A CORRELATIONAL STUDY ON THE INFLUENCE OF TEACHER-STUDENT RELATIONSHIPS ON TEACHERS' MATH SELF-EFFICACY AND MATHEMATICAL ANXIETY IN STUDENTS IN LOWER ELEMENTARY GRADES

by

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Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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ABSTRACT

The purpose of this quantitative, correlational study was to discover the influence of teacher-student relationships on teachers' math self-efficacy and math anxiety in first through third-grade students. This research was significant since the results inform and guide educational training, evaluations, and classroom management. This study was composed of 13 teachers and 84 students in the first through third grade classrooms in a Mid-Atlantic State. Teachers completed two surveys: Teacher-Student Relationship Scale and the Self-Efficacy for Teacher Mathematics Instrument. Students were surveyed concerning their math anxiety using the Math Anxiety Questionnaire for Children. Data analysis was conducted by using Pearson correlation coefficient to examine the relationship between teacher self-efficacy in math and math anxiety in students, by using a Spearman's rho correlation to examine the relationship between teacher self-efficacy and teacher-student relationship. Multiple regression analysis tested if teacher self-efficacy and teacher-student relationship influence math anxiety in students. The results revealed that there was not a significant difference between teacher self-efficacy and math anxiety in students, between teacher self-efficacy and teacher-student relationship. In addition, teacher self-efficacy and teacher-student relationship did not show a significant association with math anxiety in students. This suggests other contextual factors influence math anxiety in students besides teacher self-efficacy in math and teacher-student relationship. Limitations of the study are discussed. Lastly, recommendations for future research are provided including different research settings, qualitative research, and research that examines social and contextual influences that impact math anxiety in students.

Keywords: teacher-student relationship, teacher math self-efficacy, math anxiety in children, and math

Copyright Page

Dedication

I dedicate this writing, first and foremost, to my Lord and Savior, Jesus Christ.

In addition, I dedicate this dissertation to my family and friends; your prayers, support, and encouragement made this possible. Thanks for your love and sacrifice. I love you, Mom and Dad.

And finally, to my friend and mentor, Vivian Jackson, who made an eternal difference in my life through her prayers, laughter, words of wisdom, and courage.

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Math Anxiety Questionnaire for Children (MAQC)

Self-Efficacy for Teaching Mathematics Instrument (SETMI)

Student-Teacher Relationship Scale (STRS)

CHAPTER ONE: INTRODUCTION

Overview

Young children are faced internal and external pressures to succeed and challenges to achieve their academic goals, specifically mathematics. This quantitative correlational study explores the relationship between the level of math anxiety in first through third-grade students, teachers' self-efficacy, and the teacher-student relationship in the classroom. Chapter One begins with background information on the impact of anxiety on children, which includes the historical overview, society at large, and the theoretical framework. In addition, the problem statement, purpose statement, and significance of the study were presented. Lastly, research questions were introduced, and definitions pertinent to this study were provided.

Background

Historical Overview

Recent data from the National Survey of Children's Health indicated that 7.1% of children between the ages of 3-17 years suffer from anxiety issues, which may increase as students become older and have limited access to health resources (Ghandour et al., 2019). Bitsko et al. (2018) noted that the diagnosis of anxiety in children 6-17 years of age increased from 5.5% in 2007 to 6.4 % in 2011-2012, yet there are students in the classroom who suffer silently without a diagnosis of math anxiety. Since 1957, math anxiety has been an area of interest, focusing on number anxiety (Dreger & Aiken, 1957). Early research into math anxiety focused on adults and college-age students (Ramirez et al., 2016). As a result of society's interest in academic achievement, the area of interest and research has grown toward math anxiety and achievement in children (Dowker et al., 2016). Since math anxiety is related to math content,

math anxiety was shown to be independent of general anxiety, and research revealed that math anxiety is present in elementary school students (Hill et al., 2016).

Previous research indicated that math anxiety emerged around the sixth grade due to the idea that there was no relationship between math anxiety and math achievement in elementary-aged students (Ramirez et al., 2016). Significant evidence has emerged that indicates young children can experience math anxiety as early as first through third grade (Beilock & Willingham, 2014; Cargnelutti et al., 2017; Jameson, 2014). First through third-grade students have shown small but significant signs of high math anxiety, which was directly linked to math performance (Cargnelutti et al., 2017; Ganley & McGraw, 2016). Once the evidence in research revealed that students in lower elementary school show signs of math anxiety, research focused on examining the relationship between math anxiety and math achievement.

An abundance of interest in math anxiety within elementary school children centers on math anxiety and math achievement (Ramirez et al., 2016). In contrast, empirical research linking the level of math anxiety in students with the teacher-student relationship is not common (Kurdi & Archambault, 2018). Children's level of math anxiety influences the classroom environment and predicts the student's math academic outcomes (Semeraro et al., 2020). The math academic outcomes of students with math anxiety influence career choices, social relationships, and society (Dowker et al., 2016; Higgins & O'Sullivan, 2015).

Society-at-Large

Internalizing disorders such as math anxiety are common difficulties in early childhood children that lead to long-term consequences (Buchanan-Pascall et al., 2018; Cargnelutti et al., 2017; Kurdi & Archambault, 2018). Math anxiety, which is a non-cognitive factor, has been consistently shown to have a strong negative correlation with math achievement and math

performance (Beilock & Willingham, 2014; Semeraro et al., 2020). Over the years, research has shown that math anxiety interferes with math achievement due to the use of working memory (Beilock & Willingham, 2014; Dowker et al., 2016). When students suffer from math anxiety, they have less working memory to solve mathematical problems, hindering math achievement (Beilock & Willingham, 2014). In contrast, Zhang et al. (2019) found no significant difference in math anxiety and the math achievement link. While previous research focused on the relationship between math anxiety and math achievement, there is still more to understand about math anxiety and the teacher-student relationship (Kurdi & Archambault, 2018). Further research is necessary to explain how social relationships in the classroom impact math anxiety.

Environmental and social relationships impact the presence or level of math anxiety in lower elementary school children in the classroom (Beilock & Willingham, 2014). Conflicts with teachers can intensify a student's level of math anxiety (Kurdi & Archambault, 2018). Cultural and socio-economic factors, such as the teachers' attitudes toward students, influence math anxiety levels in young children (Dowker et al., 2016; Luttenberger et al., 2018). Semeraro et al. (2020) confirmed that the quality of teacher-student relationships might be associated with math achievement due to the influence of math anxiety. Without quality teacher-student relationships, students may experience a variety of challenges in school.

Without effective support from teachers, students are at risk of experiencing difficulties navigating through challenges in math throughout their school experience (Buchanan-Pascall et al., 2018). Evidence demonstrated that conflict, such as the pressure to perform well between students and teachers, was associated with student anxiety, especially in high-achieving girls (Kurdi & Archambault, 2018). Zee and Roorda (2018) did not find links between students' anxiety levels and the degree of closeness and quality in the teacher-student relationship;

however, students' anxiety levels were reported to be positively associated with conflict in the relationship. Conflict in the teacher-student relationship influences students' anxiety levels and school experiences.

While the conflict in the teacher-student relationship produces high levels of anxiety in students, quality teacher-student relationships decrease math anxiety (Semeraro et al., 2020). Semeraro et al. (2020) noted that teachers who foster a warm, responsive, and trusting environment provide students the opportunity to manage their math anxiety appropriately, which leads to a positive impact on math outcomes. With quality teacher-student relationships, positive math achievement emerges, which is mediated by math anxiety. Teacher self-efficacy toward math may indirectly influence the levels of math anxiety and math achievement in students through their attitudes, behaviors, and teaching practices (Chang & Beilock, 2016). As teachers become aware that their actions directly influence the students' emotional responses, teachers can adjust their reactions and feedback toward students to alleviate the negative consequences of math anxiety in children.

The consequences of math anxiety, such as avoidance of math, poor performance on tests, decrease in the level of math engagement, and reduced interest in math-related activities, have led to several interventions (Dowker et al., 2016; Ramirez et al., 2016). Interventions such as writing about negative experiences with math, cognitive tutoring, and non-invasive brain stimulation supported students to manage their anxiety levels (Dowker et al., 2016). Additionally, teachers modeling positive attitudes and avoidance of expressing negative behaviors and attitudes were noted to reduce levels of anxiety (Dowker et al., 2016). Teachers with high levels of self-efficacy in math tend to effectively regulate students' emotions, such as happiness (Alrajhi et al., 2017). Research indicated that teachers with high self-efficacy may

control and improve the learning environment in addition to math achievement in students by providing emotional support to primary students (Dowker et al., 2016; Hill et al., 2016). Further investigation of the relationship between teacher and student is needed to assess the social influences of teachers on students, which impacts the level of anxiety in the classroom (Beilock & Willingham, 2014; Dowker et al., 2016).

Theoretical Framework

The attachment theory provides a theoretical perspective to understand the impact that the teacher-student relationship and teacher self-efficacy have on the development and maintenance of anxiety in children. This theory indicates that children form an attachment to essential caregivers in their lives, including their teachers. There are four attachment organizations: secure, avoidant insecure, resistant, and disorganized. The teacher-student relationship should form a secure attachment organization in the classroom setting (Howes et al., 2002). The attachment theory also postulates that a positive and supportive relationship with teachers helps children to adjust to challenges and to communicate their needs (Hajovsky et al., 2019; Semeraro et al., 2020; Zhou et al., 2020). As a result, students feel secure and safe to make mistakes and to be challenged (Semeraro et al., 2020). A positive relationship influences the level of math anxiety and positively predicts math achievement.

In contrast, in relationships that are not close or involve high levels of conflict, students may feel emotionally less secure or less comfortable with communicating needs. Students who describe the relationship as negative, stressful, or hostile are unlikely to respond in confidence to the teacher when they need support (Zee & Roorda, 2018). In a secure teacher-student attachment relationship, children are confident that they will receive support and encouragement; however, if the relationship is not secure, students lack the confidence to seek help, which can

lead to negative emotional responses such as anxiety (Howes et al., 2002). The attachment theory provides a perspective to explain relationship development between the teacher and student.

Additionally, attachment theory provides a perspective on how the teachers' self-efficacy considers the attachment between the teacher and the students in the classroom. Quality teacher-student relationships and a high teacher sense of self-efficacy led to a positive change in the students' level of engagement (Zee & Koomen, 2019). Teachers with high self-efficacy demonstrate their passion for students to learn and strive to make the students successful. In the classroom, a teacher with high efficacy implements rigorous routine practices of math concepts and displays time-consuming efforts to make sure the students succeed (Gulistan et al., 2017). Teachers' confidence in their roles provides a secure attachment to students who experience math anxiety, and students recognize the support from the teacher (Hill et al., 2016).

When students perceive a supportive environment and a secure attachment is present, their self-confidence increases and their anxiety level is regulated as they learn new concepts and ideas (Semeraro et al., 2020). As a result of the care and support that students receive from their teacher, the teacher's self-efficacy increases and forms a desire in the teacher to foster a secure attachment with the student (Yang et al., 2021). A close teacher-student relationship may build a teacher's self-confidence about instruction and management and improve how teachers value their students (Hajovsky et al., 2019). When teacher math self-efficacy is high, it fosters secure attachment; however, the sources of anxiety in students impact and influence the attachment.

Ramirez et al. (2016) noted significant progress in understanding sources of math anxiety, consequences, and interventions. However, areas of concern, such as contextual factors related to math anxiety, still need to be addressed by future research (Jameson, 2014; Ramirez et al., 2016). The relationship between the teacher and student impacts the outcome of math anxiety

on students, impacting their current situations and influencing long-term behaviors and actions. With a deeper understanding of the factors related to math anxiety, educational institutions, teachers, and parents can develop effective interventions against math anxiety (Luttenberger et al., 2018).

Problem Statement

The teacher-student relationship is a critical factor influencing emotional responses to mathematical tasks and leading to anxiety (Kurdi & Archambault, 2018). A negative relationship may lead to student anxiety, while teachers who provide support may increase students' self-confidence towards problem-solving tasks (Kurdi & Archambault, 2018; Zhou et al., 2020). Even though Kurdi and Archambault (2018) discovered an association between the teacher-student relationship and the level of anxiety in students, Zee and Roorda (2018) indicated that a student's emotional reactions are not associated with the quality of teacher-student relationships. As a result, the school environment between teachers and students may promote, hinder, or not influence the performance level of students (Kurdi & Archambault, 2018). Further investigating the association between math anxiety and the quality of the teacher-student relationship is essential to building on the current literature (Zee & Roorda, 2018). In addition, Kurdi and Archambault indicated that research in this area of math anxiety in lower elementary school children is limited, and the quality of relationships between teachers and students may not be enough to alleviate the appearance of anxiety in children.

Teacher self-efficacy toward math may be another factor that influences the teacher-student relationship. Individuals with high efficacy will extend more energy toward a given task and support the needs of their students. At the same time, teachers who show low self-efficacy demonstrate less effort toward creating positive relationships (Zhou et al., 2020). High self-

efficacy teachers will also implement developmentally appropriate practices and create supportive environments for the social and emotional development of the students (Blazar & Kraft, 2017; Gerde et al., 2017). Teachers with low self-efficacy in math create environments that lack sensitivity to the needs of the students, which impacts the relationship and students' attitudes toward mathematical tasks (Blazar & Kraft, 2017). The problem is that the exploration of the relationship between the math anxiety level of students, the teacher-student relationship, and teacher self-efficacy has not been fully addressed in the literature.

Purpose Statement

The purpose of this quantitative, correlational study was to discover the influence of the teacher-student relationship on teachers' math self-efficacy and math anxiety in the classroom setting of first through third-grade students. This study examined the relationship between teacher self-efficacy and the quality of the teacher-student relationship. In addition, this study determined if there is an association between the teacher-student relationship and the level of math anxiety in first through third-grade students. The predictor variables were teacher self-efficacy and teacher-student relationship, and the criterion variable was the anxiety level of students. Literature defined *teachers' self-efficacy* as teachers' belief in their capability to successfully organize and execute actions required to accomplish teaching tasks in mathematics (Alrajhi et al., 2017; Bandura, 1997; Perera & John, 2020). *Math anxiety in young children* was defined as the negative emotional response such as feelings of tension and anxiety or avoidance behaviors to current or prospective situations involving mathematics that interferes with the manipulation of numbers and problem-solving mathematical problems in academic and real-life situations (Cargnelutti et al., 2017; Hill et al., 2016). Two aspects assessed when examining the teacher-student relationship were warmth which is "the level of involvement, closeness,

affection, and openness of the communication," and conflict, which was "the degree that the relationship is negative and problematic" (Kurdi & Archambault, 2018, p. 214). The participants of this study were teachers and their students in the first through third-grade classrooms. Educators may use teachers' self-efficacy and teacher-student relationship findings to identify areas of professional development and intervention strategies to reduce math anxiety in students.

Significance of the Study

Examining factors that contribute to the development, associations, and alleviation of anxiety in young children is necessary (Kurdi & Archambault, 2018). Young children who receive positive emotional and instructional support in math improve their self-concept and will likely have less anxious feelings toward math (Perera & John, 2020; Semeraro et al., 2020). However, Kurdi and Archambault (2018) indicated that the lack of conflict in the relationship does not equate to the quality of support present or needed to alleviate anxiety in children. Chang and Beilock (2016) mentioned that exploring the relationship between the classroom environment and math anxiety is necessary. This study extends the current research to clarify further the relationship between the math anxiety level of students and the teacher-student relationship.

As teachers form and maintain quality relationships with their students, students' attitudes and behaviors toward math concepts change from a negative perspective to a positive one. The attachment theory provided a theoretical framework to explain the unique and complex relationship in the classroom between teachers and students (Semeraro et al., 2020). When a positive attachment relationship is present, teachers perceive themselves as caring and supportive, which improves teacher self-efficacy (Hajovsky et al., 2019). Since attachment theory provides insights into the behavior and experiences between teachers and students, this

research study provided theoretical significance by further examining the impact of teacher-student relationships with each other and filling the gaps in understanding the dynamic experiences in the classroom.

The environment created by the teacher-student relationship emanates from the teachers' self-efficacy about their abilities in the classroom. Since further research is necessary to show that teachers' self-efficacy relates to the teacher-student relationship, this study adds to the body of knowledge on the impact of teachers' self-efficacy on the teacher-student relationship (Perera & John, 2020). A deeper understanding of the relationship between math anxiety, teacher self-efficacy, and teacher-student relationship enables the development of prevention and intervention strategies to alleviate math anxiety in the classroom, improve classroom conditions, and increase student engagement. From this research, educational policymakers will have a background understanding to produce educational training that focuses on improving teachers' math self-efficacy, teacher-student relationships, and increasing students' confidence in themselves (Yi & Na, 2019). Research on math anxiety will allow stakeholders to understand the concurrent and long-term impact on math achievement and life success (Bosmans & De Smedt, 2015). This research is significant since the data and insight gained from the study will inform and guide evaluations and educational training related to students' prevention and intervention of math anxiety.

Research Questions

RQ1: Is there a statistically significant relationship between the math anxiety of first through third-grade students and teachers’ self-efficacy toward math?

RQ2: Is there a statistically significant relationship between teachers’ math self-efficacy and the teacher-student relationship?

RQ3: How accurately can math anxiety in first through third-grade students be predicted from a linear combination of teachers' math self-efficacy and teacher-student relationship?

Definitions

1. *Math anxiety* – the negative emotional response such as feelings of tension and stress or avoidance behaviors to current or prospective situations involving mathematics that interferes with manipulation of numbers and problem -solving mathematical problems in academic and real-life situations (Cargnelutti et al., 2017; Hill et al., 2016).
2. *Teacher self-efficacy* – refers to a teacher's belief in the capability to organize and execute actions required to successfully accomplish teaching tasks in mathematics (Alrajhi et al., 2017; Bandura, 1997; Perera & John, 2020).
3. *Teacher-student relationship* – refers to two aspects: warmth which is "the level of involvement, closeness, affection, and openness of the communication" and conflict which is "the degree that the relationship is negative and problematic" (Kurdi & Archambault, 2018, p. 214).

CHAPTER TWO: LITERATURE REVIEW

Overview

A systematic review of the literature was conducted to explore the teacher-student relationship, teachers' math self-efficacy, the non-cognitive factors that can diminish anxiety, and the methods used in the educational field to reduce anxiety in elementary students. Chapter two presented a review of the current literature related to math anxiety in young children in the school setting. In the first section, the attachment theory explains the relationship between the teacher and students in the classroom; it describes the association between teachers' math self-efficacy and the teacher-student relationship. The following section details a synthesis of recent literature regarding anxiety, math anxiety, and the sources of math anxiety. The long-term impact of anxiety on young children, which can lead to problems in adulthood, is explained. In addition, the literature review defines the non-cognitive factors of self-efficacy and resilience and explains the impact of the non-cognitive factors on anxiety. The literature review examines how the teacher-student relationship and teacher self-efficacy influence the non-cognitive factors in students. Lastly, in the literature review the researcher examined previous prevention and intervention strategies implemented to reduce anxiety and support student learning. The researcher presented a gap in the literature and indicated the necessity of future research.

Theoretical Framework

The attachment theory provides the theoretical foundation that guides the understanding of the relevance of the teacher-student relationship in the classroom. John Bowly, known for formulating and developing the attachment theory, indicated that a child will thrive and flourish in secure attachments (Harlow, 2021; Kelley, 2009). From the attachment theory, researchers believe that young children's attachment behaviors foster close physical contact and allow

children to communicate their needs with adults (Kelley, 2009; Zhou et al., 2020). When an attachment occurs, an enduring affectionate bond forms a connection between the attachment figure and the child (Bergin & Bergin, 2009). The teacher who becomes the attachment figure develops an attachment pattern with the child in the classroom.

Regarding the attachment theory, there are four patterns of attachment: secure, insecure, avoidant, and resistant/ambivalent (Kelley, 2009; Zsolnai & Szabo, 2020). These four patterns are shown to be present in children within the school environment (Zsolnai & Szabo, 2020). A secure attachment develops when there is close physical contact with another figure (Kelley, 2009). When there is a strong attachment between the child and the attachment figure, the child responds with joy and comfort in moments of distress (Harlow, 2021). In a scenario with a secure attachment, the attachment figure is available, accessible, and consistently responsive to the child's needs (Kelley, 2009). When the attachment figure responds to the child's needs, stress is reduced, and independence is fostered (Bretherton, 1997). The attachment figure, who is sensitive and supportive, becomes a secure base that enables the young child to develop exploratory behavior leading to risk-taking (Ang et al., 2020; Bretherton, 1997; Kelley, 2009). A strong relationship between the attachment figure and the young child fosters positive social-emotional development and emotional regulation (Ang et al., 2020). The secure attachment relationship provides a positive connection between the teacher and student and fosters a caring and supportive environment.

In contrast, an insecure attachment results in children not seeking a connection with the attachment figure. Bergin and Bergin (2009) noted that when children are distressed, they become emotionally and physically distant from the attachment figure. Instead of the attachment figure being accessible and cooperative, the person is unavailable when the child has an

emotional breakdown. In an insecure relationship, the exploratory behavior is nonexistent or limited. Children are capable of attachment behaviors to family and non-family members such as teachers (Bergin & Bergin, 2009). The attachment behaviors explain the teacher-student relationship in the classroom setting.

The quality of the parent-child relationship and teacher-student relationship have similar characteristics, such as harmony, comfort-seeking, and resistance (Verschueren & Koomen, 2012). Even though the relationships are similar, the teacher-child relationship is not exclusive, durable, or able to provide the same perception of protection and security as the parent-child relationship (Verschueren & Koomen, 2012; Zsolnai & Szabo, 2020). In the school environment, the relationship is instructional and shared by others, and therefore, the attachment outcomes vary depending on the child's age and vulnerability (Verschueren & Koomen, 2012). According to the attachment theory, teachers who function as a secure base create an environment that allows students to explore new learning opportunities and take risks (Semeraro et al., 2020). The attachment relationship encourages a warm socioemotional atmosphere in the classroom and produces a culture of respect (Harlow, 2021). Critics of the theory indicate that it is fixed; however, Harlow noted that the theory had been developed and integrated with new insights that incorporate practices in the school environments leading to the child's well-being. Exploratory behavior and the security of the relationship can be extended to explain the teacher-student relationship (Ang et al., 2020).

The attachment theory provides a valuable approach to understanding the teacher-student relationship's unique role in the classroom setting and its impact on the child's social and emotional development (Schuengel, 2012; Zsolnai & Szabo, 2020). In the classroom environment, the teacher, who is the attachment figure, is perceived to be a secure base, which

allows the student to explore the classroom, feel safe, and adapt to challenges (Ang et al., 2020; Verschueren & Koomen, 2012). The secure attachment within the classroom impacts the cognitive functions and attention of the student in a positive manner. As a result of the attentiveness of the teacher, the reaction time increases, and the student's auditory, visual, and visual-spatial awareness improves (Commodari & La Rosa, 2021). Evidence showed that the attachment between teacher and student predicts later educational and social outcomes (Jerome et al., 2009). Implementing attachment principles by teachers in the classroom fosters improvement in students' general well-being, which impacts their math performance (Harlow, 2021).

Within the teacher-student relationship, there are two dimensions: closeness and conflict (Ang et al., 2020). Closeness is the degree to which the teacher-student relationship is positive, satisfying, motivating, and engaging (Ang et al., 2020; Semeraro et al., 2020). The relationship is characterized as warm, supportive, affectionate, and helpful, as well as promoting an environment in which students can regulate negative emotions and challenges successfully (Ang et al., 2020; Semeraro et al., 2020). When observing the relationship, the relationship shows warmth, involvement, closeness, high levels of affection, trust, and openness of communication (Bergin & Bergin, 2009; Clem et al., 2020; Kurdi & Archambault, 2018). A strong secure attachment was associated with improved social competence, self-regulation, well-being, and school achievement (Zsolnai & Szabo, 2020). Throughout elementary school, positive relationship interactions with teachers foster student engagement while, in contrast, negative relationship qualities impede the student from seeking teacher engagement (Zee & Koomen, 2019).

Quality teacher-student relationships are fundamental to supporting the students' needs and engaging the students in the learning process (Fitzsimmons et al., 2021). In secure attachment relationships, students perceive the teacher as caring, protective, supportive, predictable, and trustworthy (Colonnesi et al., 2011). Secure relationships produce positive changes and outcomes such as academic achievement, fewer internal conflicts, external behavior problems, and socioemotional skills (Ang et al., 2020; Zsolnai & Szabo, 2020). In a close teacher-student relationship, the child has shown to have increased growth in math ability due to the emotional support, sensitivity of the teacher, and increased engagement in the classroom. Students in quality teacher-student relationships are willing to take on more challenges, show confidence, and have greater emotional regulation when compared to students who are in conflict relationships (Bergin & Bergin, 2009). Additional factors influence the teacher-student relationship, including the context, attachment history of the teacher and child, internalized relationship styles, the child's cognitive development, and the home environment. Contingent on the depth of the factors, the factors may promote a close teacher-student relationship or a relationship categorized as conflict-based (Jerome et al., 2009).

In the teacher-student relationship, conflict is the degree to which the teacher-student relationship is viewed as negative, unpleasant, conflict-filled, and problematic with low self-efficacy present in students (Ang et al., 2020; Kurdi & Archambault, 2018; Semeraro et al., 2020). In the degree of conflict, the student with the insecure attachment is viewed as clingy, overly reliant, and demonstrates adjustment problems (Bergin & Bergin, 2009). As a student's math anxiety evokes negative reactions from teachers, math anxiety increases in children, creating a negative relationship pattern and affecting student academic outcomes (Zee & Roorda, 2018). The negative and insecure relationship between the teacher and student produces low

engagement, lack of motivation, and increased behavior problems in the classroom (Ang et al., 2020; Semeraro et al., 2020). Research indicated that math anxiety could reflect an insecure attachment relationship between teacher and student. Social factors such as home environment and school relationships contribute to individual differences in math anxiety. Children who have insecure attachments are less likely to seek help from teachers when they are challenged with math concepts. A child who possesses an insecure attachment and demonstrates symptoms of math anxiety has the potential to exhibit low math performance (Bosmans & De Smedt, 2015). A student's low self-efficacy and poor math performance may be influenced by the teacher's self-efficacy when the teacher fails to support and engage the student (Zee & Koomen, 2019)

The attachment theory provides a perspective on how a teacher's math self–efficacy influences a teacher's engagement with the students in the classroom. When teachers possess a high confidence in their ability to teach and support a student, they are more likely to exert effort and persistence in helping the child succeed, creating a more secure attachment (Zee & Koomen, 2019). Developing a high-quality teacher-student relationship requires high levels of emotional investment (Fitzsimmons et al., 2021). A teacher may demonstrate lower self-efficacy when a student shows external or internal behaviors such as anxiety. In a study with fourth through sixth-grade students, students increased their behavioral and emotional engagement levels with teachers who held a high self-efficacy toward them and maintained a close and conflict-free relationship. As a result of the teacher's high levels of closeness and effort, the students show effort and persistence, which creates emotional security for the teacher and student (Zee & Koomen, 2019).

The attachment theory framework illustrates how teachers are perceived as a secure base that increases the child's self-confidence in exploring new content and regulating their emotions,

which results in reducing math anxiety in children and creating a positive predictor of math achievement (Semeraro et al., 2020). Improving teacher-student relationships and forming secure attachments are valuable classroom characteristics (Jerome et al., 2009). By using the attachment theory, the study provided support and insight into the influence of the teacher-student relationship and the critical role the relationship has in the school environment (Schuengel, 2012). This research expanded the existing literature on the impact of the attachment relationship between the teacher and student math anxiety, in addition to the significance of teacher math self-efficacy as it relates to math anxiety.

Related Literature

Anxiety

Anxiety has been an increasingly common phenomenon in the general child population (Beidel & Alfano, 2011). Trait anxiety is used to describe someone more likely to be anxious. In contrast, state anxiety refers to immediate feelings of anxiousness depending on the person's vulnerability to anxiety and the presence of situational stressors (Zeidner & Matthews, 2010). According to attachment theory, the inconsistent attitudes and behaviors of an attachment figure are perceived by the child as an insecure base, which impacts the development of anxiety (Colonnesi et al., 2011). For a child who has insecure attachments, anxiety behaviors appear as a sense of uncertainty, distress, concerns over possible mental and physical disasters, mental and physical symptoms, nervous tension, and a negative emotional state (Beidel & Alfano, 2011; Zeidner & Matthews, 2010). The occurrence of repetitive negative experiences and stressors in the attachment relationship predicts later anxiety problems in children (Colonnesi et al., 2011). In addition, anxiety may be conscious, unconscious, learned, innate, biological, cognitive, about a future danger, mild, long-lasting, and damaging. A person who is struggling with anxiety may

have a sense of worry, which is a form of threat or danger. Insecure child attachment relationships produce various forms of anxiety: test anxiety, computer, sports, social, and separation anxiety disorder (Zeidner & Matthews, 2010). Rubinsten et al. (2015) concluded that children with generalized anxiety disorders are at risk of developing math anxiety when faced with challenging numerically related tasks. Since generalized anxiety is not connected to any specific threat, for instance, math or numerical-related tasks, this research will focus on math anxiety in children in the first through third grade and examine the influence the attachment relationship has on anxiety (Zeidner & Matthews, 2010).

Math Anxiety

While general anxiety may appear in all academic situations, math anxiety occurs when interference occurs during the processing of math-related or number-related information or tasks (Commodari & La Rosa, 2021). Children with insecure attachments may experience math anxiety separate from general and test anxiety which directly impacts math performance skills (Commodari & La Rosa, 2021; Dreger & Aiken, 1957; Johns et al., 2020). Math anxiety refers to a "feeling of stress in situations involving numerical information and avoiding activities which include numbers or quantities" (Rubinsten et al., 2015, p. 1). Math anxiety is associated negatively with attitudes, self-confidence in math, numerical confidence, motivation, or views about the usefulness of math which creates avoidance of math (Ashcraft, 2019; Harari et al., 2013). When examining young children, math anxiety ranged from mild to severe, minor frustrations to overwhelming emotional or physical disruption (Passolunghi et al., 2019). When insecure attachment relationships are present, the child is at risk for internal and external behavior problems (Kennedy & Kennedy, 2004).

Math anxiety is prevalent across various cultures and groups from elementary years to college age students because of different relationship attachments forming with the attachment figure (Ghandour et al., 2019; Moustafa et al., 2021; Zeidner & Matthews, 2010). For young children, math anxiety was reported to be associated with risk of failure, mathematical task difficulty, time pressure, reaction of teachers and parents, teaching methods, fear of unknown situations, and fear of receiving a bad grade. A minority of children reported a moderate or strong level of anxiety or lack of anxiety which creates math related problems (Deringol, 2018; Szczygiel & Pieronkiewicz, 2021). The early insecure attachments foster later social, emotional, and academic problems (Colonnesi et al., 2011).

Although anxiety is a common issue among young children, math anxiety is not frequently studied in children under 12 years old (Kurdi & Archambault, 2018; Luttenberger et al., 2018). Researchers were concerned that elementary school children could not express their emotions about math; however, the onset of math anxiety has been discovered to appear in early elementary school students (Ramirez et al., 2016; Tufeanu & Robu, 2019). The level and the expression of anxious behaviors depends on the attachment relationship between the teacher and student (Colonnesi et al., 2011). Few studies have targeted math anxiety in young children to explore the impact of math anxiety on classroom environment and the impact of the attachment relationship (Tufeanu & Robu, 2019). Previous research focused mostly on how math anxiety was associated with math achievement and gender differences instead of focusing on the teacher-student relationship and math anxiety (Kurdi & Archambault, 2018). The prevention and intervention of mental health disorders such as anxiety in first through third-grade children deserve increased interest and attention in the school setting to determine the impact of anxiety on class performance and the teacher-student relationship (Martinsen et al., 2016).

While the literature presented math anxiety in children as negative, math anxiety has positive components. In the classroom, math anxiety may encourage students to adapt to the environment, build resilience, motivate the students' choices about their behavior and thinking, and prepare their minds to think critically. However, if the attachment with the teacher remains insecure, math anxiety can be detrimental. Math anxiety disrupts the child's cognitive function, negative thought patterns, and mental disorganization promoting tension in the body which develops due to situations involving mathematical computations, problems-solving, and assessment (Zeidner & Matthews, 2010).

Negative physical, cognitive, and behavioral responses are associated with math anxiety and an insecure attachment. Physical responses involve sweating, difficulty breathing, hot or cold flashes, dizziness, tingling in hands or feet, nausea, muscle aches and pains, and headaches (Beidel & Alfano, 2011). Students with math anxiety have experienced cognitive responses such as negative emotions, fear of forgetting an answer, a fear of saying the incorrect answer, excessive worry, concerns about accuracy, and catastrophic thoughts (Beidel & Alfano, 2011; Dowker, 2019; Zeidner & Matthews, 2010). The behavioral responses include crying, clinging to parents, tantrums, disobedience, oppositional behavior, pretending to be sick, delay tactics, staying inside, and avoidance (Beidel & Alfano, 2011). Students with high math anxiety demonstrate less precision in number comparisons when completing tasks (Dowker, 2019). Math anxiety provokes an array of physical, cognitive, and social disfunctions; however, not all symptoms occur with every student due to the various attachment relationships (Beidel & Alfano, 2011; Colonnesi et al., 2011).

Working Memory

Working memory and math anxiety have been linked together to explain the relationship between the effects of math anxiety on mathematical performance (Orbach et al., 2020). The lack of emotional support, care, and security from the insecure attachment fosters negative mental representations and thought patterns about themselves and others (Kennedy & Kennedy, 2004). The negative cycle of thought patterns impacts cognitive functions such as working memory (Rubinsten et al., 2015). When problem-solving and mathematical content prove challenging or stressful, the effort to perform disturbs cognitive processing (Zeidner & Matthews, 2010). Due to math anxiety, working memory limits cognitive functions (Orbach et al., 2020). Since math anxiety does not allow adequate processing of information relevant to the task, working memory is dysfunctional (Passolunghi et al., 2019). Math anxiety and a lack of secure attachment impair working memory, which reduces attention to resources, potentially reducing math achievement (Kennedy & Kennedy, 2004; Rubinsten et al., 2015). As a result of reducing math anxiety, working memory enables the student to perform the mathematical task (Rubinsten et al., 2015). The literature confirms that math anxiety disturbs working memory due to the high cognitive demand impacting math performance and other arithmetic operations (Beidel & Alfano, 2011; Commodari & La Rosa, 2021).

Sources of Math Anxiety

Literature showed a relationship between insecure attachments and anxiety sensitivity in children (Colonnesi et al., 2011). In addition, research suggested that the origins of math anxiety stem from genetic factors, which account for about 40% of the math anxiety variance (Rubinsten et al., 2015). Math anxiety may be caused by a genetic predisposition to suffer from anxiety, negative environmental experiences with math, and insecure attachment relationships (Colonnesi

et al., 2011; Dowker et al., 2016; Rubinsten et al., 2015). Genetics, socialization practices, school experiences, advanced ages of the teacher, and family and social educational experiences foster math anxiety in children (Figueira et al., 2023; Zeidner & Matthews, 2010). In addition, research concluded that the relationship between anxiety and economic conditions did not exist (Beidel & Alfano, 2011). While the cause of math anxiety is unclear, combining genetics, emotional factors, low self-efficacy, and environmental experiences creates a risk for students to develop math anxiety, which impacts their math performance (Beidel & Alfano, 2011; Griggs et al., 2013; Malanchini et al., 2020). The increased math anxiety creates a cycle of declining performance and increased anxiety in children (Beidel & Alfano, 2011).

Social, cultural, and contextual factors such as the student's family environment and school atmosphere influence the development of math anxiety as explored through the attachment relationship (Chang & Beilock, 2016; Mammarella et al., 2019). With the development of insecure attachments, students react negatively to the pressure in home environments in which math skills are viewed as critical to succeed in college and career paths (Chang & Beilock, 2016). The insecure ambivalent attachment revealed a strong association with the development of anxiety compared to an avoidant attachment (Colonnesi et al., 2011). Social pressure from external relationships to succeed and engage in math-related extracurricular activities is an environmental source of anxiety when the child does not have a secure relationship (Colonnesi et al., 2011; Yi & Na, 2019).

When family members and the school culture hold strong attitudes about academics, students feel threatened by failing and have a strong desire to succeed (Yi & Na, 2019). Math anxiety in fathers was indicated to influence students' math anxiety in first-grade and third-grade girls (Szczygiel, 2020b). In comparison, math anxiety in mothers and teachers affected the level

of math achievement in third-grade children (Szczygiel, 2020b). The research findings indicated that children demonstrate anxiety when they believe they do not have adequate self-efficacy to perform the task due to interactions in their family environment (Bandura, 1983; Pajares, 1996). Parents with low anxiety in math easily help students with homework and math skills. In contrast, parents' high level of anxiety transfers negative attitudes, frustrations, and lack of understanding; still, there is no clear evidence of peer influence on attitudes (Beidel & Alfano, 2011).

According to attachment theory, students are strongly impacted by their experiences at school and their interactions between teachers and peers (Rubinsten et al., 2015). Anecdotal evidence revealed that the students' teacher was a factor in the development of math anxiety in the students (Mammarella et al., 2019). The anxiety may be a result of fear over an assignment or the fear of making a mistake (Ginsburg et al., 2019). The results from Szczygiel and Pieronkiewicz (2021) indicated that fear of failure was most often mentioned as a contributing factor in math anxiety. The insecure student develops a negative self-concept, forming negative thoughts around failure, low self-confidence, and pressures to perform well from teachers and parents, leading to anxious behaviors (Yi & Na, 2019). In addition, the fear of bad grades, the fear associated with the nature of mathematics, and the fear of the reactions of others were related to the level of anxiety in children (Szczygiel & Pieronkiewicz, 2021).

The attachment relationship that the teacher forms may influence the students' attitude toward math, either positively or negatively (Mammarella et al., 2019). The quantity and quality of social interaction with teachers impact math anxiety in students (Chang & Beilock, 2016; Nwosu et al., 2019). Students with high self-efficacy will cope with challenges, accept themselves, and adjust their decisions when faced with anxiety (Salifu Yendork & Somhlaba,

2015). Rubinsten et al. (2015) mentioned that adverse social interactions and ineffective math instruction from the teacher might contribute to the development of math anxiety. Teachers with high math anxiety levels factor into the students' math learning and math achievement (Schaeffer et al., 2021). The cues from teachers emphasizing math may negatively influence students' math anxiety levels and their responses to mathematical practices (Beilock & Willingham, 2014). Teachers create a teaching environment that empowers students to learn or fosters an environment of uneasiness and anxiety.

The teaching environment and insecure attachment relationships may promote failure, excessive competition, and harsh evaluation, which increases anxiety (Zeidner & Matthews, 2010). Math anxiety is impacted by the student's interpretation of previous math experiences and outcomes that occur in the classroom, such as negative evaluations, feedback, and interactions with peers and teachers (Passolunghi et al., 2019; Ramirez et al., 2016). Anxiety levels increase when teachers demonstrate traditional practices, authoritarian teaching styles, public exposure, and time constraints on the students (Passolunghi et al., 2019). Even though determining causal factors is complex, teacher self-efficacy beliefs were directly related to students' ability beliefs and math achievement (Beidel & Alfano, 2011). The source of math anxiety stems from different reasons and various attachment relationships; however, students demonstrate similar anxiety outcomes: worry, which is related to performance, low self-confidence, low self-efficacy, and feelings of failure (Moustafa et al., 2021; Passolunghi et al., 2019).

Long-term Impact of Anxiety in Young Children

The long-term impact and the expression of the anxious behaviors of young children depend on the attachment relationship formed in the classroom (Zee & Roorda, 2018). Everyone experiences some form of anxiety, and children will experience anxiety when they face new

situations and challenges as they learn (Brown, 2019). Childhood anxiety is a common condition impacting the student's life in the classroom, which includes approximately 15% of children aged 8-10 years old (Brown, 2019; Buchanan-Pascall et al., 2018). The literature indicated that 50% of shyness and social withdrawal cases appear before the age of six (Chronis-Tuscano et al., 2018). Positive or negative math attitudes in young children emerge early and relate to math achievement (Levine & Pantoja, 2021). The literature revealed that insecure attachments increase the risk of anxiety disorders, which create short and long-term consequences such as mood disorders, difficulty in school, and substance abuse (Brown, 2019; Colonnesi et al., 2011; van Starrenburg et al., 2017). When anxiety is not reduced or eliminated and a secure attachment is not formed, the behavior may produce mental health problems in adolescence and adulthood (Allen & Lerman, 2018; Chronis-Tuscano et al., 2018; Kertz et al., 2019). Math anxiety refers to negative feelings, fears, nervousness, or worries related to math performance (Tufeanu & Robu, 2019). The attachment theory indicates that the anxiety of the child is a result of a lack of confidence in the math teacher's ability to be present and supportive in times of need (Colonnesi et al., 2011).

The attachment theory provides insight into how math anxiety has been detrimental to a child's relationship with people in their educational outcomes and personal and social experiences that are consistent throughout their school experiences (Passolunghi et al., 2020). In the classroom, a child with anxiety may experience difficulties building friendships, becoming a recipient of bullying, and demonstrating frequent absenteeism (Allen & Lerman, 2018). When children are insecure, performance in school decreases, and engagement in extracurricular activities is non-existent (Allen & Lerman, 2018). Anxious behaviors have been observed in African American children and European American youth, which resulted in long-term

academic, social, and psychological difficulties (Chronis-Tuscano et al., 2018). As a result of the anxiety, problem-solving skills are insufficient and impair academic functioning, leading to an academic decline in math and in other content areas (O'Connor et al., 2011). Due to the lack of support in the relationship with teachers, math anxiety outcomes produce a negative impact on math aptitude and math achievement (Dowker et al., 2016). Consistent high levels of math anxiety in students result in low math academic performance, which is associated with insecure attachments (Bosmans & De Smedt, 2015; Johns et al., 2020). Early negative experiences in math predicted less proficiency over time due to the deficiencies in cognitive math skills (Cargnelutti et al., 2017). The lack of academic progress creates a burden on the teachers to intervene and provide support. The emerging problem is that the impact of the relationship between the teacher and student is not consistent, and teachers are not aware of how to manage anxiety in students (Ginsburg et al., 2019.)

Math anxiety outcomes negatively impact math aptitude, math achievement, and low effort toward learning math (Dowker et al., 2016; Luo et al., 2023). When students feel some level of math anxiety, they show emotional signs of stress: nervousness, fear, depression, feelings of helplessness, and panic, which further impacts the teacher-student relationship (Tufeanu & Robu, 2019). Students may show physical signs of math anxiety: heavy sweating, increased heart rate, trembling, headaches, stomachaches, or tightness of the body (Campbell, 2004; Tufeanu & Robu, 2019). The student might display escape, avoidance behaviors, and lack of focus (Campbell, 2004). Anxiety creates negative thought patterns and a failure outlook when completing tasks (Tufeanu & Robu, 2019). Students' high level of anxiety was associated with conflict in the teacher-student relationship and low quality of instruction (Clem et al., 2020).

The attachment relationship that teachers form with male and female students differs, which impacts the students' experience with math-related concepts and anxiety (Ganley & McGraw, 2016; Hill et al., 2016). A meta-analysis conducted by Zhang et al. (2019) indicated no significant gender differences between math anxiety and math achievement. In contrast, Ganley and McGraw (2016) reported a significant difference in math anxiety between males and females. As a result of the negative attitudes found in female students, their performance on tests will not show their best effort (Gunderson et al., 2012). Females yielded significantly higher math anxiety levels than males, which may be due to genetic factors, environmental conditions, and gender stereotyping (Ganley & McGraw, 2016; Hill et al., 2016; Zhang et al., 2019). In a systematic review of 19 studies, Bor et al. (2014) discovered that adolescent girls' internalizing symptoms had increased compared to the previous cohorts, and the boy cohorts had revealed mixed results. Even though girls are shown as having a higher level of anxiety than boys, Campbell (2004) noted that girls might be more likely to report their anxiety. Commodari and La Rosa (2021) reported a significantly noticeable difference in math anxiety between male and female students. The female students reported a higher level of anxiety about learning math and math tests (Commodari & La Rosa, 2021). The girls' anxiety level and a teacher's strong stereotype belief system impact the girls' lifelong pursuit of careers and success in math-related fields (Beidel & Alfano, 2011). The insecure attachments that teachers form with students factor into the school experiences, student outcomes, and anxiety levels of male and female students (Beidel & Alfano, 2011; Commodari & La Rosa, 2021).

The positive or negative attachment relationship that teachers form influences future student outcomes, and the presence of anxiety in students' predicted career choices (Ahmed, 2018; Beidel & Alfano, 2011). In study groups, adolescents who remained in the trajectory group

of math anxiety with consistently low or decreasing anxiety levels predicted later career choices in science, technology, engineering, and mathematics (STEM). In the sample group, math anxiety was stable throughout the study; however, individually math anxiety fluctuated between high and low anxiety levels in the participants (Ahmed, 2018). Due to the avoidance of math coursework, students develop low self-efficacy and self-concept, which predicts math achievement and career choices (Zeidner & Matthews, 2010). As a result of math anxiety interfering with a student's social, emotional, and academic development, math performance, STEM career choices, and attitudes toward math become impacted negatively due to the attachment relationship in the classroom (Beidel & Alfano, 2011; Moustafa et al., 2021).

Previous literature has focused on the relationship and impact of math anxiety and math performance. A study with school children indicated that math anxiety was negatively associated with calculation performance, numerical knowledge, calculation accuracy, and calculation speed. Math anxiety was a predictor of calculation skills, indicating that math test anxiety influences the ability to process math information accurately and automatically (Commodari & La Rosa, 2021). Literature concluded that there was a bidirectional relationship and a negative association between math anxiety and math performance (Dowker, 2019; Orbach et al., 2020). Literature confirmed that math anxiety in young children negatively correlates with math achievement (Szczygiel & Pieronkiewicz, 2021). The school environment and the attachment relationships in which students develop their non-cognitive factors is a setting in which research on math anxiety in children should be explored further.

Definitions of Non-cognitive Factors

The attachment relationship between the teacher and student influences the non-cognitive factors that form in the student. Researchers have concluded that non-cognitive factors impact

the confidence level of children, which may lead to signs of anxiety if the non-cognitive factors are not high (Jameson, 2014; Raghavan & Griffin, 2017; Salifu Yendork & Somhlaba, 2015). Non-cognitive factors also referred to as protective factors, assist in navigating students through problems and difficult situations (Salifu Yendork & Somhlaba, 2015). In secure attachment relationships, students develop strong self-efficacy and resilience (Kennedy & Kennedy, 2004). Self-efficacy and resilience are the non-cognitive factors that influence self-confidence, perseverance, and anxiety levels (Raghavan & Griffin, 2017). To effectively understand the influence of non-cognitive factors, the factors must be defined.

Self-efficacy

Literature defines *self-efficacy* as the belief in the capabilities to learn and perform actions on selected performance outcomes (Schunk & DiBenedetto, 2020). In addition, self-efficacy is the perceived capability to successfully execute the behavior required and achieve specific outcomes (Bandura, 1977; Pajares, 1996; Simonova et al., 2019). Self-efficacy and past experiences predict a student's academic performance (Oqvist & Malmstrom, 2018; Simonova et al., 2019).

Resilience

From qualitative research, common themes have emerged to describe resilience as the ability to bounce back and adapt well to the situation in the face of adversity or trauma (Aburn et al., 2016). While Aburn et al. (2016) indicated that there was no universal definition of resilience, Raghavan and Griffin (2017) define *resilience* as "the dynamic process involving interactions between various risk and protective processes both internal and external to the individual that act to mediate the influences of adverse life events" (p. 86).

Impact of Non-cognitive Factors in Reducing Anxiety

According to the attachment theory, in a secure attachment, the child perceives the attachment figure as caring, protective, and predictable. With a secure attachment, the child is characterized as having resilience, confidence, and faith in the relationship (Colonnesi et al., 2011). Having a sense of identity and enhancing the non-cognitive factors such as self-efficacy and resilience reduce internal and external problems (Raghavan & Griffin, 2017). When conflict increases, and a lower feeling of closeness occurs between the teacher and student, a child's lack of emotional regulation increases (Pianta & Stuhlman, 2004). One study indicated that building non-cognitive factors and resilience in children with intellectual disorders increased confidence and self-esteem (Raghavan & Griffin, 2017). Research showed that teacher-student attachments have a role in the ability of children to acquire non-cognitive skills to succeed (Pianta & Stuhlman, 2004). In the attachment relationship, Nwosu (2019) concluded that teachers must equip students with coping skills to build self-efficacy to reduce anxiety. The study from Nwosu (2019) builds on previous research that supports the relationship between perceived instructed coping skills and students' self-efficacy. Non-cognitive factors are coping skills that influence self-efficacy and students' resilience, which reduces anxiety. Overall, the literature concluded that there is value in researching and focusing on enhancing resilience in children to overcome adverse events in their lives through the attachment relationship (Raghavan & Griffin, 2017; Salifu Yendork & Somhlaba, 2015). However, more investigation is necessary to examine teachers' critical role in math anxiety and the attachment relationship with young children.

Role of the Teacher in Influencing Non-cognitive Factors

As a result of the attachment relationship in the classroom, research suggested that teachers are influential in fostering non-cognitive factors such as resilience in students and in

impacting the mathematical future of students (Piper, 2017; Szczygiel & Pieronkiewicz, 2021). Oqvist and Malmstrom (2018) commented that "a teacher can make the difference between a student who achieves at high levels and one who slips through the cracks" (p. 158). Research on the importance of positive and negative aspects of the teacher-student relationship is significant for achieving learning outcomes (Roorda et al., 2011). Simonova et al. (2019) stated that "teacher's beliefs influence how teachers interact with students and thus affect not only the quality of the instruction but also students' learning outcomes" (p. 313). Pianta and Stuhlman (2004) noted that the associations between the teacher-child relationship and the child's development were small or insignificant. However, other research revealed that teachers have an important role in fostering personal growth in their students, increasing behavior engagement, and enhancing non-cognitive outcomes (Ab Ghaffar et al., 2019; Doumen et al., 2012; Park et al., 2018). Beilock and Willingham (2014) noted a link between teachers' behavior and positive math outcomes in the classroom. In the classroom, the teachers' math self-efficacy and the quality of the relationship influence the preference for math-related activities and math achievement in students (Semeraro et al., 2020).

Attitudes and Self-Efficacy of Teachers

A teacher's belief system and their relationship with the student influence the non-cognitive outcomes of the students whom they interact with daily (Simonova et al., 2019). This concept is important because a teacher's self-efficacy can affect the learner's self-efficacy and student learning outcomes (Morris et al., 2017; Schunk & DiBenedetto, 2020). Research has shown that teachers with high math self-efficacy engage and motivate students at a higher level in the classroom than teachers with low math self-efficacy (Zee & Koomen, 2019). In secure attachment relationships, students feel the teachers' trust and care, which fosters their self-

efficacy. As a result, higher self-efficacy fosters positive student learning behavior and emotional well-being (Yang et al., 2021). Alrajhi et al. (2017) noted the importance of teachers managing their emotions and regulating their students' emotions. Morris et al. (2017) indicated that a teacher's strong self-efficacy leads to effective teaching and a commitment to professionalism.

Since educational background and teaching experiences do not predict math self-efficacy, teachers may struggle with content and new approaches to math practices (Gerde et al., 2017). When the self-efficacy level of the teachers is low, the teacher's ability to support the non-cognitive needs of the students in the classroom is not achieved (Schunk & DiBenedetto, 2020). In the content area of math, professional development for teachers is often overlooked, resulting in low self-efficacy (Blazar & Kraft, 2017). The formation of a high level of math self-efficacy is critical in supporting students' academic and emotional behaviors (Gerde et al., 2017).

As a result of the supportive and positive relationship with students, closeness, and conflict predicted teachers' self-efficacy (Hajovsky et al., 2019). When there is a lack of support and intervention from the teacher, a student's anxiety level may increase (Schunk & DiBenedetto, 2020). In contrast, teachers' math self-efficacy levels that foster supportive learning environments may reduce the level of anxiety in students and promote academic resilience (Hajovsky et al., 2019). When interacting with individual children, a teacher's math self-efficacy will be differentiated depending on the behavior of the child or the gender of the child (Zee & Koomen, 2019). Male teachers seemed to respond differently toward children with anxious behaviors than female teachers due to their gender roles (Allen & Lerman, 2018). As a result of the application in authentic settings, professional development, and modeling are the most powerful influences on teachers' self-efficacy and building teacher-student relationships (Morris et al., 2017).

The math teacher's self-efficacy is a factor in the relationship development with the student, which influences student academic achievement (Gulistan et al., 2017). The teachers' self-efficacy impacts their thoughts, choices, behavior, and performance in the classroom (Zhou et al., 2020). In contrast, Roorda et al. (2011) indicated that no evidence was discovered to support the moderating role of the teacher's characteristics in the classroom. As teachers maintain confidence in their roles and skills as math instructors, they provide the emotional support necessary to meet the needs of young students who experience math anxiety due to their lack of coping strategies in challenging situations (Hill et al., 2016).

Positive teacher self-efficacy contributes toward positive teacher-student relationships. In addition, the conflict perceived in the teacher-student relationship may "result" in a lack of teacher-student communication, which decreases the teachers' belief in effectively instructing the student. In relationships, conflict and closeness may directly and indirectly impact teacher self-efficacy (Hajovsky et al., 2019). Further research is needed to understand the association of the teachers' math self-efficacy on the teacher-student relationship as it relates to math anxiety in students.

Teacher-Student Relationships

The attachment theory supports the position that positive affective relationships between the teacher and student promoted learning in the classroom and predicted child's well-being (Semeraro et al., 2020). The teacher's role shapes and promotes learning outcomes by providing support that satisfies the three psychological needs of the students: autonomy, competence, and relatedness (Oqvist & Malmstrom, 2018). Nwosu (2019) analyzed descriptive data that revealed that students agreed that their teachers equipped them with coping skills that enabled them to handle complex cognitive tasks. When challenged with new content, a student is most likely to

approach the teacher when a positive relationship is present (Semeraro et al., 2020). Research has shown that a positive teacher-student relationship positively influences student engagement and math performance (Yang et al., 2021). There is a risk that students with anxiety will develop conflicts and dependency with their teachers (Zee & Roorda, 2018). The findings of Zee and Roorda (2018) indicated that students with anxiety had a positive association with conflict and dependency in the teacher-student relationship. Teachers' frustrations and lack of skills to handle the situation caused conflict. Zee and Roorda (2018) suggested that this could occur due to the negative feelings that teachers develop when trying to engage with children with anxiety.

The degree of closeness or conflict may vary due to the gender and cultural background of the teacher and student. One study discovered that the teacher-student relationship impacts academically challenged students; however, it was still unclear how the relationship impacted boys versus girls (Roorda et al., 2011). In another study, girls seemed to be more susceptible to feeling anxious when conflict with teachers occurs (Kurdi & Archambault, 2018). The quality of the teacher-student relationship was rated more positively by teachers when the student and teacher reflected the same ethnic background (Saft & Pianta, 2001). In addition, Hajovsky et al. (2019) indicated that teachers supported students with similar backgrounds and experiences, while unshared cultural experiences resulted in less attentiveness. Quality teacher-student relationships were more influential for older students than younger students. However, the engagement level of younger students is highly influenced by negative relationships (Roorda et al., 2011).

Zee and Roorda (2018) suggested that reflection-focused intervention programs may help teachers reflect on their behaviors, intentions, and feelings concerning anxious students. As teachers express warmth, responsiveness, and trust, the students become capable of regulating

their emotions (Semeraro et al., 2020). When the school culture develops high quality teacher-student relationships and emphasizes growth, the result is supportive and nurturing learning environments (Park et al., 2018). Since the teacher-student relationship provides a sense of security and support, Zhou et al. (2020) reaffirmed the value of the teacher-student relationship.

The relationship dynamics between a teacher and student are unique, and some teachers form secure relationships more easily with some students (Jerome et al., 2009). The internalizing behavior of the students influences the quality of their relationship with their teachers (Zee & Roorda, 2018). In addition, teachers were found to form quality relationships with students based on their experiences, attachment behaviors, and biases (Jerome et al., 2009). Negative teacher-student relationships are associated with high anxiety as early as third and fourth grade. However, positive relationships were discovered to have no link to a change in anxiety (Kurdi & Archambault, 2018).

In contrast, quality relationships were found to reduce math anxiety, which positively impacted math performance (Semeraro et al., 2020). In addition, positive teacher-student relationships impacted mathematical problem-solving ability, which was partially mediated by self-efficacy (Zhou et al., 2020). When the level of anxiety in students is high, Beilock and Willingham (2014) noted that teachers may ensure basic mathematical skills, continue math training, change the assessment, and find strategies to support the needs of the students. Kurdi and Archambault (2018) noted that conflict is a more powerful influencer than warmth in a relationship. A positive relationship may not be the only factor that influences math anxiety in children (Kurdi & Archambault, 2018).

The problem is that lower elementary students who engage in math-related problems and situations may suffer from math anxiety, which may be related to the quality of the teacher-

student relationship present and teacher self-efficacy towards teaching math (Zhou et al., 2020). A study discovered that the teacher-student relationship was insufficient to improve student learning and indicated that other factors may be involved that influence engagement and achievement; in contrast, a recent study showed that the teacher-student relationship was key to improving student learning (Pianta, 2019; Roorda et al., 2011). Gaps explaining the impact of the teacher-student relationship and examining relationships across grades remain (Pianta, 2019). The connection between the quality of teacher-student relationships and math-related problems warrants further investigation into possible factors that impact the teacher-student relationship and anxiety in children (Kurdi & Archambault, 2018).

Building Non-cognitive Factors

Children with secure attachment relationships develop positive mental images of themselves, while insecure children develop low non-cognitive factors (Kennedy & Kennedy, 2004). Previous literature has focused on improving non-cognitive factors such as self-esteem and self-efficacy to reduce math anxiety and improve math achievement (Semeraro et al., 2020). As teachers model strategies to decrease anxiety, students imitate the model and develop strategies to use when feeling anxious (Bandura, 2012). When teachers use persuasive verbal statements and provide feedback, self-efficacy is impacted (Schunk & DiBenedetto, 2020). As a result of teachers improving students' self-efficacy by developing secure attachments, students' self-efficacy increases, and positive mental images form about themselves (Bandura, 1986,1997; Kennedy & Kennedy, 2004).

Secure students begin to implement strategies to overcome problems through self-development and perseverance. When students perceive a caring, challenging, and goal-focused environment, their self-efficacy toward math increases (Semeraro et al., 2020). The interactions

between teacher and student can enhance resilience as a result of the secure student's ability to explore and have confidence in the attachment figure (Colonnesi et al., 2011). When teachers improve the students' problem-solving skills, develop their confidence level, and foster a secure attachment, students' resilience improves (Raghavan & Griffin, 2017). Simonova et al. (2019) examined the relationship between non-cognitive outcomes: perseverance, self-efficacy, and educational aspirations and their teachers' attitudes. The results indicated that "students' non-cognitive outcomes are related to the academic optimism of their teachers" (Simonova et al., 2019, p. 313).

Semeraro et al. (2020) noted that self-esteem and secure teacher-student relationships impacted math achievement, which was mediated by math anxiety. When examining the association between the teacher-student relationship, math performance, and math anxiety, Zhou et al. (2020) also discovered that the association between the teacher-student relationship and math performance was impacted by math anxiety. In contrast, Zee and Roorda (2018) discovered no links between student anxiety and the degree of closeness in the teacher-student relationship. However, the quality of the teacher-student relationship was linked to the conflict level of anxiety, which may have resulted from the negative feelings that teachers experienced when students displayed anxious behaviors (Zee & Roorda, 2018).

A positive teacher-student relationship enables teachers to implement strategies to reduce anxiety and increase socioemotional skills (O'Connor et al., 2011). As a result of the teachers' close contact and interactions with the students, teachers may provide support and encouragement (Allen & Lerman, 2018). When anxiety becomes a problem and children can no longer perform well in school academically, socially, or emotionally, prevention and intervention programs in the classroom are necessary (van Starrenburg et al., 2017). This research will fill in

the gap by providing further insight into math anxiety by examining the relationship math anxiety has with the teacher-student relationship and teacher math self-efficacy, providing research-based information to guide prevention and intervention strategies.

Prevention and Intervention Strategies

Attachment-based prevention and intervention strategies positively impact children with anxiety. As prevention and intervention strategies formulate secure attachment relationships in the classroom, the strategies can change the course and direction of a child's association with math and math anxiety (Colonnesi et al., 2011). Prevention and intervention efforts benefit students who are at risk and lack the skills to foster quality and secure teacher-student relationships. Researchers discovered that intervention efforts to increase quality teacher-student interactions impacted the students' later academic and behavioral outcomes (Hamre & Pianta, 2001). When intervention programs focus on improving teacher skills that support the emotional and behavioral engagement of the child, the student's level of anxiety is reduced (Zee & Koomen, 2019). One study discovered that math anxiety training for teachers developed their knowledge and skills, which improved students' decreasing math anxiety levels; however, training did not impact math achievement (Passolunghi et al., 2020). By increasing students' self-confidence and encouraging students to persevere, teachers create an atmosphere in which students perceive failure as less threatening (Yi & Na, 2019). As a result of attachment-based practices, the teacher-student relationship is a critical element in the classroom for student success (Colonnesi et al., 2011).

Based on attachment theory, the interaction between teacher and students contributes to the tone of the classroom and should be supportive and non-threatening, thus providing a positive classroom tone (Johns et al., 2020). When a student is challenged with an assignment,

teachers should make interactions to identify problems privately (Cargnelutti et al., 2017). When teachers develop a sense of privacy, they build positive secure relationships, so students feel accepted and supported while fostering a classroom setting conducive to learning (Johns et al., 2020). As teachers instruct students with anxiety, the teachers avoid power struggles and maintain a calm approach by scaffolding tasks into small parts and providing additional time for work (Cargnelutti et al., 2017; Johns et al., 2020). The literature revealed that teachers who have positive interactions with students and possess a strong self-efficacy in math support students who struggle with anxiety through varied techniques, including scaffolding (Hajovsky et al., 2019). In the teacher-student relationship, when teachers engage in calming conversations, implement activities that decrease stress levels, and implement accommodations, the secure attachment enables students to engage and become less anxious about learning math (Moran, 2016).

In secure attachment relationships, teachers provide instructions that contain fewer challenging problems, require minimal help and scaffolding, and gradually increase the level of difficulty so that students perceive their own success and move forward with less anxiety (Yi & Na, 2019). Passolunghi et al. (2020) suggested that math anxiety training features students recognizing and managing anxiety feelings as they perform specific math calculations and strategies. Since several students do not receive individualized intervention plans for anxiety, universal delivery programs offer many children access to the support that they need (Kozina, 2020). The literature lacks consensus regarding the most effective method of preventing and treating math anxiety (Zeidner & Matthews, 2010). The most common interventions are cognitive behavioral theory programs, group programs, pharmacological, and parent or family interventions (Beidel & Alfano, 2011).

Cognitive Behavior Therapy

The cognitive behavior therapy (CBT) approach is a widely known method of reducing anxiety in children. The cognitive behavioral approach is a conventional and effective approach to reducing anxiety (Brown, 2019; Kozina, 2020). In a treatment group of elementary school students, the study indicated that the students increased their math self-concept and demonstrated a lower level of math anxiety when using CBT because students adjusted their negative thinking patterns about math (Asanjarani & Zarebahramabadi, 2021). The CBT approach adjusts the student's thinking from irrational thoughts and avoidance behaviors to positive thoughts and productive behaviors (Asanjarani & Zarebahramabadi, 2021; Zeidner & Matthews, 2010). Due to the lack of confidence and support that children with anxiety have with their attachment figure, negative belief systems and behavioral patterns form (Colonnesi et al., 2011). Individualized CBT (D-CBT) changes the erroneous belief system of the child, which increases self-esteem (Moustafa et al., 2021). Coping strategies provide ways to resolve problems, reduce emotional distress, and eliminate future instances (Zeidner & Matthews, 2010). From the research, several programs have been developed that incorporate the CBT approach.

The Coping Cat Program is an intervention program that uses cognitive behavior therapy techniques. In addition to the Coping Cat program incorporating all the recommendations for effective anxiety programs, the program focuses specifically on anxiety, is cost-effective, and emphasizes exposure techniques. The results from the children's self-report indicated that the anxiety levels decreased significantly in the experimental group compared to the control group (van Starrenburg et al., 2017). The ability to generalize the program and implement it in the classroom setting is limited since the study was conducted using trained psychologists and not implemented using teachers.

The My FRIENDS program incorporates social-emotional learning and cognitive behavioral program techniques that support the effective use of a cognitive behavioral approach to prevent anxiety for students in grade eight (Kozina, 2020). My FRIENDS program is mostly used for anxiety prevention; however, the program lacks a sole focus on anxiety, is not freely available, and lacks exposure techniques (van Starrenburg et al., 2017). The Coping Cat program and the My FRIENDS programs effectively administered cognitive behavior techniques to reduce anxiety; however, limitations were present, such as low effect sizes and the lack of diversity in their population sample (Kozina, 2020). In addition to the above limitations, the intervention strategy to reduce anxiety in children was based on the cognitive-behavioral approach instead of the attachment theory, which focuses on attachment relationships in the classroom. CBT with family and teacher involvement has been shown to be more effective due to the focus on improving attachment relationships (Colonnesi et al., 2011).

School-based Programs

Since school-based programs allow accessibility to treatments and can reach a diverse population, school-based programs are valuable to families lacking economic resources and prevent stigmatization. A school-based program was used to explore the impact on anxiety levels in children aged 10-11. After the intervention, a statistically significant difference was found between the intervention group and control groups, which indicated that the school-based program effectively reduced the participants' anxiety scores (Ab Ghaffar et al., 2019). Like the EMOTION programs, these school-based programs were delivered by a specialist or trained professionals (Ab Ghaffar et al., 2019; Martinsen et al., 2016). Researchers have debated the effectiveness of teachers compared to specialists in the field when implementing a program (Martinsen et al., 2016). The findings of Martinsen et al. (2016) revealed that there is no

significant difference between teachers implementing the program versus professionally trained individuals; however, there are advantages when teachers are involved, such as active collaboration between students, teachers, and parents. Another advantage is that teachers are perceived by the children as secure attachments when they are actively involved with intervention programs (Colonnesi et al., 2011).

Mindfulness and Parent-group Programs

Advantages and limitations are evident in mindfulness and parent-group programs. After a systematic review and meta-analysis on the effectiveness of a mindfulness-based intervention on anxiety in children and adolescents, Ruiz-Iniguez et al. (2019) did not obtain statistically significant results between the interventions and reducing anxiety. The advantages of parent-group programs are that they offer social support and provide extra insights into supporting children with internalizing problems (Buchanan-Pascall et al., 2018). After a systematic review and meta-analysis, parent group programs yielded a modest statistically significant relationship between the parent group intervention and reducing internalizing problems in children aged 4-12 (Buchanan-Pascall et al., 2018). Without prevention or intervention strategies, children with anxiety will continue to struggle with academic achievement, socioemotional development, attachment relationships, and regulation of emotions (Kertz et al., 2019). As a result of the advantages and limitations, other interventions and approaches need to be explored to support teachers as they interact with students.

Research contributes to improving teacher prep programs on the importance of fostering positive and secure teacher-student relationships (Zee & Koomen, 2019). Teachers are able to recognize anxiety and support students; however, they are not responsible for diagnosing the student. Teachers may direct families to resources and healthcare professionals (Moran, 2016).

As a result of finding evidence of a correlation between math teacher self-efficacy and student academic achievement, policymakers can create teacher preparation programs that increase teacher self-efficacy beliefs in math (Gulistan et al., 2017). Educational programs designed to reduce math anxiety aid teachers in understanding their attachment relationship with students in the classroom, provide insight into the setup of classroom culture, and support teachers as they foster the enjoyment of learning math instead of increasing anxiety (Yi & Na, 2019).

In addition, stakeholders develop a higher quality teacher training based on research-based evidence and the attachment theory to show that at-risk students should be matched with teachers who show motivation to form positive and supportive relationships (Jerome et al., 2009). To research, professional development courses may be designed to focus on self-regulation, emotional control, working memory, improving relationship quality, and overcoming inherent biases (Jerome et al., 2009; Yi & Na, 2019). Also, further training of teachers is necessary to improve attachment relationships with a student whose background is not similar to their own and to change negative ways of interacting with children (Hajovsky et al., 2019; Passolunghi et al., 2019). As a result of teacher self-efficacy mediating between teacher-student relationship and math achievement, professional development in self-efficacy in math is recommended to help instructors build self-confidence in math instruction. Thus, when conflict arises, the teacher can still foster learning, reduce conflict in the relationship, and promote warm relationships (Hajovsky et al., 2019). The association between relationship quality and emotional experiences in the classroom requires further research (Goetz et al., 2021). Professional development based on research-based best practices will guide stakeholders in developing quality training. This research will add to the existing body of literature by supporting

stakeholders as they create professional development training for teachers to reveal the importance of a healthy and positive teacher-student relationship.

Given these findings, it is critical to examine the significant impact that teacher-student relationships and teachers' math self-efficacy have on math anxiety in students. An essential element for effective math teaching is training on current math content knowledge and mathematical practices that enhance self-efficacy and build secure teacher-student relationships (Gulistan et al., 2017). The attachment theory explains the importance of establishing a secure relationship between the child and an attachment figure (Zee & Koomen, 2019). Since parents are the primary attachment figures, research focused on the parent's role in the intervention; however, the teacher demonstrates a critical role in providing quality teacher-student interaction and offering prevention strategies to reduce math anxiety in their students (Kertz et al., 2019; O'Connor et al., 2011). Further research into the teacher-student interaction may inform education policymakers about teachers' impact on students with anxiety, which factors into math performance and career paths (Yi & Na, 2019). This quantitative study has potential benefits for teachers and educators to modify educational training that enhances teacher sensitivity toward students with math anxiety and strengthens the teacher-student relationship. This study will reveal the teacher-student relationship's influence on teacher math self-efficacy and math anxiety in students. Further investigation into the value of quality teacher-student relationships in the educational community from the attachment theory perspective is needed to shape educational policies and promote student success in math (Pianta, 2019).

Summary

The aim of this literature review was to examine how the teacher-student relationship influences teachers' math self-efficacy and math anxiety in students. The attachment theory

provided a theoretical foundation that demonstrated the significance of the teacher-student relationship and teachers' math self-efficacy to support the necessity to further understand the impact that the relationship and teachers' math self-efficacy has on the classroom environment and math anxiety in students (Gunderson et al., 2012; Zsolnai & Szabo, 2020). The literature revealed that the source of math anxiety results from a multitude of causal interacting factors that influence a child's reaction to mathematical tasks (Rubinsten et al., 2015). Then, the literature review showed the importance of the role of teachers in forming healthy attachment relationships with the students to enhance resilience and self-efficacy in the classroom (Raghavan & Griffin, 2017; Simonova et al., 2019). In addition, the literature review examined the impact of anxiety on children, explained the need for prevention and intervention programs, and explored the non-cognitive factors which show that high levels of self-efficacy and resilience are valuable which was fostered by a secure teacher-student relationship. Next, the literature review examined approaches used to reduce anxiety in students which were limited since the programs did not include diverse populations and did not yield significant results (Ab Ghaffar et al., 2019). Finally, in the literature review, the researcher confirmed the need to further investigate the association between teacher-student relationships, teacher math self-efficacy, and the math anxiety in students.

CHAPTER THREE: METHODS

Overview

The purpose of this quantitative, correlational study was to discover the relationship between teachers' self-efficacy, teacher-student relationships, and math anxiety in the classroom setting of first through third-grade students. Chapter three begins by introducing the research design and methodology, including complete definitions of all variables. The research questions and null hypotheses were outlined within the following chapter, as well as the participants and setting. Finally, the instrumentation, procedures, and data analysis plans were presented in this chapter.

Design

The research design for this study was a quantitative, correlational research design that provides information on the degree and direction of the relationship between two or more variables using correlational statistics (Gall et al., 2007). A quantitative design allows for inferences about the relationship between variables and for selecting a sample representative of the population to generalize the results (Creswell & Creswell, 2018; Gall et al., 2007). The correlational research design is a non-experimental research method because researchers do not manipulate the independent variable (Gall et al., 2015). This study was modeled after a study by Nwosu et al. (2019), who determined the extent to which the variables related to one another without the intention of manipulating any of the variables by using a correlational research design. To conduct a correlational research design, a researcher collects data on two or more variables from each participant in a sample and analyzes the data to determine the correlation coefficient (Gall et al., 2007).

Since correlational design analyzes the degree of the relationship of variables, correlational research has an advantage over causal-comparative designs. The advantage is that researchers may analyze a relationship of a large number of variables singularly or in a combination in a study simultaneously (Gall et al., 2007). The correlational design explores the causal relationships, but the design does not prove them (Gall et al., 2015). Researchers must be aware that an artifact may be the reason for the correlational relationship between two variables. Even though correlational research has limits, various correlational statistics are beneficial when estimating the strength of the relationship or predictability (Gall et al., 2007).

The purpose of this study was to explore the relationship between teachers' math self-efficacy, the teacher-student relationship, and math anxiety in students by utilizing first through third grade teachers and their students in the corresponding classrooms. A correlational research design purpose is to yield data on the degree and direction of the relationship between two or more variables by using correlational statistics (Creswell & Creswell, 2018; Gall et al., 2007). By implementing a correlational research design, the study examined the degree and the direction of the relationship between teachers' math self-efficacy, the teacher-student relationship, and math anxiety in students. Since the intent of the study was to determine the extent of the relationship and not manipulate variables, a correlational research design is an appropriate design for this study (Gall et al., 2015). The criterion variable was math anxiety in students in first through third grade, and the linear combination of predictor variables are teachers' math self-efficacy and the teacher-student relationship. Math anxiety was the negative emotional response to situations that involves mathematics (Cargnelutti et al., 2017; Hill et al., 2016). The teacher-student relationship refers to two aspects: warmth and conflict (Kurdi & Archambault, 2018). Teacher math self-efficacy refers to a teacher's belief in the capability to execute actions required to accomplish

teaching tasks in mathematics (Alrajhi et al., 2017; Bandura, 1997; Perera & John, 2020). The quantitative, correlational research assisted the researcher in making inferences about the relationship between variables that align with the research problem (Creswell & Creswell, 2018).

Research Questions

RQ1: Is there a statistically significant relationship between the math anxiety of first through third grade students and teachers' self-efficacy toward math?

RQ2: Is there a statistically significant relationship between teachers' math self-efficacy and the teacher-student relationship?

RQ3: How accurately can math anxiety in first through third grade students be predicted from a linear combination of teachers' math self-efficacy and teacher-student relationship?

Hypotheses

The null hypotheses for this study were:

$H_0$1: There is no statistically significant relationship between the math anxiety of first through third grade students as measured by the Math Anxiety Questionnaire for Children (MAQC) and teachers' self-efficacy toward math as measured by the Self-Efficacy for Teaching Mathematics Instrument (SETMI).

$H_0$2: There is no statistically significant relationship between teachers' math self-efficacy, as measured by the SETMI and the teacher-student relationship as measured by the Student-Teacher Relationship Scale (STRS).

$H_0$3: There is no statistically significant predictive relationship between criterion variable (math anxiety of first through third grade students) as measured by the MAQC and the linear combination of predictor variables (teachers' math self-efficacy and teacher-student relationship) as measured by SETMI, and STRS.

Participants and Setting

This study comprised teachers and students in the first through third grades as the research examined the dynamics between teachers and students. This section began with the researcher describing the population and the participants in a Mid-Atlantic state. The sampling technique and the sample size were discussed. Finally, this section concluded with a description of the setting.

Population

The target population was first through third grade teachers who teach math and their students. For this study, convenience sampling occurred, which indicates that the teachers and students will be chosen based on convenience and availability (Creswell & Creswell, 2018). Convenience sampling allowed for inferencing the target population so that the results might be generalized (Gall et al., 2007). The convenience sample came from the school districts in a Mid-Atlantic state. In quantitative research, researchers select a sample that fits the purpose and convenience of the study (Gall et al., 2007). The participants for the study were recruited from an accessible population of first through third grade teachers and their students located in a Mid-Atlantic state.

Participants

For this study, the number of teachers sampled will exceed the required minimum when assuming a medium effect size. Statistical power depends on the true effect size of the population, alpha level, and the number of subjects (Warner, 2013). For a medium effect size with a statistical power of 0.7 at the 0.05 alpha level, Gall et al. (2007) suggested a minimum of N= 66 first through third grade teachers for a hypothesis testing of a correlation coefficient (r). The sample of teachers came from different Christian elementary schools in the area. Within

each school, teachers were selected from first through third grade math classes. The student sample consisted of students from the teachers' classroom. Each teacher had one set of data from the average of the student's math anxiety scores. The demographic information included the age, ethnicity, gender, teaching experience, and grade level of participants. The study consisted of 00 male teachers and 13 female teachers from first through third grade classrooms, as well as the 39 male students and 47 female students that participated. Convenience sampling was used to recruit teachers and students through emails to administrators and teachers at elementary schools after permission was granted. The desired minimum sample size for a multiple regression analysis with two predictor variables, assuming medium effect size, an alpha = .05, and a statistical power of .70, is 106 (Warner, 2013).

Setting

In this correlational study, the focus was on the relationship between first through third grade teachers and their students in private and public lower elementary school settings in a Mid-Atlantic State. The study site occurred in the first through third grade classrooms with teachers and their corresponding students. For a correlational study, a reasonable and desirable number of participants sampled should exceed N= 106, and the number of corresponding students should be at least N= 10 from each classroom (Gall et al., 2007).

Instrumentation

The focus of the survey instruments was to gather data about the teachers' perceptions of their teaching ability towards math, teachers' attachments with students, and students' anxiety towards math. The surveys consisted of questions to gather demographic information about the sample population. All survey instruments began with a consent form to grant permission to the researcher to collect the data. Teachers received two surveys: The STRS and the SETMI. In

addition, students were administered the MAQC. Each author of the surveys was contacted by email to gain permission to use their survey as part of this study.

Student-Teacher Relationship Scale

The purpose of the STRS was to examine the teachers' relationship with their students in their classroom (Pianta, 2001). Since Pianta and Nimetz (1991) designed the STRS for preschool through third grade teachers, the STRS is an appropriate survey for this study. Pianta and Nimetz (1991) developed the STRS to assess the teachers' perceptions of the quality of their relationship, which was based on observations and interactions with first, second, and third grade students. In a study of 24 kindergarten teachers with three children each in their classrooms, the authors determined the best items to evaluate security and insecurity in the teacher-child relationship (Pianta & Nimetz, 1991).

As a result of the study, the survey consisted of 15 items on a five-point Likert scale that ranges from Definitely Does Not Apply to Definitely Applies. The responses were as follows: Definitely Does Not Apply = 1, Not Really =2, Neutral, Not Sure = 3, Applies Somewhat = 4, and Definitely Applies = 5 (Kurdi & Archambault, 2018; Pianta, 2001). This 15-item survey was more flexible and less time demanding than the longer STRS scale (Tsigilis & Gregoriadis, 2008). The teachers were administered the instrument and rated how each statement applied to their current relationships with a particular child (see Appendix A for instruction; O'Connor et al., 2011). The scale contained three subscales: closeness, which is the amount of warmth and open communication, conflict which evaluates the extent of the relationship that is marked by antagonistic and disharmonious interactions; and dependency, which examines the extent that teachers experience the student showing clingy or demanding behavior (O'Connor et al., 2011; Zee & Roorda, 2018). The formula for the STRS-SF scoring consisted of finding the constant

using the maximum and minimum scores possible on the conflict questions on the survey; and then adding the two numbers together. As a result, the scoring constant on the STRS-SF is 42.

The conflict score, which was calculated from the teacher response scores, was subtracted from the constant score. The final score for conflict was added to the closeness raw score. The total raw scores range from 15 to 75 for conflict and closeness (Zee & Roorda, 2018). Individual scores were calculated according to values on the Likert scale except for Item 4, which was reverse scored. To indicate final individual scores, the researcher calculated the following: [(Max Conflict Score + Min Conflict Score) – Conflict Score] + Closeness Score = Final Raw Score. As a result of the raw scores being calculated, the high scores indicate a high-quality relationship between teacher and student, which reflects the degree of closeness and security in the relationship, while a low score reflects the degree the teacher perceives the relationship as negative, unpleasant, and unpredictable (Koomen et al., 2012; O'Connor et al., 2011). The STRS total raw score and the SETMI calculated Pearson's correlation coefficient. The STRS total raw score and the MAQC scale calculated Pearson's r correlation coefficient. In addition, the STRS total raw score, MAQC, and SETMI were used to conduct a multiple regression analysis.

The instrument was used in numerous studies that also confirmed the validity and reliability of the instrument (O'Connor et al., 2011; Pianta & Nimetz, 1991; Zee & Roorda, 2018). The STRS is a reliable instrument to assess teacher perception of the quality of the teacher-child relationship with a Cronbach's coefficient alpha of 0.88 first grade, 0.85 third grade, and 0.91 for fifth grade (O'Connor et al., 2011). In addition, the subscales were reliable, with indicated alpha coefficients of 0.86 for closeness, 0.86 for conflict, and 0.82 for dependency (Zee & Roorda, 2018). In addition, the scale has been validated for construct validity of 3 dimensions: conflict, closeness, and dependency and validated for concurrent validity (Koomen

et al., 2012). The model Chi-squared assesses the overall fit and the discrepancy between the sample and fitted covariance matrices. Its p-value should be > .05 (i.e., the hypothesis of a perfect fit cannot be rejected). However, it is quite sensitive to sample size (Zee & Roorda, 2018). The STRS is an appropriate use for this study since it measures teacher-student relationships. The scale lasted approximately 10 minutes for each child participating in the study in the classroom setting. The permission letter to use STRS for research purposes is found in Appendix B.

Self-Efficacy for Teaching Mathematics Instrument

Self-Efficacy for Teaching Mathematics Instrument (SETMI) by McGee and Wang (2014) measured teachers' self-efficacy for teaching math. Wilhelm and Berebitsky (2019) noted the importance of assessing the teacher's sense of difficulty in teaching math and the confidence to complete the task. McGee and Wang (2014) agreed that a test instrument should distinguish between teachers' mathematics self-efficacy and self-efficacy for teaching mathematics. While teachers' mathematics self-efficacy refers to "a teacher's own belief in his or her ability to perform mathematical tasks," self-efficacy for teaching mathematics refers to "a teacher's belief regarding his or her ability to teach others mathematics" (McGee & Wang, 2014, p. 4). To provide a scale that was content and context-specific for measuring teachers' self-efficacy beliefs for elementary teachers, the SETMI was designed based on Bandura's social cognitive theory and the teacher's complex mathematical belief system (McGee & Wang, 2014).

The best practice for measuring teachers' self-efficacy beliefs included using an instrument that measures for self-efficacy that associated with the task being assessed (McGee & Wang, 2014). The Teachers' Sense of Self-Efficacy Scale (TSES), which was used in numerous studies to examine teacher self-efficacy, consists of three factors: student engagement self-

efficacy, instructional strategies' self-efficacy, and classroom management self-efficacy (Inel Ekici, 2018; Tschannen-Moran & Hoy, 2001; Wilhelm & Berebitsky, 2019). Since the Teachers' Sense of Self-Efficacy Scale (TSES) was not content specific to mathematics, McGee and Wang (2014) used the TSES as a framework for constructs to include items on efficacy for pedagogy in mathematics (EPM) from the TSES short form which were modified for mathematical content. The first section of the instrument assessed efficacy for pedagogy in mathematics (EPM), which reflects items one through seven. A sample item was "To what extent can you motivate students who show low interest in mathematics?" (McGee & Wang, 2014, p. 396). In addition, McGee and Wang (2014) gleaned mathematics content-specific items from "Teaching Mathematics in Inclusive Settings" for SETMI. The second section of the instrument contained items on the efficacy of teaching mathematics content (ETMC). The instrument used a five-point Likert scale that ranges from None at All to A Great Deal. Responses are as follows: None at All =1, Very Little = 2, Strong Degree = 3, Quite a Bit = 4, and A Great Deal = 5. The combined possible scores on the SETMI range from 22 to 110 points. A score of 22 is the lowest possible score, which indicates a lack of confidence in the teacher's ability to accomplish a goal, and the highest score of 110 points refers to confidence in the teacher's ability to accomplish a goal. The researcher calculated the instrument. The SETMI contains 22 items to measure the math self-efficacy of elementary school teachers, which will take approximately 10- 15 minutes to complete (see Appendix C for instruction).

McGee and Wang (2014) provided evidence of validity of SETMI. For reliability, SETMI showed moderately strong reliability of Cronbach's alpha for efficacy in pedagogy in mathematics (EPM) at .86, efficacy for teaching mathematics content (ETMC) at .93, and the relationship between EPM and ETMC showed a statistically significant relationship, $r = .52$, $p <$

.001 (McGee & Wang, 2014). EPM refers to the teachers' belief about their capabilities and actions that produce a desired outcome of learning and engagement, which includes subconstructs: efficacy in student engagement and efficacy in instructional strategies (McGee & Wang, 2014; Tschannen-Moran & Hoy, 2001). ETMC refers to the degree of self-efficacy for teaching specific math skills to elementary students. Testing of the construct validity was performed using confirmatory factor analysis (CFA). The model fit the data after allowing for modifications, and the goodness-of-fit index for SETMI was .83. The SETMI proves to be a valid and reliable instrument to measure pedagogy in mathematics and teaching mathematics content. Since teachers' math self-efficacy was critical to understand as it relates to their beliefs and student learning, the SETMI was an appropriate instrument to use in this study (McGee & Wang, 2014). The permission letter to use SETMI for research purposes is found in Appendix D.

Math Anxiety Questionnaire for Children

The purpose of the MAQC was to measure math anxiety in young children. In this study, the researcher incorporated the MAQC from the work of Szczygiel (2020b) to use with young children and to simplify the response scale for first to third-grade students (Szczygiel, 2020a). The MAQC contains 12 items based on the Mathematics Anxiety Scale in Young Children (Harari et al., 2013) and items based on the Scale for Early Mathematics Anxiety (Wu et al., 2012) and uses a 3-point Likert-type scale to reduce the cognitive demands on young children and encourage thoughtful responses from the students (Harari et al., 2013; Szczygiel, 2020a). The instrument uses a 3-point Likert scale that ranges from Yes to No. The responses are Yes = 1, A Little = 2, and No = 3 for items 1-3, and Yes = 3, A Little = 2, and No = 1 for items 4-12 (Szczygiel, 2020a). The combined possible score on the MAQC ranges from 12 to 36 points. A high score of 36 indicated a high level of math anxiety related to performing math activities, and

a low score of 12 refers to a lack of math anxiety related to performing math activities. The MAQC provided a useful tool to measure the response of young children.

The advantage of this instrument is that it can be used for brief group administration (Harari et al., 2013; Vukovic et al., 2013). Researchers found that reading the test items to the students helps with standardization of administration and reduces the impact of various reading levels (Harari et al., 2013; Szczygiel, 2020a; Vukovic et al., 2013). The teachers administered the MAQC to the students who had signed consent from a parent or guardian to participate. The teacher read instructions for each task and all items. The survey lasted approximately 15 minutes (see Appendix E for instructions). The researcher calculated the instrument. Numerical values were assigned to the items, and the higher scores indicate a greater level of anxiety (Szczygiel, 2020b).

Szczygiel (2020a, 2020b) explored the reliability and validity of the MAQC using the construct of math anxiety, which refers to "a type of anxiety that concerns solving math problems in various academic situations" (p. 430). The results indicated an internal consistency of 0.77 for the group and for test-retest reliability, $r = .56$, $p < .001$, which is very satisfactory (Szczygiel, 2020a, 2020b). The MAQC contained two subscales: learning and testing math anxiety. Exploratory and confirmatory factor analysis was performed to reveal a unidimensional solution and a comparative fit index indicating a good model fit according to the established cutoff values of 0.08 for the root-mean square error of approximation and standard root-mean square residual (Szczygiel, 2020a). However, the standardized root mean square residual was relatively high due to the sample size (Szczygiel, 2020b). The three-factor model resulted in CFI values = 0.911 and SRMR= 0.062, which supports the discriminant validity of the three internalizing symptoms in the study (see Appendix E for the instrument and Appendix F for

permission to use the instrument for research purposes; Szczygiel, 2020a).

Procedures

Permission was obtained from the heads of private schools to perform the proposed research before applying to the Institutional Review Board (IRB). The researcher submitted the study to the IRB for research with human subjects in participating schools for approval (see Appendix L for IRB approval). With approval from the IRB, the researcher contacted schools, teachers, parents, and students in the Mid-Atlantic region to invite them to participate in the study. The invitations were conducted through email.

Consent of school authorities such as heads of school districts, administrations of private schools for research purposes, consent of parents or guardians, teachers, and students (assent) was obtained. Ethical consent from teachers and parents was obtained, which included information that each participant had the right to withdraw from the study at any point in the process. The consent forms contained information on the purpose, procedure, benefits, risks associated with participation, and confidentiality measures (see Appendix G, H, and I for forms). Preliminary questions were asked of the participants to ensure the data were collected from teachers who taught mathematics in the first grade and matched with students in their first-grade classroom; collected from teachers who taught mathematics in the second grade and matched with students in their second-grade classroom; and collected from teachers who taught mathematics in the third grade and matched with students in their third-grade classroom.

After receiving permission from the school administrator to use class time for the study, each teacher who consented to participate in the study received directions on how to complete and administer the surveys. The teachers completed a digital version of the STRS and SETMI surveys. Teachers were asked to complete the STRS addressing their relationship with each of

the students who have permission to participate in the study, as well as questions about their background characteristics. The teachers administered the MAQC electronically only to students who gave assent and families who provided paper consent.

For standardization of administering the tool and to assist the students with reading, teachers read the directions and test items to the group of students (Harari et al., 2013; Vukovic et al., 2013). The teacher distributed the survey and allowed the students to complete the survey within 10-15 minutes. The classroom teacher monitored the filling of the questionnaire from the students. Students completed the survey online using Qualtrics, an online survey system. The surveys remained confidential for the teachers and students. Once the researcher collected the surveys, data were tabulated and uploaded to Excel. Data were uploaded into Statistical Package for the Social Science (SPSS) software for analysis. All teacher and student data were linked to their identification numbers to maintain confidentiality. Data were secured at all stages, information that could identify the participants was protected, and identifying information was removed from the data. Data were stored securely, and only the researcher had access to the records. Data were stored on a password-protected external drive. When not being used, the external drive was stored in a locked filing cabinet. All files will be kept for five years and locked in a fireproof cabinet. After five years, all files will be destroyed.

Data Analysis

To examine the relationship between two variables, Pearson's Product coefficient was obtained from variables: math anxiety in students and teachers' math self-efficacy, as well as teachers' math self-efficacy and student-teacher relationships. Because the study had two variables in RQ1 and RQ2 and was determining the extent of the relationship and not making a prediction, the Pearson Product-Moment statistic was used (Gall et al., 2007). The RQ3 was

analyzed using multiple regression analysis to examine the predictability of the variables (Gall et al., 2015). A multiple linear regression was necessary since children with math anxiety are the criterion variable, and the teachers' math self-efficacy and the teacher-student relationship are the predictor variables (Gall et al., 2007).

Initially, demographic information such as age, ethnicity, gender, educational level of the teacher, and grade level was examined. Descriptive statistics such as mean and standard deviations were obtained on each variable (Creswell & Creswell, 2018). Before examining the variables, the data screening was completed using visual screening for missing and inaccurate data (Gall et al., 2007). Analysis was conducted in three phases to address each hypothesis.

Correlation

First, the researcher assessed the relationship between the math anxiety of first through third grade children and teachers' self-efficacy toward math by conducting the analysis in the Statistical Package for the Social Science (SPSS) software for the Pearson Product-Moment correlation coefficient. The researcher conducted data screening visually for missing data and inconsistencies. Once the data were examined, the mean scores for each variable were calculated for each variable, and data were inputted into the SPSS software. A scatter plot will determine the assumption of bivariate outliers between the two variables to identify extreme bivariate outliers (Warner, 2013).

Next, the researcher obtained information on the descriptive statistics: mean and standard deviation (Warner, 2013). Then, assumption testing was conducted for the assumption of linearity and bivariate normal distribution by using a scatter plot (Warner, 2013). For RQ1, the scatter plot consisted of the predictor variable (teachers' math self-efficacy) and the criterion variable (math anxiety in students). For the RQ2, the scatter plot consisted of the predictor

variable (teachers' math self-efficacy) and the criterion variable (teacher-student relationship). The data from the bivariate scatter plots assessed the linear relationship between the variables and whether a classic "cigar shape" was present.

For the first null hypothesis, a Pearson Product-Moment correlation was conducted to determine if there is a relationship between the math anxiety of the students and teachers' self-efficacy toward math. For the second null hypothesis, a Pearson Product-Moment correlation was conducted to determine if there is a relationship between teachers' math self-efficacy and the teacher-student relationship. Pearson's r described the strength and direction of the linear relationship between the two variables, ranging from -1 for a perfect negative relationship and 1 for a perfect positive relationship. Pearson's r^2 estimates the proportion of variance of the linear relationship between two variables (Warner, 2013). Guidelines were used for verbal labels for sizes of r: "r of about .10 or less ($r^2 < .01$ is small, r of about .30 ($r^2 = .09$) is medium, and r greater than .50 (r2 >.25) is large" (Warner, 2013, p. 298). The researcher determined the significance of the results at a 0.05 alpha level with a 95% confidence interval (Warner, 2013).

To determine the effect size of this correlational study, the researcher reported r and r^2 from the results to explain the different aspects of the relationship (Warner, 2013). The effect size was determined from the statistical model summary. The null hypothesis will be rejected if $p < .05$, which shows a significant relationship.

Multiple Linear Regression Analysis

For the third hypothesis, data were analyzed using a multiple linear regression analysis since the researcher is examining the predictability of teachers' math self-efficacy and teacher-student relationship (predictor variables) and math anxiety in the students (criterion variable), which were measured on a continuous scale. The researcher determined if there was a significant

predictive relationship between teachers' math self-efficacy, teacher-student relationship, and math anxiety in the students by conducting the analysis in the SPSS software.

A matrix scatter plot between all pairs of predictor variables (teachers' math self-efficacy, teacher-student relationship) and the criterion variable (student math anxiety) detected extreme bivariate outliers. The researcher visually screened the data and conducted the assumption of linearity using a matrix scatter plot and obtained information on the descriptive statistics: mean and standard deviations (Warner, 2013). The scatter plot consisted of the predictor variables (teachers' math self-efficacy and teacher-student relationship and the criterion variable (student math anxiety). The scatter plot determined if the assumption of linearity was met. The assumption of bivariate normal distribution was assessed to determine if the assumption was met using a scatter plot.

To provide evidence that there was an absence of multicollinearity, a variance inflation factor (VIF) test was conducted. If the VIF is too high, then the multicollinearity has violated the assumption. The acceptable values are between 1 and 5 (Warner, 2013).

The multiple regression analysis explained if the level of math anxiety in children could be predicted by teachers' self-efficacy and the teacher-student relationship. The ANOVA output was used to determine if the regression model was statistically significant. The researcher analyzed the significance of the results at a 0.05 alpha level with a 95% confidence interval at an effect size of *R2*, and *R2* explained the variance of the criterion variable. If the data rejects the null hypothesis, the *R2* determines the extent of the relationship. Further analysis of the coefficients determined which variable was the best predictor based on the significant *p* values (Warner, 2013). After the data analysis was conducted, the researcher reported the findings.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this quantitative correlational study was to determine if teacher self-efficacy in math and teacher-student relationships impacted math anxiety in students. For RQ1, the predictor variable was teachers' self-efficacy in math scores. The criterion variable was math anxiety scores in students. A Pearson's product correlation was used to test the hypothesis for RQ1. For RQ2, the predictor variable was teachers' self-efficacy in math scores. The criterion variable was teacher-student relationship. A Spearman's rho correlation was used to test the hypothesis for RQ2. In addition, the study was to determine if teacher math self-efficacy and teacher-student relationship influenced math anxiety in students. For the RQ3, a multiple regression was conducted to test the hypothesis. The predictor variables were teacher math self-efficacy and teacher-student relationship, and the criterion variable was math anxiety in students. This chapter included the research questions, null hypotheses, data screening, descriptive statistics, assumption testing, and results.

Research Question One

RQ1: Is there a statistically significant relationship between the math anxiety of first through third grade students and teachers' self-efficacy toward math?

Null Hypothesis

$H_0$1: There is no statistically significant relationship between the math anxiety of first through third grade students as measured by the MAQC and teachers' self-efficacy toward math as measured by the SETMI.

Descriptive Statistics

Basic demographic information was collected for each participant. The study included 13 teacher participants, of which 13 were females, and no males were included. The teachers' educational level indicated either a bachelor's degree or a graduate/professional degree. There were five first-grade teachers (38.46%), three second-grade teachers (23.08%), and five third-grade teachers (38.46%). The teacher participants' ethnicity included eight Caucasian (57.14%), four Black/African American (28.57%), one Asian (7.14%), and one other (7.14%).

The study included 84 student participants, consisting of 45 females and 39 males. The study included 38 first graders (45.20%), 19 second graders (22.60%), and 27 third graders (32.10%). The students' ages ranged from 6-9 years of age. The student participants' ethnicity included 17 Caucasian (20.20%), 50 Black/African American (59.50%), six Asian (7.10%), 10 Other (12.00%), and one Native Hawaiian/Other Pacific Islander (1.20%). Appendix J displays the frequency information on the categorical demographic variables of the student participants, and Appendix K displays the frequency information on the categorical demographic variables of the teacher participants.

Table 1 provides the mean and standard deviation for each variable: Math anxiety scores and Self-efficacy teaching math scores.

Table 1

Descriptive Statistics

Variable	*n*	*M*	*SD*
Math Anxiety Scores	84	18.7	4.1
Male Anxiety Scores	40	17.9	4.4
Female Anxiety Scores	44	19.4	3.6
Self-Efficacy Teaching Math Scores	84	81.6	15.2

Results

Data Screening

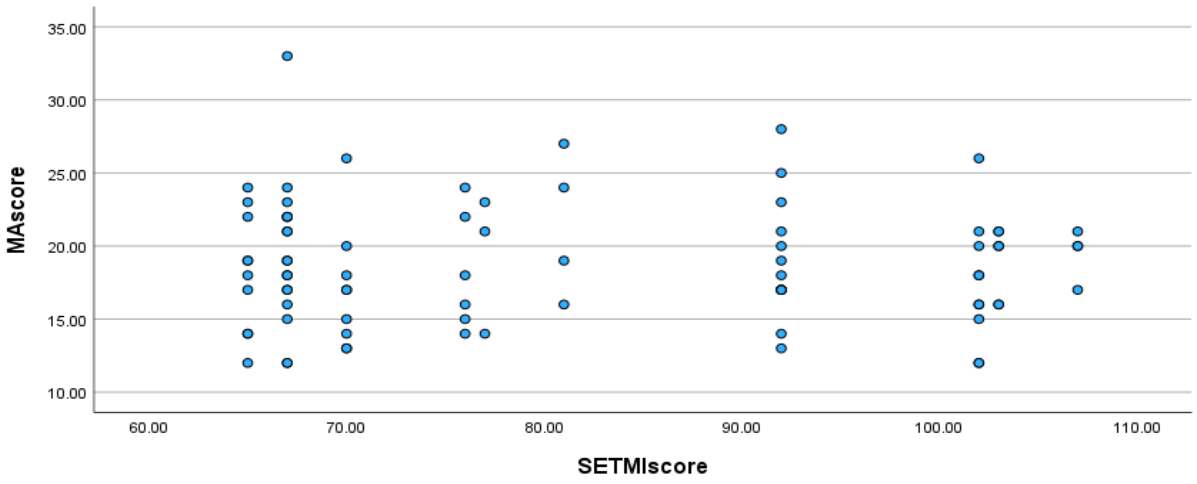
Data screening was conducted on all variables. The researcher examined the data set for missing data points and inconsistencies. No data errors or inconsistencies were identified; therefore, no data were excluded.

Assumption Testing

A Pearson product-moment correlation was used to test the null hypothesis. Pearson's correlation requires that the assumptions of no bivariate outliers, linearity, and bivariate normal distribution are met. A scatterplot was created to test these assumptions. Examination of the scatterplot shows that the assumption of linearity and no bivariate outliers are tenable. The assumption of bivariate normal distribution was also met, as illustrated in the cigar shape data points observed in the scatterplot graph. Figure 1 provides a scatter plot of the scores for each variable.

Figure 1

Scatterplot of Math Anxiety vs. Self-Efficacy for Teaching Math Score



A Pearson product-moment correlation was run to test the null hypothesis, which states that there is no statistically significant relationship between the math anxiety of first through third grade students as measured by the MAQC and teachers' self-efficacy toward math as measured by the SETMI. The researcher did not reject the null hypothesis at the 95% confidence level where $r(82) = -.009$, $p = .932$. There was no apparent correlation between math anxiety in students and teachers' math self-efficacy. Therefore, the null hypothesis was not rejected. Table 2 provides the results of the correlation analysis.

Table 2

Correlation Results

		MA Score	SETM Score
MA Score	Pearson Correlation	1	-.009
	Sig. (2-tailed)		.932
	n	84	84
SETM Score	Pearson Correlation	-.009	1
	Sig. (2-tailed)	.932	
	n	84	84

Note. Correlation is not significant at the 0.05 level (2-tailed). MA= Math Anxiety; SETM= Self-Efficacy Teaching Math.

Research Question Two

RQ2: Is there a statistically significant relationship between teachers' math self-efficacy and the teacher-student relationship?

Null Hypothesis

$H_0$2: There is no statistically significant relationship between teachers' math self-efficacy, as measured by the SETMI and the teacher-student relationship as measured by the STRS.

Descriptive Statistics

Table 3 provides the mean and standard deviation for each variable.

Table 3

Descriptive Statistics

Variable	*n*	*M*	*SD*
Self-Efficacy Teaching Math Score	13	82	15.4
Student-Teacher Relationship Score	13	64.3	5.3

Results

Data Screening

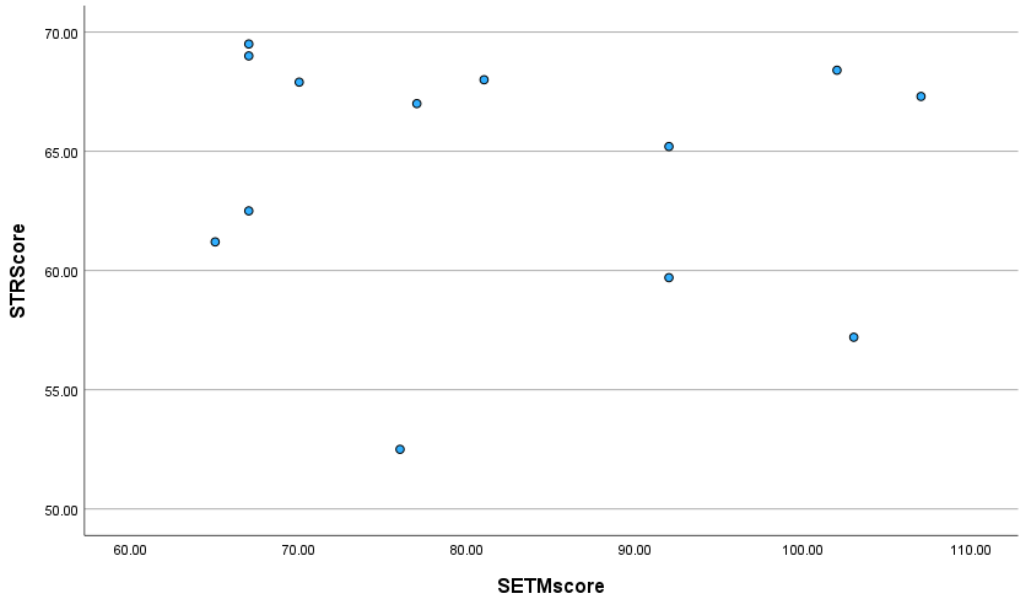
Data screening was conducted on all variables. The researcher examined the data set for missing data points and inconsistencies. No data errors or inconsistencies were identified; therefore, no data were excluded.

Assumption Testing

A Spearman's rho correlation was used to test the null hypothesis. Spearman's rho correlation requires that the assumptions of variables measured on an ordinal scale, two variables represent paired observations, and a monotonic relationship. A scatterplot was created to test these assumptions. Figure 2 provides a scatter plot of the scores for each variable.

Figure 2

Scatterplot of Self-Efficacy for Teaching Math vs. Student-Teacher Relationship Scores



Pearson's product correlation requires that the assumptions of no bivariate outliers, linearity, and bivariate normal distribution are met. Examination of the scatterplot showed that the assumption of linearity was not met. Since the assumption of linearity was not met, the researcher used Spearman's rho correlation. After conducting the assumption tests, Spearman's rho was utilized to test the null hypothesis, which states that there is no significant relationship between teachers' math self-efficacy, as measured by the SETMI, and the teacher-student relationship as measured by the STRS. The researcher did not reject the null hypothesis at the 95% confidence level where $r(11) = -.158$, $p = .607$. There was no apparent correlation between the student-teacher relationship and teachers' math self-efficacy. Therefore, the null hypothesis was not rejected. Table 4 provides the results of the correlation analysis.

Table 4

Correlation Results

		SETM Score	STR Score
SETM Score	Spearman's rho	1	-.158
	Sig. (2-tailed)		. 607
	n	84	84
STR Score	Spearman's rho	-.158	1
	Sig. (2-tailed)	.607	
	n	84	84

Note. Correlation is not significant at the 0.05 level (2-tailed). SETM = Self-Efficacy Teaching Math; STR = Student-Teacher Relationship.

Research Question Three

RQ3: How accurately can math anxiety in first through third grade students be predicted from a linear combination of teachers' math self-efficacy and teacher-student relationship?

Null Hypothesis

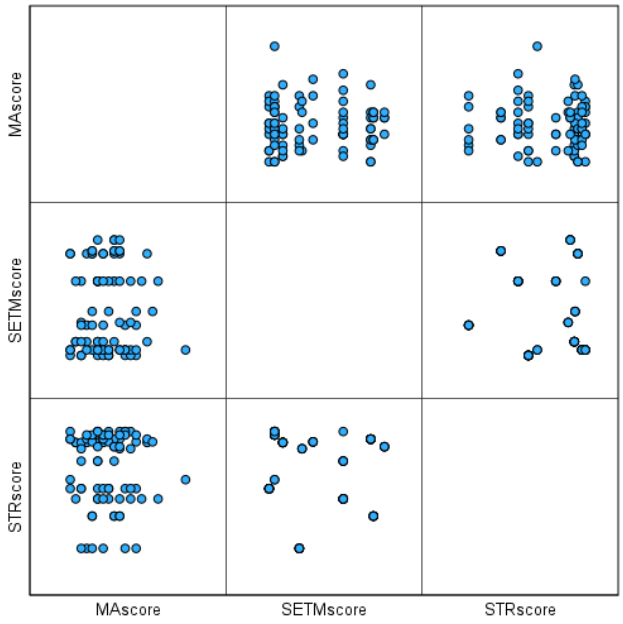
$H_0$3: There is no statistically significant predictive relationship between criterion variable (math anxiety of first through third grade students) as measured by the MAQC and the linear combination of predictor variables (teachers' math self-efficacy and teacher-student relationship) as measured by SETMI and STRS.

Data Screening

The researcher sorted the data and scanned for inconsistencies in each variable. No data errors or inconsistencies were identified. A matrix scatter plot was used to detect bivariate outliers between predictor variables and the criterion variable. No bivariate outliers were identified. See Figure 3 for the matrix scatter plot.

Figure 3

Matrix Scatter Plot of Math Anxiety Scores, Self-Efficacy for Teaching Math Scores, and Student-Teacher Relationship Scores.



Descriptive Statistics

Descriptive statistics were obtained on each of the variables. The sample consisted of 84 participants. Scores on the MAQC ranged from 12 to 36. A high score of 36 indicated high anxiety towards math, whereas a low score means that the students have little or no anxiety towards math. Teachers' self-efficacy for math was measured using the SETMI. A high score of 110 indicated that the teacher had high confidence towards math, whereas a low score of 22 indicated a lack of confidence in the teacher's ability towards math. The teacher-student relationship was measured using the STRS. A high score of 75 indicated a high-quality relationship between teacher and student, whereas a low score of 15 indicated that the teacher

perceived the relationship as negative, unpleasant, and unpredictable. Table 5 provides the mean and standard deviation for each variable.

Table 5

Descriptive Statistics

Variable	*n*	*Min*	*Max*	*M*	*SD*
TSR Score	84	52.5	69.5	64.4	5.2
MA Score	84	12.0	33.0	18.7	4.1
SETM Score	84	65.0	107.0	81.6	15.2

Note. TSR = Teacher-Student Relationship; MA = Math Anxiety; SETM = Self-Efficacy Teaching Math

Assumption Testing

Assumption of Linearity

The multiple regression requires that the assumption of linearity be met. Linearity was examined using a scatter plot. The assumption of linearity was met. See Figure 3 for the matrix scatter plot.

Assumption of Bivariate Normal Distribution

The multiple regression requires that the assumption of bivariate normal distribution be met. The assumption of bivariate normal distribution was examined using a scatter plot. The assumption of bivariate normal distribution was met. Figure 3 provides the matrix scatter plot.

Assumption of Multicollinearity

A VIF test was conducted to ensure the absence of multicollinearity. This test was run because if a predictor variable (Self-efficacy for teaching mathematics) is highly correlated with another predictor variable (Student-teacher relationship), they essentially provide the same information about the criterion variable. If the VIF is too high (greater than 10), then multicollinearity is present. Acceptable values are between 1 and 5. The absence of

multicollinearity was met between the variables in this study. Table 6 provides the collinearity statistics.

Table 6

Collinearity Statistics

Model		Collinearity Statistics	
		Tolerance	VIF
1	SETM	.988	1.01
	STR	.988	1.01

Note. VIF = Variance Inflation Factor; SETM = Self-Efficacy for Teaching Mathematics; STR = Student-Teacher Relationship

[a] Dependent variable: Math Anxiety

Results

A multiple regression was conducted to see if there was a relationship between math anxiety scores and teacher-student relationships scores with teachers' math self-efficacy scores. The predictor variables were teacher-student relationships scores and teachers' math self-efficacy scores. The criterion variable was math anxiety scores. The researcher did not reject the null hypothesis at the 95% confidence level where $F(2,81) = .062$, $p = .940$. There was not a significant relationship between the predictor variables (teacher-student relationship and teachers' self-efficacy in math scores) and the criterion variable (math anxiety in students). Table 7 provides the regression model results.

Table 7

Regression Model Results

Model		*SS*	*df*	*MS*	*F*	*Sig.*
1	Regression	2.15	2	1.07	.062	.940
	Residual	1395.41	81	17.23		
	Total	1397.56	83			

Note. Correlation is not significant at the 0.05 level (2-tailed)

[a] Dependent variable: Math Anxiety Score

[b] Predictors: (Constant), Student-Teacher Relationship Score, Self-Efficacy for Teaching Mathematics

The model's effect size was low where $R = .158$. Furthermore, $R^2 = .025$ indicated that approximately 2% of the variance of the criterion variable can be explained by the linear combination of predictor variables. Table 8 provides a summary of the model.

Table 8

Model Summary

Model	R^2	R	Adjusted R^2	*SEM*
1	.039	.002	-.023	4.15

[a] Predictors: (Constant): SETM sum, STR score

CHAPTER FIVE: CONCLUSIONS

Overview

This quantitative correlational study examined the influence of teachers' math self-efficacy and teacher-student relationships on math anxiety in students. Chapter five provides a detailed discussion of the findings for each research question. Practical and theoretical implications in education are included. Furthermore, a discussion of the limitations of the study and suggestions of recommendations for future research are provided.

Discussion

The purpose of this quantitative correlational study was to examine the influence of teachers' math self-efficacy toward math on students' math anxiety and to examine the relationship between teachers' math self-efficacy and teacher-student relationships. Also, this study examined the impact of teachers' self-efficacy in math and the teacher-student relationship on math anxiety in students.

RQ1: Is there a statistically significant relationship between the math anxiety of first through third grade students and teachers' self-efficacy toward math?

Research has shown that a teacher's math self-efficacy level is a predictor of regulating students' emotions (Alrajhi et al., 2017). The study analyzed the data from a math anxiety survey for students and compared the data from teachers' self-efficacy toward math. The results of this research question showed no statistically significant relationship between math anxiety scores in first through third grade students and teachers' self-efficacy toward math, $r(82) = .009$, $p = .932$. The findings suggest that teachers' self-efficacy towards math does not impact math anxiety in students. Previous studies showed that teachers' self-efficacy may indirectly influence students' attitudes toward math (Chang & Beilock, 2016). However, this study suggested that teachers'

math self-efficacy is not a direct factor that influences math anxiety in students. Determining causal factors of how teachers' math self-efficacy beliefs relate to students' beliefs about math is complex (Beidel & Alfano, 2011). The results of the study suggested that other contextual factors may be involved in math anxiety in students besides teachers' math self-efficacy beliefs (Chang & Beilock, 2016).

The results of the study indicated that the mean teacher math self-efficacy score associated with the study's sample was 81.6, which indicates that teachers displayed positive perceptions of efficacy related to teaching math. A teacher's math self-efficacy beliefs related to classroom engagement affect the quality of classroom practices (Perera & John, 2020). When teachers demonstrate high self-efficacy, they are motivated to learn effective strategies and techniques to support student success (Gulistan et al., 2017). This study suggested that teachers with high self-efficacy may show levels of engagement in the classroom, which might factor in alleviating math anxiety in the classroom.

The results indicated that math anxiety is present in students who are in first through third grade classrooms. This is important because students with math anxiety have less working memory dedicated to math-related tasks (Beilock & Willingham, 2014). Moreover, the findings showed that the mean math anxiety scores for boy and girl students was 18.7, which is in the medium range. Research has also found that students who were in first through third grades reported elevated levels of math anxiety in classrooms (Ganley & McGraw, 2016). In the current study, males reported a mean value of 17.9, which was lower than their female counterparts who reported a mean score of 19.4. The research has also reported that females have higher levels of anxiety than males, regardless of their performance ability (Figueira et al., 2023; Jameson, 2014). Notably, literature has indicated the presence of inconsistency in gender differences concerning

male and female students' math anxiety scores (Ganley & McGraw, 2016).

In the theoretical framework for this study, attachment theory should show that teachers with high self-efficacy form secure attachments since teachers are motivated to support student learning and achievement. Secure attachments are formed when students perceive that teachers support their efforts and that the environment is a safe place for learning (Hill et al., 2016; Semeraro et al., 2020). However, the teachers in this study's math self-efficacy scores did not show a relationship with students' math anxiety scores. Teachers with high self-efficacy should have been associated with forming secure attachments. Attachment theory does indicate that several factors impact the secure or insecure relationships that students form with figures in their lives. The study's findings suggested that the source of a secure attachment may stem from other factors besides teachers' math self-efficacy.

RQ2: Is there a statistically significant relationship between teachers' math self-efficacy and the teacher-student relationship?

Previous research has shown that self-efficacy is positively associated with quality interactions between teachers and students (Perera & John, 2020). The study analyzed the data from a survey for teachers' self-efficacy toward math and compared the data from the teacher-student relationship. The results of research question two revealed no statistically significant relationship between teachers' self-efficacy toward math and the teacher-student relationship, $r(11)= -.158$, $p =.607$. The results contrasted with previous literature that stated that teachers who believe that they are capable of completing a task are expected to have high-quality teacher-student relationships (Perera & John, 2020).

According to the attachment theory, diversity in the relationship impacts student experiences with math concepts (Ganley & McGraw, 2016; Hill et al., 2016). This study

explored whether teachers' math self-efficacy level was associated with teachers forming secure or insecure relationships with students. Teachers with high self-efficacy create supportive environments and build relationships (Blazar & Kraft, 2017). In addition, teachers with high levels of self-efficacy will form a secure relationship and will more likely respond to students' needs and reduce their stress (Bretherton, 1997). However, the findings from this study indicated that a teacher's math self-efficacy is not directly related to the development of secure or insecure teacher-student relationships in the classroom.

RQ3: How accurately can math anxiety in first through third grade students be predicted from a linear combination of teachers' math self-efficacy and teacher-student relationship?

In this study, the researcher analyzed the data from a math anxiety survey for students with teachers' self-efficacy toward math and teacher-student relationship surveys to determine if a predictive association was apparent. The researcher did not find a statistically significant predictive relationship between math anxiety scores in first through third grade students and teachers' self-efficacy toward math with the teacher-student relationship, $F(2,82) = .062$, $p = .940$. This suggests that negative emotional reactions towards math are not associated with the quality of teacher-student relationships and teachers' self-efficacy in math. The results of this study confirmed that the lack of conflict in the teacher-student relationship is not associated with interventions to alleviate anxiety in children (Kurdi & Archambault, 2018). Similar results showed no links between students' math anxiety and quality teacher-student relationships (Zee & Roorda, 2018).

The attachment theory postulates that high teacher self-efficacy in math influences the formation of positive attachments with teachers (Semeraro et al., 2020). Also, research indicated that when teachers have low self-efficacy, less effort is demonstrated in developing positive

relationships (Zhou et al., 2020). However, the study's results indicated that high self-efficacy in math does not directly influence the secure attachments forming in the classroom. The factors that impact math anxiety may stem from different environmental reasons and various attachment relationships (Moustafa et al., 2021; Passolunghi et al., 2019). The environmental and social relationships may impact the level of math anxiety in students (Beilock & Willingham, 2014).

Based on this study, it is uncertain about the factors that account for math anxiety in first through third grade students. However, literature has shown that in quality teacher-student relationships, teachers showed greater emotional and instructional support for students. Also, quality teacher-student relationships were found to reduce emotional distress (Perera & John, 2020). From this study, the findings indicated that the quality of the teacher-student relationship and teachers' self-efficacy towards math may not be sufficient to lessen the appearance of anxiety in children.

Implications

The findings of this study have valuable implications in the educational field. The results provided evidence that math anxiety occurs in young students in first through third grade. Educators must evaluate the environment in the classroom to determine stressors for students, such as threatening events or triggers to anxiety. Educators should prepare instruction and the classroom environment in a manner that is conducive to learning, utilizes techniques that support students’ success, and reduces math anxiety (Deringol, 2018). Exploring the social and contextual factors that impact math anxiety is vital in understanding the ongoing outcomes of students (Chang & Beilock, 2016; Ramirez et al., 2016). The findings from this study imply that educators must be reflective and evaluate their environment for contextual factors that impact the level of anxiety in students.

Also, the findings suggest that administrators and educators engage in ways to build self-efficacy in math for teachers and students. Low teachers' self-efficacy beliefs create environments that are not supportive of the needs of the students (Blazar & Kraft, 2017). However, high teachers' self-efficacy beliefs towards math were found to be related to desirable outcomes such as job satisfaction and student instructional support (Perera & John, 2020). Other findings show the importance of educators enhancing self-efficacy in math to support the emotional regulation of students (Alrajhi et al., 2017). By obtaining data from these findings, other researchers can further examine teachers' self-efficacy toward math and explore the gender differences in the level of math anxiety of students and their self-efficacy level in math. This is valuable since the students' confidence level plays a role in their level of math anxiety and math performance (Jameson, 2014). Educational training should focus on building teachers' and students' self-efficacy towards math since high self-efficacy in math benefits student learning outcomes.

This study contributes to the literature by examining the impact of teachers' math self-efficacy and teacher-student relationship on math anxiety in students, which has not been extensively covered in previous studies. As a result of the findings, stakeholders must encourage and aid students in building confidence towards math. Math anxiety was shown to be related to low math performance, and researchers continue to pursue strategies to alleviate it (Beilock & Willingham, 2014). Professional development may focus on best instructional practices that provide strategies for emotional and instructional support toward students (Alrajhi et al., 2017). This present study can benefit administrators by providing insight into the influence of teachers on students, which will assist administrators in designing training focused on math anxiety.

In addition, the results of this study may motivate teachers to engage in quality teacher-student relationships. Attachment theory illustrates that the quality of interactions determines the development of a secure attachment. Teachers can begin to monitor and reflect on their relationships and interactions with their students to support the emotional needs of the students (Ganley & McGraw, 2016). Educators may find opportunities in the classroom for students to express their anxieties and concerns around math through exploration, engagement, and practice. This study adds to the literature on attachment theory by showing that the teacher-student relationship is not the only factor that impacts the students' level of math anxiety. The findings revealed that other secure or insecure attachments in the students' lives influence their attitudes toward math. The findings from this study yielded several implications in the field of education:

- Evaluate the classroom environment.
- Explore contextual factors that impact students' level of anxiety.
- Enhance professional training by focusing on self-efficacy in math.
- Encourage teachers to engage in quality teacher-student relationships.

This study generated beneficial implications in the educational field since the findings of this research will inform and guide educational training, evaluations, and classroom experiences.

Limitations

There were limitations revealed in this study that could have threatened the validity of the study; however, the design of the study, the procedures, and the researcher's actions minimized any internal or external threats. Since the study's surveys were self-reported, survey bias from teachers and students was a factor due to social desirability. This could be a threat to internal validity since biases influence the ways participants respond to surveys (Alrajhi et al., 2017). To reduce this threat to validity, the researcher considered the wording and response format of the

survey. The original surveys contained reverse-worded items to minimize bias. The study included a reasonably wide range of scores on both the predictor variables (teachers' self-efficacy in math and teacher-student relationship) and the criterion variable (math anxiety in students) to eliminate the threat to validity. Students were under supervision when the surveys were administered (Warner, 2013). In addition, the researcher communicated the level of confidentiality, and the participants' identities and responses were protected. The participants were given unique codes to track their responses and maintain confidentiality. By considering the wording, response format, reverse-worded items, a reasonably wide range of scores, supervision of the survey, and maintaining confidentiality, the threat to internal validity was minimized.

Participants in this study were from one Mid-Atlantic state and were all female teachers, which could reduce generalizability. In addition, the participants were teachers and students from Christian schools. Because this study focused on Christian private schools, a study including non-religious schools, public schools, and other private schools may have yielded different results. This limits generalizability to a larger population of teachers, posing a threat to external validity; however, the study incorporated measures to enhance generalization (Warner, 2013). Threats to external validity were addressed by implementing procedures and utilizing an online survey system to eliminate non-response errors and increase the generalizability of the findings. The capacity for generalization was achieved by the researcher clearly defining the sample population and how the sample was obtained. The study utilized a well-defined accessible population and testing procedures to strengthen external validity, allowing for generalization to other settings (Warner, 2013). As a result of the design of the study, implementation of clear procedures, and the researcher's approach to confidentiality, the threats to validity were reduced.

While attachment theory was used as the theoretical framework to describe the teacher-student relationship, other theories, such as the social cognitive theory, may provide additional insight into the interactions between teachers, parents, and students. However, the findings from the study suggested that there is a possibility that other variables impact secure attachments, which influence math anxiety in students. Teacher and parental roles in the interactions with students may have an indirect influence on their attitudes toward math (Chang & Beilock, 2016).

Recommendations for Future Research

Additional research must be done to completely comprehend the factors that impact math anxiety in students in first through third grade classrooms. Based on the findings, future research could reexamine the teachers' math self-efficacy and teacher-student relationships with math anxiety levels in students to discern the degree of influence these factors have on math anxiety with a larger population or a population that includes private and non-religious elementary schools. Future studies might provide insight into math anxiety in students by exploring other social and contextual influences such as environmental factors, personal factors, internal pressures, or parental interactions. Since high math anxiety was linked to low math performance, the exploration of factors that trigger math anxiety in students is necessary (Chang & Beilock, 2016).

Due to the inconsistency in literature on gender differences in math anxiety, research can extend this study's findings by examining the differences in anxiety between male and female students and by examining how the teacher-student relationship impacts male versus female students. Also, qualitative research may explore the teachers' perspective of quality relationships and the interventions used to support students with math anxiety. Lastly, implementing longitudinal studies across first through high school grades may provide valuable insight into the

long-term impact that math anxiety has on student outcomes and career choices. Additional research with a focus on gender differences, social and contextual influences, or environmental influences may offer support to current studies. Furthering the exploration of math anxiety may lead to new interventions and thus assist students in greater mastery of math skills.

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APPENDIX A: Student-Teacher Relationship Scale (STRS)

STUDENT-TEACHER RELATIONSHIP SCALE – SHORT FORM

Please reflect on the degree to which each of the following statements currently applies to your relationship with this child. Using the scale below, circle the appropriate number for each item.

Definitely does not apply 1	Not really 2	Neutral, not sure 3	Applies somewhat 4	Definitely applies 5

1.	I share an affectionate, warm relationship with this child.	1	2	3	4	5
2.	This child and I always seem to be struggling with each other.	1	2	3	4	5
3.	If upset, this child will seek comfort from me.	1	2	3	4	5
4.	This child is uncomfortable with physical affection or touch from me.	1	2	3	4	5
5.	This child values his/her relationship with me.	1	2	3	4	5
6.	When I praise this child, he/she beams with pride.	1	2	3	4	5
7.	This child spontaneously shares information about himself/herself.	1	2	3	4	5
8.	This child easily becomes angry with me.	1	2	3	4	5
9.	It is easy to be in tune with what this child is feeling.	1	2	3	4	5
10.	This child remains angry or is resistant after being disciplined.	1	2	3	4	5
11.	Dealing with this child drains my energy	1	2	3	4	5
12.	When this child is in a bad mood, I know we're in for a long and difficult day.	1	2	3	4	5
13.	This child's feelings toward me can be unpredictable or can change suddenly.	1	2	3	4	5
14.	This child is sneaky or manipulative with me.	1	2	3	4	5
15.	This child openly shares his/her feelings and experiences with me.	1	2	3	4	5

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For details see http://curry.virginia.edu/about/directory/robert-c.-pianta/measures

APPENDIX B: Permission to Use STRS Instrument

Sunday, March 13, 2022 at 9:13:26 PM Eastern Daylight Time

Subject: FW: [External] Re: Instrumentation Usage Permission
Date: Tuesday, February 1, 2022 at 6:48:23 PM Eastern Standard Time
From: Bates, Erica
To: Erica Bates

Erica M. Bates, EdS
[redacted]

From: Pianta, Robert [redacted]
Date: Tuesday, Februa[redacted]
To: Bates, Erica [redacted]
Subject: [Extern[redacted]ission

You don't often get email from rcp4p@virginia.edu. Learn why this is important

[EXTERNAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

You have my permission to use the STRS for the purposes of your research as described below

Robert C. Pianta, Ph.D.
Batten Bicentennial Professor of Early Childhood Education
Dean, School of Education and Human Development
[redacted]

From[redacted]
Date
To:
Subj

Dear Dr. Pianta,

My name is Erica Bates. I'm currently enrolled in the doctoral program at Liberty University. My research question for my dissertation aligns with using the "Student- Teacher Relationship Scale- Short Form". I would like permission to use this instrument in my research study and to inquire about the

APPENDIX C: Self-efficacy for Teaching Mathematics Instrument (SETMI)

Self-efficacy for Teaching Mathematics Instrument (SETMI)
Elementary Teacher Version

Directions: Please circle the number that matches your response.

None at All	Very Little	Strong Degree	Quite a Bit	A Great Deal
1	2	3	4	5

1.	To what extent can you motivate students who show low interest in mathematics?	1	2	3	4	5
2.	To what extent can you help your students' value learning mathematics?	1	2	3	4	5
3.	To what extent can you craft relevant questions for your students related to mathematics?	1	2	3	4	5
4.	To what extent can you get your students to believe they can do well in mathematics?	1	2	3	4	5
5.	To what extent can you use a variety of assessment strategies in mathematics?	1	2	3	4	5
6.	To what extent can you provide an alternative explanation or example in mathematics when students are confused?	1	2	3	4	5
7.	How well can you implement alternative teaching strategies for mathematics in your classroom?	1	2	3	4	5

How well can you teach students to...

8.	Describe characteristics of Numbers (i.e. whole numbers, rational/ irrational numbers).	1	2	3	4	5
9.	Perform strategies for composing and decomposing numbers by manipulating place value in addition and subtraction.	1	2	3	4	5
10.	Perform strategies for composing and decomposing numbers by manipulating place value in multiplication and division.	1	2	3	4	5
11.	Convert a fraction to a decimal and vice versa.	1	2	3	4	5
12.	Compare equivalence of fractions and decimals	1	2	3	4	5
13.	Interpret inverse relationships between operations (i.e. +, - and *, ÷)	1	2	3	4	5
14.	Manipulate coordinate planes.	1	2	3	4	5
15.	Collect, plot and interpret data (on any type of graph)	1	2	3	4	5
16.	Measure area and perimeter	1	2	3	4	5
17.	Convert between units in the same system (i.e. grams → kilograms, inches → yards).	1	2	3	4	5
18.	Convert between units in a different system (i.e. kilograms → pounds, inches → centimeters).	1	2	3	4	5
19.	Measure the length of objects.	1	2	3	4	5
20.	Discover and create mathematical patterns	1	2	3	4	5
21.	Interpret variables in an algebraic equation.	1	2	3	4	5
22.	Interpret probability of outcomes	1	2	3	4	5

!

!

APPENDIX D: Permission to Use SETMI

Appalachian
STATE UNIVERSITY
[redacted]

College of Education
Department of Curriculum and Instruction
[redacted]

You have my permission to use the Self Efficacy for Teaching Mathematics Instrument in your research. Please reference the validity information and scoring guide when publishing your findings.

Sincerely,

Jennifer R. McGee, Ed.D.
College of Education
Appalachian State University
[redacted]

APPENDIX E: Math Anxiety Questionnaire for Children Instrument (MAQC)

The Math Anxiety Questionnaire for Children (MAQC)

Instruction: I will ask you some questions related to mathematics. Please, answer "yes", "a little" or "no" to my questions.

1	Do you like solving mathematical problems?	Yes	A little	No
2	Do you like being asked questions during math classes?	Yes	A little	No
3	Do you like to speak about mathematics?	Yes	A little	No
4	Are you nervous when you ask questions about mathematics?	Yes	A little	No
5	Are you nervous at the thought of making a mistake when solving tasks?	Yes	A little	No
6	Are you afraid of mathematics?	Yes	A little	No
7	When you are in math class and the teacher says that you will be discussing a new topic, are you nervous?	Yes	A little	No
8	When you do your homework in mathematics, are you nervous?	Yes	A little	No
9	When you start to solve a difficult task, are you nervous?	Yes	A little	No
10	When you solve a task on the blackboard during math class, do you get stressed?	Yes	A little	No
11	When the teacher explains how to solve a math problem, are you nervous?	Yes	A little	No
12	When you have to ask your teacher for help because you do not know how to solve a task, are you nervous?	Yes	A little	No

Note. Items 1–3 are reversed. Content of items 7, 8, 10, 11, 12 is based on the SEMA, items 1, 2, 5, 6 are inspired by the MASYC, and items 3, 4, 9 are my own proposal. The scale is also available in a 14-item version (author paper).

APPENDIX F: Permission to Use MAQC Instrument

Sunday, March 20, 2022 at 4:49:16 PM Eastern Daylight Time

Subject: [External] ODP: Permission to use Math Anxiety Questionnaire for Children
Date: Thursday, March 17, 2022 at 4:58:15 AM Eastern Daylight Time
From: Monika Szczygieł
To: Bates, Erica

[EXTERNAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

Dear Erica,

the MAQC is free available measure that you can use in your project. Good luck with research!

Best regards
Monika Szczygieł

Od: Bates, Erica [redacted]
Wysłane: środa, 16 marca 2022 23:05
Do: Monika Szczygieł [redacted]
Temat: Permission to use Math Anxiety Questionnaire for Children

Dear Dr. Szczygiel,

My name is Erica Bates. I'm currently enrolled in the doctoral program at Liberty University. My research question for my dissertation aligns with using the "Math Anxiety Questionnaire for Children". I would like permission to use this instrument in my research study and to inquire about the cost of using this instrument. Listed below are my research questions.

RQ1: Is there a statistically significant relationship between the math anxiety of first through third grade students and teachers' self-efficacy toward math?

RQ2: Is there a statistically significant relationship between teachers' math self-efficacy and the teacher-student relationship?

RQ3: How accurately can math anxiety in first through third grade students be predicted from a linear combination of teachers' math self-efficacy and teacher-student relationship?

Thank you for considering granting me permission to use the instrument in my research. This instrument will be used for research purpose only and not for profit.

Sincerely

APPENDIX G: Teacher Consent Form

Title of the Project: The Influence of Teacher-Student Relationships on Teachers' Math Self-Efficacy and Mathematical Anxiety in Students in Lower Elementary Grades
Principal Investigator: Erica Bates, Ed.S, Doctoral Candidate, Liberty University

Invitation to be Part of a Research Study

You are invited to participate in a research study. To participate, you must be currently teaching students in the first, second, or third-grade level and teaching a mathematics class. 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.

What is the study about and why is it being done?

The purpose of the study is to discover the relationship between teachers' self-efficacy, teacher-student relationships, and math anxiety in the classroom setting of first through third-grade students. This study will examine the relationship between teacher self-efficacy and the quality of the teacher-student relationship. In addition, this study will determine if there is an association between the teacher-student relationship and the level of math anxiety in first through third-grade students.

What will happen if you take part in this study?

If you agree to be in this study, I will ask you to do the following things:

1. You will be asked to complete a brief online scale on teacher math self-efficacy. This is estimated to take about 10 minutes.
2. You will be asked to complete a brief online rating scale on your relationship with each student in your classroom whose parents agree to allow him/her to participate in this study. It is estimated that this may take 8-10 minutes per student.

How could you or others benefit from this study?

Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include guiding and developing educational trainings related to students' prevention and intervention of math anxiety in the classroom which impacts students' learning and achievement.

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 and faculty sponsor will have access to the records.

- Participant responses will be kept confidential through the use of codes.

Liberty University
IRB-FY22-23-325
Approved on 3-13-2023

- 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.

How will you be compensated for being part of the study?

Participants will be compensated for participating in this study. Each participant will be emailed a small token of appreciation in the form of a $10.00 gift card towards Starbucks or Amazon.

Does the researcher have any conflicts of interest?

The researcher serves as a second-grade teacher at Forcey Christian School. This disclosure is made so that you can decide if this relationship will affect your willingness to participate in this study. No action will be taken against an individual based on his or her decision to participate or not participate in this study.

Is study participation voluntary?

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University or your school. 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 included in the next paragraph. Should you choose to withdraw, data collected from you will be destroyed immediately and will not be included in this study.

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

The researcher conducting this study is Erica Bates. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her a[redacted]ou may also contact the researcher's faculty sponsor, Dr. Hoiwah Fong, at [redacted]

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, **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.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

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.

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

_____
Printed Participant's Name

_____
Signature & Date

Liberty University
IRB-FY22-23-325
Approved on 3-13-2023

APPENDIX H: Parental Consent Form

Parental Consent

Title of the Project: The Influence of Teacher-Student Relationships on Teachers' Math Self-Efficacy and Mathematical Anxiety in Students in Lower Elementary Grades
Principal Investigator: Erica Bates, Ed.S, Doctoral Candidate, Liberty University

Invitation to be Part of a Research Study

Your child is invited to participate in a research study. Participants must be in the first, second, or third grade. 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 discover the relationship between teachers' self-efficacy, teacher-student relationships, and math anxiety in the classroom setting of first through third-grade students. This study will examine the relationship between teacher self-efficacy and the quality of the teacher-student relationship. In addition, this study will determine if there is an association between the teacher-student relationship and the level of math anxiety in first through third-grade students.

What will participants be asked to do in this study?

If you agree to allow your child to be in this study, I will ask him/her to do the following things:

1. Your child will be asked to answer questions about how math makes him or her feel which will take approximately 8 -10 minutes online.

How could participants or others benefit from this study?

Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include guiding and developing educational training related to students' prevention and intervention of math anxiety in the classroom which impacts students' learning and achievement.

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 and faculty sponsor will have access to the records.

- Participant responses will be kept confidential through the use of codes.
- 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.

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Approved on 3-13-2023

How will participants be compensated for being part of the study?

Participants will not be compensated for participating in this study.

What conflicts of interest exist in this study?

The researcher serves as a second-grade teacher at Forcey Christian School. This disclosure is made so that you can decide if this relationship will affect your willingness to allow your child to participate in this study. No action will be taken against an individual based on her or his decision to allow his or her child participate in this study.

Is study participation voluntary?

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. 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.

What should be done if a participant wishes to withdraw from the study?

If you choose to withdraw your child from the study or your child chooses to withdraw, please contact the researcher at the email address included in the next paragraph. Should you choose to withdraw her or him or should your child choose to withdraw, data collected from your child will be destroyed immediately and will not be included in this study.

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

The researcher conducting this study is Erica Bates. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact Erica Bates at [redacted].
You may also contact the researcher's faculty sponsor, Dr. Hoiwah Fong, at [redacted].

Whom do you contact if you have questions about 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, **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.

Disclaimer: The Institutional Review Board (IRB) is tasked with ensuring that human subjects research will be conducted in an ethical manner as defined and required by federal regulations. The topics covered and viewpoints expressed or alluded to by student and faculty researchers are those of the researchers and do not necessarily reflect the official policies or positions of Liberty University.

Your Consent

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.

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

Liberty University
IRB-FY22-23-325
Approved on 3-13-2023

Your Consent/Opt-Out

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.

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.

_____
Printed Child's/Student's Name

_____
Parent's Signature Date

_____
Minor's Signature Date

Liberty University
IRB-FY22-23-325
Approved on 3-13-2023

APPENDIX I: Assent Form

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 The Influence of Teacher-Student Relationships on Teachers' Math Self-Efficacy and Mathematical Anxiety in Students in Lower Elementary Grades, and the person doing the study is Erica Bates, Ed.S, Liberty University.

Why is Erica Bates, Ed.S, doing this study?
Erica Bates wants to know how a teacher's confidence level in math impacts the level of math anxiety in first through third grade students.

Why am I being asked to be in this study?
You are being asked to be in this study because you are a first, second, or third grade student.

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 be asked to complete a survey, which will take approximately 8-10 minutes to complete online.

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.

_____

Witness Date

Erica Bates
[redacted]

Dr. Fong
[redacted]

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

Liberty University
IRB-FY22-23-325
Approved on 3-13-2023

APPENDIX J: Student Demographics

Demographic Characteristics of Students

	Frequency	Percent
Student Gender		
Female	45	53.6%
Male	39	46.4%
Student Ethnicity		
Black or African American	50	59.5%
Asian	6	7.1%
White or Caucasian	17	20.2%
Native Hawaiian/Other Pacific Islander	1	1.2%
Other	10	12.0%
Student Age		
6-7 years old	47	56.0%
8-9 years old	37	44.0%
Student Grade		
First Grade	38	45.2%
Second Grade	19	22.6%
Third Grade	27	32.1%

APPENDIX K: Teacher Demographics

Demographic Characteristics of Teachers

	Frequency	Percent
Teacher Gender		
Female	13	100%
Male	0	0%
Teacher Ethnicity		
White or Caucasian	8	57.1%
Black or African American	4	28.5%
Asian	1	7.1%
Other	1	7.1%
Teachers' Level of Education		
Bachelor's Degree	10	76.9%
Graduate or professional degree	3	23.1%
Grade Level of Teacher		
First Grade	5	38.5%
Second Grade	3	23.1%
Third Grade	5	38.5%

APPENDIX L: IRB Approval

Sunday, April 30, 2023 at 7:39:29 AM Eastern Daylight Time

Subject: [External] IRB-FY22-23-325 - Initial: Initial - Expedited
Date: Monday, March 13, 2023 at 11:08:39 AM Eastern Daylight Time
From: do-not-reply@cayuse.com
To: Bates, Erica, Fong, Hoiwah Benny (Doctor of Education)
Attachments: ATT00001.png

[EXTERNAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

March 13, 2023

Erica Bates
Hoiwah Benny Fong

Re: IRB Approval - IRB-FY22-23-325 The Influence of Teacher-Student Relationships on Teachers' Math Self- Efficacy and Mathematical Anxiety in Students in Lower Elementary Grades

Dear Erica Bates, Hoiwah Benny Fong,

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 following date: March 13, 2023. If you need to make changes to the methodology as it pertains to human subjects, you must submit a modification to the IRB. Modifications 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(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) 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(s) 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
Research Ethics Office