to allow your child to participate, she or he is free to not answer any question or withdraw at any time without affecting those relationships.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What should be done if a participant wishes to withdraw from the study?</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you choose to withdraw your child from the study, please contact the researcher at the email address/phone number included in the text paragraph. Should you choose to withdraw her or him, data collected from your child will be destroyed immediately and will not be included in this study.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Whom do you contact if you have questions or concerns about the study?</th>
</tr>
</thead>
<tbody>
<tr>
<td>The researcher conducting this study is Wanda Calhoun. You may ask any questions you have now. If you have questions later, you are encouraged to contact her at [redacted]. You may also contact [redacted].</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Whom do you contact if you have questions about rights as a research participant?</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Institutional Review Board, 1971 University Blvd., Green Hall Ste. 2845, Lynchburg, VA 24515 or email at <a href="mailto:irb@liberty.edu">irb@liberty.edu</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Your Consent</th>
</tr>
</thead>
<tbody>
<tr>
<td>By signing this document, you are agreeing to allow your child to be in this study. Make sure you understand what the study is about before you sign. You will be given a copy of this document for your records. The researcher will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.</td>
</tr>
</tbody>
</table>

I have read and understood the above information. I have asked questions and have received answers. I consent to allow my child to participate in the study.

☐ The researcher has my permission to video-record my child as part of his/her participation in this study.

______________
Printed Child’s/Student’s Name

______________
Parent’s Signature

Date

______________
Minor’s Signature

Date
APPENDIX G

Child Assent to Participate in a Research Study

What is the name of the study and who is doing the study?
The name of the study is Perceptions of Math Teachers Working with Students Who Suffer From Math Anxiety: A Collective Case Study and the person doing the study is Wanda Calhoun.

Why is Wanda Calhoun doing this study?
Wanda Calhoun wants to know why students have anxiety about math.

Why am I being asked to be in this study?
You are being asked to be in this study because you are a math student who may or may not experience math anxiety.

If I decide to be in the study, what will happen and how long will it take?
If you decide to be in this study, you will take a survey (10 min). If selected based on the survey, you will be interviewed (15 minutes) and you will write a letter to a future math teacher (30 minutes).

Do I have to be in this study?
No, you do not have to be in this study. If you want to be in this study, then tell the researcher. If you don’t want to, it’s OK to say no. The researcher will not be angry. You can say yes now and change your mind later. It’s up to you.

What if I have a question?
You can ask questions any time. You can ask now. You can ask later. You can talk to the researcher. If you do not understand something, please ask the researcher to explain it to you again.

Signing your name below means that you want to be in the study.

________________________________________
Signature of Child/Witness

________________________________________
Wanda Calhoun

Liberty University Institutional Review Board
1971 University Blvd, Green Hall 2845, Lynchburg, VA 24515
irb@liberty.edu

Liberty University
IRB-FY20-21-197
Approved on 11-19-2020
APPENDIX H

Teacher Interview Questions

1. Please introduce yourself to me
2. Please tell me about your collegial background and training.
3. Please tell me about your path in education thus far and what prompted you to teach math.
4. Tell me how many years you have been teaching and what types of schools you have taught at.
5. How often do you experience students in your class that you feel suffers from some level of math-related anxiety?
6. How would you describe a student that has math-anxiety?
7. How would you describe a student mannerisms or outward displays that alerts you to math-anxiety?
8. Describe any specific characteristics that you look for when determining if a student has math-anxiety.
9. How does your perception of students’ anxiety level impact your method of teaching?
10. Describe best practices that you routinely use with students?
11. Describe your perception of well you respond to your students’ needs when they are experience math-anxiety?
12. Tell me about the struggles you’ve experienced when working with students who have math-anxiety.
13. Why do you think interventions works with some students and not others?
14. Describe a situation, if any, when a student had math-anxiety and you were not able to reduce the anxiety or support them adequately?
APPENDIX I

Teacher Focus Group Questions

1. What characteristics does a productive learning environment have for students to learn math?
2. What practices do you have in place to ensure that students feel safe to make mistakes in your classroom?
3. What is considered the first sign for you that a student is experiencing some level of math anxiety?
4. Are there common characteristics that you look for within students to identify who you believe suffers from math anxiety?
5. What structures do you put in place in your classroom to ensure that students with math anxiety can be successful?
6. What strategies do you use that specifically address the needs of students who suffer from math anxiety?
7. What is the relationship between math anxiety and math performance?
APPENDIX J

Student Interview Questions

1. Please introduce yourself to me.
2. How do you feel about school in general?
3. What is your favorite subject in school and why you like it?
4. What is your least favorite subject in school and why?
5. How do you describe your feelings about math?
6. Have you always been anxious about math?
7. Why do you think you have anxiety about math?
8. How is your performance in math?
9. How would you describe your attitude about learning math?
10. How does your attitude affect your performance in math?
11. What does your teacher do that helps you with your anxiety?
12. How does your teacher have an impact on how you learn math?
APPENDIX K

Instructions:
Please give each sentence a score in terms of how anxious you would feel during each situation. Use the scale at the right side and circle the number which you think best describes how you feel.

<table>
<thead>
<tr>
<th></th>
<th>Low anxiety</th>
<th>Some anxiety</th>
<th>Moderate anxiety</th>
<th>Quite a bit of anxiety</th>
<th>High anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Having to complete a worksheet by yourself.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Thinking about a maths test the day before you take it.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Watching the teacher work out a maths problem on the board.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Taking a maths test.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Being given maths homework with lots of difficult questions that you have to hand in the next day.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Listening to the teacher talk for a long time in maths.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Listening to another child in your class explain a maths problem.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Finding out you are going to have a surprise maths quiz when you start your maths lesson.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Starting a new topic in maths.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
APPENDIX L

Student Writing Prompt

Please write a letter to a new math teacher that has no experience working with students. Tell the new teacher why math makes you anxious or nervous.

Some things you may think about to help you write:
• Math makes me anxious because…
• Math is hard for me because…
• I get anxious when being called on in class…
• I feel anxious when I walk through the door of math class because…
• I feel unprepared for math class because…
• I struggle because my teacher…

Please end your letter by telling this new teacher what he/she can do as a math teacher that will help students be less anxious about math.

Some things you may think about to help you write:
• You can help your students by…
• Students will be more comfortable in your classroom if …
• I learn best by using hands on activities, working in groups…
• I feel valued by my teacher if…
• I enjoy being in math class when…