Mathematics Anxiety and the Instructional Triangle: A Case Study of Remedial College Instructors

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ABSTRACT

Approximately 80% of community college students and 25% of four-year students taking mathematics courses in post-secondary institutions struggle with moderate to high math anxiety, and 67% of two-year and 44% of four-year students are remedial noncompleters "no degree and not enrolled" (Chen, 2016, p. 35). Tobias (1993) stated that it makes no difference if the failure occurs in a K-12 or college course; failure is both instant and frightening (1993, p. 50). Tobias (1993) connected students' anxiety and their avoidance of degrees and or occupations that required mathematical tasks. As remedial courses serve as the gateway for students to access core and degree earning courses, remediation is pivotal in a students' college career. Ususimaki and Nason (2004) examined three origins of mathematics anxiety: environmental, intellectual, and personality factors. The environmental components of math anxiety seem to be more external, including parents, teachers, and peers. The researchers sought to discover the incongruencies between curriculum design, teachers' practices, and curriculum implementation. Thus, the interactive or relational nature of teaching rather than the vision or design of education is the focus of *The Instructional Triangle*, which illustrates the relationships between the environmental factors within a mathematical environment (teacher, students, other students, and content) (Ball & Forzani, 2009). The purpose of this study was to determine the strategies and practices used by educators who taught remedial mathematics courses at postsecondary institutions in South Georgia to students with moderate to high math anxiety who are unlikely to graduate. This study may have value for educators at any level as they may develop and implement instruction to address anxiety. Additionally, higher education institutions and their pedagogical programs and classes may apply this study's findings to increase students' matriculation and retention.

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ACKNOWLEDGEMENTS

As no worthy endeavor is ever undertaken alone, so has my journey been a composite of many co-laborers' contributions. My journey of fighting fear started in the sixth grade when my Aunt Carolyn told me to change my attitude and stop being afraid. Her call to arms changed the trajectory of my life. She did what I could not do for myself (she equipped me to teach fearlessness). Secondly, it was a push from a colleague (Ryan Teter) to get my Masters' Degree, and during that time, I had amazing mentors and educators. One such mentor (Dr. Patrick Biddix) proclaimed to my parents that one day I too would be a doctor on my Master's graduation day. Dr. Biddix's prompting, along with my father's (Papa smurf), would jump-start my initial pursuit of a terminal degree at Walden University. Friends like Monica Stallings, Aziz Agbo-Panzo, Vivian Vaughn, Njeri Kaittany, John Dingfelder, Brittany Philbert, Latoya James, Takiwi Milton-Babalola, and Tomika Jackson would pray with and hold my arms up when I was weary of the work. Dr. Christine Sherling, thank you for providing perspective when looking at my data, thanks for being a soundboard whereby one of the greatest discoveries of my research occurred. Beyond the data to our relationship, thanks for being a friend and a big sister. Thanks for calling me "home."

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DEDICATION

To my heavenly Father, so many times, I have fallen short of giving you the very best of me, but you never fail to give me the very best of you (Psalm 138:8, you are in the details). I pray you continue to bless the work of my hands and mind, that this work accomplishes the mandate to challenge fear (as fear erodes identity and a people that don't know who they are will not accomplish all that they can), so let's become FEARLESS.

Chapter I

INTRODUCTION

Education is an ever-changing organism that evolves as a reflection of policies, culture, and trends (Tyack & Cuban, 1995). Remedial education has roots in several key legislative and progressive educational changes occurring in the 20th century, such as the Servicemen's Readjustment Act of 1944 (G.I. Bill), the National Defense Education Act (NDEA, 1958, 1964), and *A Nation at Risk* (Gardner et al., 1983). The G.I. Bill (1944) had a tremendous impact on colleges by increasing enrollment across the nation (Servicemen's Readjustment Act of 1944, 1944). As a result, colleges and universities lowered their admissions requirements to accommodate the new mandate (Servicemen's Readjustment Act of 1944, 1944). Many students entering college were underprepared, and thus, colleges and universities created remedial or learning support courses to ensure students' academic achievement (Servicemen's Readjustment Act of 1944,

1944).

Later policies expanded educational opportunities in the United States increasing the need for remedial education. The NDEA (1958, 1964) was implemented under Eisenhower's presidency in 1958 and enabled the Federal government to fund post-secondary education. After World War II (WWII), an amended NDEA (1964) provided for three initiatives: vocational training, support for STEM (Science, Technology, Engineering, and Mathematics), and foreign language instruction with an emphasis on teaching disadvantaged youth. Because of these initiatives, more individuals entered higher education. With the increase in enrollment, there was also an increase in the demand for remediation.

Over the next several decades, an increasingly global economy meant that the United States had to compete with the education of other developed nations. Subsequently, *A Nation at Risk*, a report commissioned by the National Defense Education Act, was used to bolster educational standards nationally and internationally (Gardner et al., 1983). *A Nation at Risk* highlighted the impact of an educated populace on the country's progress. The report included data concerning literacy rates, critical thinking skills, standardized testing scores, remedial mathematics course grades, and graduation rates. The report contained remedial mathematics course offerings that increased across 4-year colleges and universities at a 72% increase rate (Gardner et al., 1983). However, the Department of Education has not made many changes to remedial mathematics education since the policies aforementioned were implemented.

As remedial courses serve as the gateway for students to access core and degree-earning courses, remediation is pivotal in a student's college career. Unfortunately, the odds are not in students' favor as remedial non-completers have a higher probability of dropping out of college during their first two years (Chen, 2016, p. 72). Additionally, less than a third of community college remedial mathematics students will enroll in college-level mathematics courses (p. 6). Given these statistics, further examination of remedial mathematics in higher education is warranted.

One factor attributing to these poor outcomes is the invisible students' battle, anxiety. Hart and Ganley (2019) stated that moderate anxiety is not relegated to students at school but impacts the general adult population. Tobias (1993) stated that many students feel that failing math is like a "sudden death" (p. 50). Tobias (1993) stated that it makes no difference if the failure occurs in a K12 or college course, "failure was instant and frightening" (p. 50). Additionally, Tobias (1993) found a connection between students' anxiety and their avoidance of degrees and/or occupations that require mathematical tasks. The phenomenon of mathematics anxiety impacts students as early as elementary education and as late as advanced collegiate education (Jackson & Leffingwell, 1999). However, mathematics anxiety has not been specifically studied within the context of remedial mathematics.

Mathematics Anxiety

Educational researchers have investigated three types of anxiety: mathematics, general, and testing anxiety, which are all related (Dowker et al., 2016). Individuals have expressed accounts of mathematics anxiety since early as the 16th century. However, it has only been since 1957 that "number anxiety" was a subject of research (Dreger & Aiken, 1957). In the early 1980s, researchers categorized mathematics anxiety into two types: cognitive and affective (Dowker et al., 2016; Liebert & Morris, 1967). Cognitive anxiety relates to students' abilities to complete mathematical tasks, while affective anxiety relates to how students feel while completing mathematical tasks. In either case, anxiety can affect students' working memory, cognitive load, and engagement level with mathematics activities (Dowker et al., 2016).

Other researchers asserted that mathematics anxiety is more prevalent than general or testing anxiety (Ashcraft & Ridley, 2005; Dew et al., 1983; Hembree, 1990). In addition to the three types of anxiety mentioned above, students may also struggle with "performance anxiety" when completing tasks other than tests and exams (Dowker et al., 2016). It should be noted that mathematics anxiety elicits "stronger emotional reactions" than other academic subjects (Dowker et al., 2016, p. 2). In fact, "mathematics anxiety interferes with the performance of mathematical tasks" (Dowker et al., 2016, p. 2). Consequently, mathematics anxiety may also affect students' likelihood of taking general mathematics courses or career-required mathematics courses.

Braham and Libertus (2018) defined math anxiety as "a negative emotional reaction to situations involving numbers or math" (p. 15). Boaler (2016) and other researchers stated that math anxiety is detected as early as kindergarten but is distinct in grades fourth and fifth (Jackson & Leffingwell, 1999). Additionally, teachers' beliefs and instructional practices can exacerbate or increase students' math anxiety (Jackson & Leffingwell, 1999). Even when identified early on, math anxiety continues to plague students' motivation toward mathematical concepts well into adulthood (Driscoll, 2005). Thus, avoidance of math can adversely impact a student's choice of major, the likelihood of college completion, and subsequent career choices.

Various researchers have examined bolstering other factors that impact mathematics performance, including self-efficacy, self-confidence, and math self-concept, as ways to mitigate or lessen the effects of mathematics anxiety. Self-efficacy or the self-belief in one's ability to complete a task was first defined by Bandura (1986). Bandalos et al. (1995) built upon this understanding of self-efficacy in defining the math self-concept. The math self-concept is defined as "students' perceptions of their math ability" (Bandalos et al., 1995, p. 612). Students who have a positive math self-concept are less likely to report math anxiety. Although several studies have examined mathematics anxiety and these associations, researchers have not identified a definite cause of mathematics anxiety (Dowker et al., 2016).

Ususimaki and Nason (2004) examined three origins of mathematics anxiety: environmental, intellectual, and personality factors (p. 370). The environmental components include ineffective instruction, parental expectation and pressure, the inflexibility of traditional mathematics instructional design (low student engagement and exchange), content confidence, result focus vs. process focus, gender bias, and insensitive instructors (Looney et al., 2017; Uusimamki & Nason, 2004). The environmental components of math anxiety seem to be more external, including parents, teachers, and peers. Math anxiety's intellectual components include instructional delivery and learning preference incompatibility, poor academic and study skills, low content confidence, mathematical attitudes, and math usability perceptions (Uusimamki & Nason, 2004). Math anxiety personality components include low self-esteem, socially acceptable gender-related functionality within mathematics, and low level engagement. Socially acceptable gender-related roles in mathematics are expressed exclusively within the male domain (Uusimamki & Nason, 2004, p. 370).

Impactful instructional and pre-service training should include methods that allow teachers to gain higher self-efficacy levels, content confidence, and improved creative instructional design and implementation. Looney et al. (2017) stated that students develop positive mathematics beliefs and high content confidence when taught by teachers with positive mathematics beliefs who teach more rigorously. Instructional and pre-service training may improve instructional design and address some intellectual components of math anxiety, which seem to be more internal, such as low content confidence and negative math attitudes.

Problem Statement

Math anxiety is very prevalent and poses a barrier to successfully completing mathematics courses necessary to graduate from college. Approximately 80% of community college students and 25% of four-year college students taking mathematics courses struggle with moderate to high math anxiety (Beilock & Willingham, 2014). Additionally, 67% of two-year and 44% of four-year students are remedial non-completers "no degree and not enrolled" (Chen, 2016, p. 35). Given that math anxiety is a barrier to math performance, remedial math instruction should be examined for mitigating factors.

Specifically, mathematics developmental study programs provide a bridge for students who have not mastered the necessary skills and knowledge to navigate their college education. According to the National Center for Education Statistics (NCES; 2017), only 30% of first-time degree or certificate-seeking students graduate from a two-year postsecondary institution within two years. Additionally, NCES (2013) reported that

28% of students enrolled between 1999-2000 in a degree-seeking program were also required to take remedial classes. These national statistics warrant further exploration of remedial math instruction.

At the state level, remedial math instruction is also of great concern. For example, the number of remedial mathematics students who fail to complete their two-year or four-year degrees within the state of Georgia is greater than the national average (University System of Georgia, 2018). University System of Georgia (2018) reported that of the 37% of students enrolled in learning support/remediation at two-year institutions, only seven percent graduated within three years (University System of Georgia, 2018). Thus, 93% of two-year students enrolled in learning support/remediation fail to graduate (University System of Georgia, 2018). Additionally, of the 52% of students enrolled in learning support/remediation at four-year institutions, only 25% graduate within six years (University of System of Georgia, 2018). Consequently, 75% of the students enrolled in learning support at four-year institutions fail to graduate (University of System of Georgia, 2018). Math anxiety may play a role in this devastating outcome.

Purpose Statement

To further understand how to mitigate the role of math anxiety in college student math performance, this study focused on remedial math instruction. The purpose of this study was to determine the strategies and practices to mitigate math anxiety used by educators who teach remedial mathematics courses at identified postsecondary institutions in South Georgia. Based on the literature, students in remedial mathematics are likely to experience moderate to high math anxiety and are unlikely to graduate.

Furthermore, the researcher sought to understand educators' experiences teaching remedial mathematics courses regarding various topics, such as how their knowledge and experience impacted their teaching philosophy, and how they interact with students with moderate to high math anxiety. This study was motivated by my personal experiences of fear, connection, and disconnection within the classroom. Three pivotal educational experiences shaped me as a learner: first grade, sixth grade, and college

Algebra.

During both the first and sixth grade, I struggled with fear and disconnection from my teacher, other students, and, most importantly, the content (mathematics). However, my sixth-grade experience would change the trajectory of my life. My Aunt Carolyn challenged me to stop being afraid of math and change my attitude. I took that advice and made strong connections with my teachers, other students, and, most crucially, the content. Throughout high school, I learned to love learning again, especially math. Even on standardized tests, such as the SATs, PSATs, and high school exit exams, I scored well in math. My college experience would solidify my math self-concept and self-efficacy as I overcame another strong disconnection experience. I learned how to mitigate fear by working harder to connect with the content and ultimately became a mathematics instructor.

Research Questions

Using a combination of a grounded theory and case study approach, this study sought to answer the following research questions:

1. What are the life and career experiences of educators who teach remedial mathematics at identified at post-secondary institutions in South Georgia?
2. What are the strategies used by these educators to mitigate anxiety?
3. What are the practices used by these educators to mitigate anxiety?

Significance of the Study

Approximately 80% of students taking mathematics courses in four-year institutions struggle with moderate to high math anxiety (Beilock & Willingham, 2014). Additionally, 67% of two-year and 44% of four-year students are remedial non-completers "no degree and not enrolled" (Chen, 2016, p. 35). The purpose of this study was to determine the strategies and practices used by educators who taught remedial mathematics at postsecondary institutions in South Georgia. Examining their practices with a focus on mitigating math anxiety was especially prudent, given that their students were likely to struggle with math anxiety and at risk of course failure. This study may have value for educators at any level as they may develop and implement instruction to address anxiety. Additionally, discoveries from this study concerning math anxiety may inform curriculum changes to adjust and update instructional practices. In particular, pedagogical programs and classes within institutions of higher education may apply the findings of this study to increase students' matriculation, retention, and graduation. Increased retention and graduation rates would increase revenue, allowing institutions to increase hiring opportunities, course offerings, and degree offerings (Broton, 2019).

Theoretical Framework

To examine remedial math instruction, as well as strategies and practices used by educators to mitigate math anxiety, the following theoretical lens was adopted. The instructional triangle (Ball & Forzani, 2009), originally represented as bidirectional connections between teacher, student, and content, served as a tool throughout data collection and analysis to discuss connection and disconnection as related to math anxiety. An adapted version of the instructional triangle is presented in Chapter 2. This framework provided language to describe both the teacher and student perspective of remedial math instruction as interpreted from interviews, observations, and review of documents.

The Instructional Triangle

Ball and Forzani (2009) studied the work of teaching and the challenge of teacher education. The researchers sought to discover the incongruences between curriculum design, teachers' practices, and curriculum implementation. Thus, the interactive or relational nature of teaching rather than the vision or design of education is *The Instructional Triangle*'s focus, which illustrates the relationships between the environmental factors within a mathematical environment (teacher, students, other students, and content).

Herbst and Chazan (2012) illustrated the flexibility and dynamic movement of each triangle's elements. Herbst and Chazan (2012) proposed further interactions between the three elements of the triangle given social context and highlighted the "three-way" relationship between teacher, student, and content (p. 13). In Herbst and Chazan's (2012) illustration, teachers are described as administrators of the curriculum with the flexibility to reformat the delivery to best suit the student participants.

Summary of Methodology

A case study design was utilized to develop educator profiles based on experience, strategies, and classroom practices. Teachers were selected from two or four-year institutions with single or concurrent remedial mathematics course offerings in South Georgia. The purposeful sampling method was beneficial in selecting a specified criterion and qualifications (full-time or adjunct mathematics educators in higher education who teach remedial mathematics). The sample group received a survey that helped the researcher identify participants who met the study's more in-depth criteria. Data collection included observations, interviews, and a review of documents, such as educational philosophies and instructional materials. The researcher conducted two in-depth interviews and observations and collected the teachers' instructional materials (practice exams, workbooks, worksheets, and PowerPoints). A grounded theory approach was used to analyze the cases in this study. An iterative process of coding data yielded several findings, as well as a proposed revised theory of remedial math instruction in the form of an instructional pyramid.

Limitations

This study included several limitations. For example, one limitation of the study is the exclusion of student participants. Students could have provided more insight into how anxiety affects their connections with the instructor, other students, and, more importantly, the content. Although the *Instructional Triangle* depicts the types of relationships in learning environments, the framework lacks the students' perspective of themselves and teachers' perspectives of themselves (Ball & Forzani, 2009). Thus, examining students' level of self-efficacy (math self-concept) could have enriched the study by revealing how students overcome negative relationships (with instructors or other students) to make strong connections with the content. Without student data, there was no opportunity to understand how students self-mitigate mathematics anxiety.

Additionally, the study structure did not permit an opportunity to examine how students' levels of ownership affect the relationships of *The Instructional Triangle* (Ball & Forzani, 2009). Data related to students' admission statuses and preparedness levels could have served as indicators or predictors of students' persistence to graduation. Furthermore, placement exam data could have provided educators with an understanding of students' preparedness levels related to the course materials. Overall, the lack of student participants did not provide an opportunity to examine how students persist and overcome anxiety to achieve in mathematics.

Limitations that are outside of the scope of this study include the exclusion of K-12 teachers, students' participation, and the diversity between the two types of learning environments. Additional limitations are related to the design, the scope of the questions, the size of the sample, the types of institutions, and the limitations related to teachers' perspectives and expertise. The K-12 population and environment have produced in-depth research concerning mathematics anxiety and curriculum design. Several underpinning themes of K-12 research include the impact of anxiety on teachers and curriculum design and implementation. The proposed interventions include pre-training and courses that allow teachers to use reflection to combat anxiety (Geist, 2015). The limitations related to the questions' scope are limited to answering questions about the educator's experiences, expertise, strategies, and practices. The questions mentioned above cannot be used to answer questions related to identifying students who may be struggling with anxiety, nor can the questions be used to discover in-class or institutional interventions for students. In general, a combined limitation was the inability to discover how students, educators, and institutions mitigate anxiety independently and collectively.

Definition of Terms

The following terminology will be utilized throughout the study:

- *Cognitive Consistency*. The cognitive consistency theory expands the
- Instructional Triangle and demonstrates the eight different types of relationships within an educational environment (Ball & Forzani, 2009; Schunk, 2016).
- *Cognitive Processes*. Cognitive processes involve the "…acquisition of knowledge and skills, the formation of mental structures, and the processing of information and beliefs" (Schunk, 2016, p. 22).
- *Connection.* The development of depth in the relationships illustrated by *The Instructional Triangle* (teacher to content, teacher to student, student to teacher, student to student, and student to content) (Ball & Forzani, 2009).
- *Developmental Education.* Developmental education and remedial, remediation, learning support are all pre-requisite to core courses.
- *Disconnection.* Lack of depth in developing the relationships as illustrated by the *Instructional Triangle* (teacher to content, teacher to student, student to teacher, student to student, and student to content) (Ball & Forzani, 2009).
- *Fixed Mindset*. A fixed mindset is "the belief that one's math ability is innate and limited" (Dweck, 2006, as cited by Sun, 2015, p. iv).
- *Grit*. Angela Duckworth (2016) defined grit as "a special blend of passion and persistence" to achieve long term goals (p.8).

- *Growth Mindset*. A growth mindset is “the belief that math ability is something that is malleable and can be developed through hard work and perseverance.” (Dweck, 2006 as cited by Sun, 2015, p. iv).
- *Instructional Belief.* Instructional belief comprises an educator’s beliefs, educational background, teaching efficacy, and educational philosophy.
- *The Instructional Triangle. The Instructional Triangle* depicts the relationships within an educational environment between teacher and content, teacher and student, student and student, student and teacher, and student and content (Ball & Forzani, 2009).
- *Mathematics Anxiety.* Braham and Libertus (2018) defined math anxiety as “a negative emotional reaction to situations involving numbers or math” (p. 15).
- *Mathematics Instructional Anxiety*. “Mathematics teaching anxiety (MTA) is defined as anxiety associated with real or perceived deficits in teaching mathematics” (Peker, 2009, as cited by Olson & Stoehr, 2019, p. 73).
- *Math Self-Concept.* Math self-concept is a student’s perception of their ability to complete mathematical tasks (Bandalos et al., 1995, p. 612).
- *Practices.* Practices are based upon an educator’s instructional strategies, affecting instruction implementation within the classroom or instructional environments.
- *Self-Efficacy*. Self-Efficacy is “an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments.” (Bandura, 1986).
- *Strategies.* Strategies are instructional preparations that are based upon instructional beliefs, typically occurring outside of the classroom.
- *Teaching Efficacy*. Teaching Efficacy is a “teachers’ confidence in their ability to promote students’ learning” (Hoy, 2000).

Chapter II

REVIEW OF LITERATURE

Purpose Statement

To further understand how to mitigate the role of math anxiety in college student math performance, this study focused on remedial math instruction. The purpose of this study was to determine the strategies and practices to mitigate math anxiety used by educators who teach remedial mathematics courses at identified postsecondary institutions in South Georgia. Based on the literature, students in remedial mathematics are likely to experience moderate to high math anxiety and are unlikely to graduate (Beilock & Willingham, 2014).

Problem Statement

Math anxiety is prevalent and poses a barrier to successfully completing mathematics courses necessary to graduate from college. Approximately 80% of community college students and 25% of four-year college students taking mathematics courses struggle with moderate to high math anxiety (Beilock & Willingham, 2014). Additionally, 67% of two-year and 44% of four-year students are remedial non-completers "no degree and not enrolled" (Chen, 2016, p. 35). As math anxiety is a barrier to math performance, remedial math instruction should be examined for mitigating factors.

This study is significant because policymakers deem community colleges the most appropriate, cost-efficient developmental education source. (Pusser & Levin, 2009). With the cost of college increasing with an inverse relationship with completion rates for remediated students, there is intentionality in investigating issues that may impact students' success (College Board, 2017). Due to poor college readiness, remedial students often struggle to complete the initial attempts in their developmental courses (Hodges, 1998). Frequently, students lose motivation, which leads to their attrition and or a delay in graduation and degree completion. However, students who are enrolled and successfully pass their math developmental studies courses also pass regular college math courses (Hodges, 1998). Thus, developmental studies' impact on students' completion rates is a key concern in colleges and universities. College and universities are redesigning their developmental studies programs to address the issues that cause students to repeat courses and contribute to their attrition (Public Policy Institute of California, 2016).

In narrowing this study's focus, the researcher was interested in studying a subset of the development studies population, developmental math educators working at two-year or four-year college institutions in South Georgia. Additionally, the researcher focused on issues educators of developmental studies face, such as math anxiety, instructional anxiety, students' anxiety, college readiness, rigorous curriculum delivery, and time limits. Overall, this study examined educational strategies and practices employed to teach students struggling with math anxiety while enrolled in a developmental math course.

Research Questions

1. What are the life and career experiences of educators who teach remedial mathematics at identified post-secondary institutions in South Georgia?
2. What are the strategies used by these educators to mitigate anxiety?

3. What are the practices used by these educators to mitigate anxiety?

History of Remediation and Current Trend of Mathematics Remediation

Arendale (2002) defined developmental education as a bridge to repair students' academic preparedness gap. The phases of the evolution of developmental education are divided into six phases or eras. Arendale (2002) defined phase one as one in which education and remediation were available only for white men. Institutions such as Harvard, William Mary, and Yale were established between the mid-1600s and 1820s (Arendale, 2002). These institutions' missions and visions were related to the agricultural industry; however, access for women and minorities was limited or unavailable (Arendale, 2002). Tyack and Cuban (1995) examined how elitist policymaking was challenged to provide more access to marginalized groups. Although the official college admission policy was slated to include a diverse socioeconomic population group, admitted students were from wealthy backgrounds (Arendale, 2002).

As education is indicative of culture and political prowess, students were often admitted without satisfying the prerequisite educational standards (Arendale, 2002). Legislation such as *Brown vs. Board of Education 1954, Title I of the Elementary and Secondary Education Act of 1965,* and *Title IX of 1972 are* policies that provided more access for minorities, persons of lower socioeconomic means, and women (Tyack & Cuban, 1995). Although new standards of access were made available on both the national and state-wide levels, there was a lack of accountability or adherence to a college preparatory standard (Arendale, 2002). The issues of low college preparedness plagued the education systems until the 1970s, as examined within the *A Nation at Risk report* (Arendale, 2002; Gardner et al., 1983). With the lack of accountability and the admittance of underprepared students, there was a need to create a mechanism to equip students for the rigor of college education, thus the installation of developmental education.

Current Trends in Developmental Education

In the 1970s, policies, and bills such as the G.I. Bill (1944) and the NDEA (1958, 1964) had a tremendous impact on the enrollment of underprepared students across the nation as well as increased need for remediation (National Defense Education Act, 1958, 1964; Servicemen's Readjustment Act of 1944, 1994). The NDEA (1958, 1964) made provisions grants available for programs emphasizing STEM (Science, technology, engineering, and mathematics) and foreign languages and made loans available for students seeking degrees in the same subject matter (National Defense Education Act, 1958, 1964). Additionally, the G.I. Bill (1944) provided an alternative for unemployed veterans as a college education became an option (Gardner et al., 1944). Institutions' missions and admissions policies changed to accommodate and attract students to sustain institutions economically (Arendale, 2002). Both preparatory institutions and developmental studies programs saw an increase during the 1970s as military-aged boys and men became a targeted enrollment population (Arendale, 2002).

Developmental studies are a response to students lacking college readiness. As a result of the G.I. Bill (1944) and access to other federal funding, higher education institutions increased access to a broader population (United States War Department, 1944). Brothen and Wambach (2012) stated that during the 1960s and 1970s most of the students admitted during this period were "under-prepared," and institutions utilized stand-alone developmental (remediation) courses to address the skill deficits (p. 34).

Understanding how students are placed in developmental education is a pivotal element in understanding developmental education as a whole.

Remedial Placement in postsecondary education students' high-school grade point averages (GPAs), placement exams, and college entry exams determine remedial placement. An important placement variable would be how institutions weigh students' high school GPAs versus their placement exam scores. Students struggling with either or both test and mathematics anxiety may not fare well on the placement exams. Thus, based on the previously cited research, if students fail remedial courses and fail to graduate, they are limited by student loan debt and diminished earning power (Shields & O'Dwyer, 2017; Tobias, 1995).

Developmental mathematics courses have the "highest failure and withdrawal rates of postsecondary courses" (Acee et al., 2017, p. 2). Typically, students required to take developmental or remedial courses are categorized as "high-risk" for dropout (Hodges, 1998, p. 59). The national and local governments and higher education institutions are trying to address developmental students' persistence. Recently, higher education systems have been revamping the developmental or remedial programs within the state institutions. For example, one of the University System of Georgia's initiatives is to phase out all singular remedial course offerings and convert them to concourses across 28 institutions (University System of Georgia, 2018).

Today, many four-year institutions are discontinuing the stand-alone course in favor of the corequisite course. Sim (1995) defined corequisite as "a condition of enrollment consisting of a course that a student is required to simultaneously take to enroll in another course" (p. 2). Corequisite should not be confused with prerequisite, a course that a student must complete in meeting the baseline readiness requirement.

Standalone remedial courses serve as a prerequisite, while corequisites are courses in which students take remediation courses simultaneously with the core required course. Given that these are new interventions, questions about the effectiveness of corequisites in addressing students 'anxiety as related to students' mathematic achievement. If corequisites do not address mathematics anxiety issues, are students' achievement in the core and remedial mathematics courses negatively impacted?

The University System of Georgia's (2018) *Complete College Georgia* is an initiative of the University System of Georgia, whereby interventions related to remediation and retention efforts are being instated at several institutions within the system (University System of Georgia, 2018). The University System of Georgia (2018) reported that two-year institutions have 37% of students enrolled in learning support courses. Of that percentage of students, 57% complete learning support courses, 17% complete their gateway courses within two years, and 7 % graduate within three years. Thus, 93% of students enrolled in learning support courses at two-year institutions fail to graduate. Additionally, the University System of Georgia (2018) reported that at four-year institutions, 18% of students are enrolled in learning support courses (University System of Georgia, 2018). Of that percentage of students, 52% complete learning support courses, 35% complete their gateway courses within two years, and 25% graduate within six years (University System of Georgia, 2018). Thus, 75% of students enrolled in learning support courses at four-year institutions fail to graduate (University System of Georgia, 2018).

As previously stated, most four-year institutions discontinue stand-alone remediation courses; thus, two-year institutions have become the hub for remediation.

Students seek to complete remediation and transfer into institutions from which they complete their program of study. Thus, it is not surprising that the *Complete College Georgia* report illustrated a larger loss of remedial students for community college or two-year institutions than that of the loss at four-year institutions (University System of Georgia, 2018). The lack of retention within both types of institutions warrants investigation. The issues related to remediation are not relegated to community colleges and state institutions. As previously stated, early on in the development of higher education, Ivy League institutions such as Harvard and Yale provided remediation or developmental studies courses to support students enrolled in Greek and or Latin courses (Royer & Baker, 2018).

Remedial Mathematics and Mathematics Anxiety

Luttenberger et al. (2018) stated that anxiety disorders, overall, serve as a global mental healthcare problem. Luttenberger et al. (2018) stated some form of math anxiety affects 93% of American adults, while 17% experience high math anxiety levels (p. 312). Iossi (2007) stated that remedial students are adversely impacted by math anxiety in that 50% fail the course (Iossi, 2007). Additionally, Iossi (2007) alluded to mathematic anxiety attributing to the failure of intelligent and determined students. Iossi (2007) also encouraged teachers to mentor students with anxiety with the hopes that they could self-mitigate and manage their math anxiety.

Mathematics Anxiety and Cognition, Working Memory, and the Brain

In learning science, it is well known that “memory systems” allow students to acquire and store knowledge, as well as retrieve and utilize stored information (Driscoll, 2005, p. 288). However, math anxiety negatively impacts work memory capacity (WM), a component of the retrieval system (Ching, 2017; Suárez-Pellicioni et al., 2016). Researchers conducted studies examining WM processes correlated with math anxiety (Ashcraft & Kirk, 2001; Suárez-Pellicioni et al., 2016). Suárez-Pellicioni et al. (2016) stated that math anxiety might increase worried or intrusive thinking, limiting the WM's attention resources to process current tasks. Additionally, the issues are exacerbated by the task's complexity; thus, there is an "anxiety complexity effect" (Suárez-Pellicioni et al., 2016, p. 7).

Participants who reported having high math anxiety (HMA) or low math anxiety (LMA) were tasked with WM exercises to ascertain the impact of math anxiety on WM (Ashcraft & Kirk, 2001; Suárez-Pellicioni et al., 2016). Ashcraft and Kirk's (2001) noted that HMA individuals' WM was negatively impacted by math anxiety (Ashcraft & Kirk, 2001; Suárez-Pellicioni et al., 2016). Overall, math anxiety lowered the available WM capacity and hindered HMA individuals' current task performance abilities (Ashcraft & Kirk, 2001; Suárez-Pellicioni et al., 2016).

Additionally, individuals who experienced math anxiety had their pain region of the brain activated (Lyons & Beilock, 2012 as cited by Suárez-Pellicioni et al., 2016, p. 14). Lyons and Beilock (2012) conducted an experiment in which HMA and LMA individuals were tasked to perform numerical calculations, and HMA individuals performed poorly while LMA (control) showcased no effect (Lyons & Beilock 2012 as cited by Suárez-Pellicioni et al., 2016). Thus, individuals struggling with math anxiety may experience pain while also experiencing a lower WM capacity negatively impacting their performance or achievement. To counter such effects, Boaler (2016) examined brain plasticity and the concept of a growth mindset as being agents of empowerment for students struggling with math anxiety (Dweck, 2006 as cited by Boaler, 2016).

Three Components of Anxiety

Hadfield and McNeil (1994) proposed three interrelated factors of mathematics anxiety: environmental, intellectual, and personality factors. As a component of their study, Hadfield, and McNeil (1994) focused on personality factors. They conducted a correlational study of mathematics anxiety of pre-service teachers using the Myers Briggs personality typology. Hadfield and McNeil (1994) concluded that teachers serve as an environmental factor that may contribute to the anxiety of their students. In fact, teachers can exacerbate or increase their students' mathematics anxiety (Jackson & Leffingwell, 1999). Thus, it is very advantageous for educational institutions to devise methods to train and alleviate their educators' mathematics anxiety (Hadfield & McNeil, 1994).

Personality and Intellectual Components (Self-Efficacy and Math Achievement)

Mathematical anxiety consists of both cognitive and metacognition components. Mathematical anxiety, as defined by Tobias and Weissbrod (1980), is "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (p. 65). Schunk (2016) defined self-efficacy as a collective self-perception derived from the interpretation of experiences within a specific environment, and self-perception is reinforced by a person of significance. Self-perception includes self-esteem and self-confidence; self-esteem is an individual concept of self-worth. Self-confidence is the belief that one can accomplish or achieve (self-efficacy) (Schunk, 2016). Schunk (2016) stated that students' achievement, self-confidence, and self-esteem are interconnected. Students' achievement enhances students' self-esteem and self-confidence; conversely, students with poor achievement may struggle in the areas of self-esteem and self-confidence. These concepts are considered in relation to math for this study.

Bandalos et al. (1995) provided a foundational understanding of math self-concept and self-efficacy by examining Bandura's (1986) definitions of self-efficacy and how parents, teachers, and other peers may attribute to a student's self-efficacy (Bandalos et al., 1995; Bandura, 1986). Students' self-perceptions impacted how their perception of their abilities helped them accomplish their current math-related task. Additionally, the researchers cited Benson et al.'s (1994) findings of a positive correlation between math self-concept and students' perceived self-efficacy within their math course (Benson et al., 1994 as cited by Bandalos et al., 1995).

More recently Luo et al. (2014) examined the relationship between students' math concept, math anxiety, and achievement. The researchers examined data from a survey designed to ascertain students' math self-concept, academic goals, and self-perception. In contrast, the researchers utilized a math achievement test to collect data related to mastery and achievement (Luo et al., 2014). Luo et al. (2014) examined several attributing factors such as social comparison, parental influence, and math anxiety, and how those factors foster a self-concept that added to or hindered achievement. The results illustrated the influences of environmental factors on personality and intellectual components of math anxiety. Thus, it is important to examine math anxiety's environmental factors: parents, teachers, and peers.

Environmental Components – Teachers' Math Anxiety & Instructional Anxiety

This study's scope focused on the teacher's environmental elements of math anxiety, such as teachers' math anxiety, teachers' instructional anxiety, and teachers' beliefs (teaching efficacy). Similar to students' math anxiety, teachers' math anxiety is attributed to early negative experiences within the classroom (Geist, 2015). Additionally, Geist (2015) stated that teachers struggling with math anxiety could impact students' achievement. Teachers' math anxiety impacts instructional design and delivery, and teachers who struggle with math or instructional anxiety are subject to utilize avoidance as a means to deal with their anxiety (Geist, 2015). Teachers who are anxious about math spend 50% less time teaching (Geist, 2015; Sloan, 2010). Peker and Ertekin (2011) proposed that teachers' math anxiety is correlated to teachers' instructional anxiety (Geist, 2015; Peker & Ertekin, 2011).

Thus, teachers' math and instructional anxiety may impact instructional design and serve as a determinant contributing to students' math anxiety (Geist, 2015). Additionally, there may be a gender difference in which female students are impacted more by teachers' math anxiety than their male counterparts (Geist, 2015). Beilock et al. (2010) examined how female teachers' anxiety negatively impacted female' math achievement. Beilock et al. (2010) speculated that female students having a highly anxious female teacher confirms the stereotype about math being a male domain (Beilock et al., 2010; Trujillo & Hadfield, 1999 as cited by Uusimaki & Nason, 2004). Consequently, teachers' math anxiety impacts teachers' instructional anxiety showcases low teaching efficacy levels, and adversely impacts math achievement (especially for females).

Educators as Environmental Factors of Anxiety

In researching mathematical anxiety and interventions that address mathematical anxiety, it is important to discover the impact of instruction and the beliefs that drive instructors. Additionally, to address mathematics anxiety and create interventions it is also important to determine the role of students, the roles of instructors, and the partnership and relationship between students and instructors. Lastly, it is important to determine the role of instruction in addressing mathematical anxiety and to assist students in developing self-efficacy. The triangulation of the relationship between educators, students, and knowledge highlights educators' beliefs concerning education. Thus, it is necessary to examine educators’ connection to mathematical knowledge, their belief concerning mathematical knowledge, and educators’ relationship with students.

Educators serve as culture transmitters and create an environment conducive to learning or potentially hindering learning outcomes (Dewey, 1938; Tyack & Cuban, 1995). Theorists Dewey (1983) and Tyack and Cuban (1995) stated that the system of education has been utilized to socialize and or transmit “cultural heritage” (Dewey, 1938, p. 78; Tyack & Cuban, 1995, p. 43). As previous research has indicated, educators can exacerbate or increase their math students’ anxiety (Jackson & Leffingwell, 1999). In particular, the researchers stated that math anxiety factors included communication barriers between instructors and students for first-year college students. Overt behaviors included instructors’ verbal statements and behaviors, which hindered, limited, or halted an exchange between them and the instructor. Covert behaviors included instructors' usage of body language, verbal cues of a demeaning nature, or justifying students' non-acknowledgment and or students' questions (Jackson & Leffingwell, 1999).

In another study about teacher math beliefs, Aguirre, and Speer (2000) researched the connection between teachers' math beliefs, teachers' goals, and prioritization of goals based upon beliefs and actual in-moment teaching practices (Aguirre & Speer, 2000). The researchers examined two secondary mathematics algebra teachers. Their analysis included combining the analysis of classroom videos and personal interviews into a compiled dataset (Aguirre & Speer, 2000). Aguirre and Speer (2000) focused on beliefs and practices and goal development and prioritization. Data demonstrated that teacher goal shifting was related to teachers' math beliefs, which were hierarchical in nature (Aguirre and Speer, 2000). Given the prevalence of math anxiety, mitigating math anxiety should be a goal of math educators.

Likewise, Polly et al. (2013) studied the relationship between teachers' math beliefs, instructional practices, and student learning outcomes. Polly et al. (2013) utilized several instruments to capture data concerning teachers' beliefs, teachers' practices, teachers' mathematical knowledge of teaching, as well as student achievement measures. Overall, there was a significant relationship between teacher orientation (transmission, discovery, connectionist), instructional practices (student- vs. teacher-centered), and student achievement (Polly et al., 2013, p. 21). In particular, teachers who identified as discovery/connectionists frequently utilized student-centered instructional practices (Polly et al., 2013). In addition, student-centered approaches appear to be more effective and engaging, as well as congruent with teachers' belief

(Polly et al., 2013). Further research is needed to examine the effect of specific practices that may mitigate math anxiety.

Math Anxiety Assessments

In examining the literature concerning teachers' ability to assess math anxiety, the researcher found a number of self-report measures that students may take themselves. However, there is little data on how educational institutions train educators to assess and create interventions for students struggling with math anxiety. Ganley et al, (2019) stated that the lack of training is "due to a lack of math anxiety measures validated for use with practicing teachers" (Ganley et al., 2019, p. 1). Several assessments have been professionally developed that encompasses anxiety, content confidence, teaching efficacy, and *The Instructional Triangle's* relationships (Ball & Forzani, 2009). However, educators may not receive training on how to effectively access, utilize, and develop interventions from the use of such assessments as the following:

- Mathematics Anxiety Rating Scales (Richardson & Suinn, 1972)
- Teachers' Beliefs Questionnaire and Teacher Practices Questionnaire (Polly et al., 2013; Swan, 2007)
- Content Knowledge for Teaching Mathematics (CKT-M) (Swan, 2006)
- Mathematics Anxiety & Teaching Efficacy Survey (Sasser, 2010)
- Abbreviated Math Anxiety Scale (AMAS) (Hopko et al., 2003)
- Anxiety about Teaching Mathematics (ATM) (Sasser, 2010)
- Mathematics Teaching Efficacy Beliefs Instruments (MTEBI) (Enochs et al., 2002)

Researchers Escalera-Chavez et al. (2016) conducted a study in which mathematic anxiety was divided into additional subtopics. The subtopics included anxiety toward evaluation, anxiety toward temporality, anxiety toward understanding mathematical problems, anxiety about numbers and mathematical operations, and anxiety toward mathematical situations in real-life (Escalera-Chavez et al., 2016). A widely utilized instrument to measure mathematic anxiety is the Mathematics Anxiety Rating Scale (MARS-R) (Richardson & Suinn, 1972). Richardson and Suinn (1972) developed MARS-R in 1972; originally, the instruments had 92 items, which were utilized to diagnose and treat individuals suffering from mathematics anxiety (Yucedag-Ozcan & Brewer, 2011).

The Mathematics Anxiety Rating Scales (MARS) and the Abbreviated Math Anxiety Scale (AMAS) would allow the teacher and the student to examine their anxiety level concerning the content (Hopko et al., 2003; Plake & Parker, 1982). The Content Knowledge for Teaching Mathematics (CKT-M) is an instrument that highlights the teacher's relationship with the content and the student (Swan, 2006). The CKT-M, along with either the MARS or AMAS, could help educators determine if they struggle with either instructional or mathematics anxiety (Hopko et al., 2003; Plake & Parker, 1982; Swan, 2006). Thus, three relationships can be further assessed with the assessments mentioned above, students' anxiety towards the content, teachers' anxiety towards the content, and teachers' anxiety towards delivering the content to students. The other three instruments also are associated with the teacher-to-student relationship, as each examines teachers' beliefs and practices, efficacy, or anxiety in developing and implementing instruction to students. Students can also choose their methods of assessment. Several free assessments, along with professionally administered assessments, can be provided for students. The quick informal assessments in an underdeveloped area, as educators can use quick methods to assess and create interventions to meet their students' needs. However, educators are not encouraged or trained to use these assessments or direct students to the free assessments available; such assessments have primarily been used in research studies.

McKibben (2017) stated that teachers should avoid diagnosing students' anxiety but must be fully aware of the red flags (McKibben, 2017). McKibben (2017) encouraged educators to teach their students self-awareness of the "feel," for example, if they have an elevated heart rate (p. 4). Additionally, McKibben (2017) outlined three overall symptoms: somatic complaints, distorted cognitions, and behavior (p. 4). McKibben (2017) stated that anxious students might complain about "headaches, stomachaches, nausea, heart palpitations, light-headedness, or other physical ailments (without having an underlying medical condition)" (p. 4). Typically, these students utilize forms of avoidance and thus may have to be excused to use the restroom more often than non-anxious students (McKibben, 2017, p. 4). Anxious students may also have a distorted perception of their cognition abilities and thus focus on the possibilities of failure and overcome their perceived deficiencies through perfectionism (McKibben, 2017, p. 4).

Typically, students with fixed mindsets also exhibit some of the same avoidant traits in order to maintain their image (Boaler, 2016; Dweck, 2006). A student's desire to engage in image maintenance is negligible in the face of the opportunity to learn (Boaler, 2016; Dweck, 2006). Dweck (2006) described students with fixed mindsets as needing to be fast and perfect, while students with a growth mindset fail and learn something new (p. 24). Boaler (2016), in *Mathematical Mindsets*, stated that research showed that successful individuals made more mistakes than less successful individuals (p.13). Additionally, Moser et al. (2011) examined the brain activity for both a fixed and growth mindset individual. They found that the growth mindset brain has more activity when making mistakes (Moser et al., 2011; p. 1487). Thus, educators must encourage students to learn through mistakes and create a safe environment in which students can exercise this skill.

McKibben (2017) stated anxious students practice avoidance through frequent restroom's use (p. 4). Additionally, McKibben (2017) stated anxious students may altogether shut down and refuse to do the work of being a student (in-class participation, test-taking) (p. 4). McKibben (2017), much like Suárez-Pellicioni et al. (2016), explored how the brain of an anxious student is feeling pain and thus is in fight or flight mode (McKibben, 2017, p. 4; Lyons & Beilock, 2012 as cited SuárezPellicioni et al., 2016, p. 14). Thus, McKibben's (2017) earlier advice for educators to encourage students' self-awareness would allow students to test how they "feel" and what their bodies are saying to them (p. 4). Amy Cuddy-social, a psychologist (2012), presented a TedTalk in which she discussed how your body could change your mind. She implored anxious individuals to strike an empowering pose to get their cortisol levels down and their testosterone levels up (associated with confidence) (Cuddy, 2012). Thus, educators can encourage both relaxation (calming) techniques and empowering techniques as methods for students to self-mitigate in anxious situations.

Strategies vs. Practices

As previously stated, it should be noted that how teachers interact with math is a model for how students could potentially interact with mathematics (Ball & Forzani, 2009, Cohen et al., 2003). Teachers' beliefs and their backgrounds will impact instructional design, instructional delivery, and their ability to make themselves and the content accessible to students (Ball & Forzani, 2009; Cohen et al., 2003; Geist, 2015). Additionally, as demonstrated by the *Instructional Triangle* or more specifically *Cognitive Consistency/Balance Theory*, teachers can have a really strong connection with the content but a poor connection with students, and this can impact the students' connection with the content (Ball & Forzani, 2009; Cohen et al., 2003; Schunk, 2016, p. 344). Thus, it is important to understand that strategies include mindset, beliefs, instructional preparations, educational background, beliefs about students' ability, beliefs about teaching ability, and teachers' connection to the content. Practices are in class or direct interactions with students in which the strategies are carried out. This research may utilize the terms strategies and practices interchangeably; the researcher will clarify distinctions between the two concepts related to this study's scope.

Strategies for Teachers

Several research articles examined the root of pre-service teachers' anxiety (Finlayson, 2014, p. 99; Ganley et al., 2019, p. 16; Geist, 2015). Several studies, such as Geist (2015), examined how pre-service teachers' training provides a way to address both teachers' anxiety of content and instructional anxiety (Geist, 2015). Reflection is a key component of such training, as it allows teachers to examine and acknowledge their emotional state as they address their abilities to meet students' needs (Ganley et al., 2019; Geist, 2015). Thus, any strategies should include ways in which teachers can develop a stronger sense of self-awareness. Teachers' level of self-awareness can also lead teachers to become more aware of their students' struggles, thus, improving their empathic responses. Teachers “need to put themselves in their student’s shoes and recall how intimidating learning new math concepts can be” (Klips, 2007). Teachers' connection to the content will drive their instructional practices in the classroom.

Researchers Jackson and Leffingwell's (1999) recommendations included instructors taking an “active role in reducing performance anxiety,” which could lead to greater enjoyment for students completing math courses (Jackson & Leffingwell, 1999, p. 586). Jackson and Leffingwell (1999) suggested that instructors rely on how they overcome math anxiety with their students (p. 586). Other math anxiety-reducing strategies included: instructors’ demonstration of their enjoyment of math, providing support for students struggling with math anxiety, and creating a respectful and “psychologically safe” environment (Jackson & Leffingwell, 1999, p. 586). Additionally, instructors can offer one-on-one tutoring to ensure students’ questions are answered and provide exam reviews and exam preparation materials (Jackson & Leffingwell, 1999, p. 586). Lastly, Jackson and Leffingwell (1999) suggested that instructors seek help when they feel overwhelmed by “the teaching experience,” and offer alternative times to provide students an opportunity to test one-on-one to reduce anxiety (Jackson & Leffingwell, 1999, p.586). Several of Jackson and Leffingwell's (1999) recommendations would be considered practices; safe environment, tutoring, and exam alternatives would fit into the practices category as they are implemented within the classroom (p. 586).

Researcher Iossi (2007) provided several strategies, including:

1. Curricula strategies: retesting, self-paced learning, distance education, single-sex classes, and math anxiety courses,
2. Strategies: manipulatives, technology, self-regulation techniques, and communication.

3. Non-instructional strategies: relaxation therapy and psychological treatment (pp. 30-31).

Iossi's (2007) first two strategies are a mixture of strategies and practices. Iossi's (2007) third strategy serves as a method for students to self-mitigate their anxiety. Here are some additional ways that students can develop self-mitigating practices:

- Practice math every day (Blazer, 2011, pp. 5-6)
- Use good study techniques (Blazer, 2011, pp. 5-6)
- Study according to one's learning style (Blazer, 2011, pp. 5-6)
- Don't rely solely on memory (Blazer, 2011, pp. 5-6)
- Focus on past successes (Blazer, 2011, pp. 5-6)
- Ask for help (Blazer, 2011, pp. 5-6)
- Practice relaxation techniques (Blazer, 2011, pp. 5-6).

It should be noted that several of the researchers stated that students' ability to relax and self-regulate aids in their ability to mitigate anxiety (Blazer, 2011, pp. 5-6; Iossi, 2007). Researchers Brunye et al. (2013) evaluated four inventions for overcoming the negative emotions associated with math anxiety. The interventions included three behavioral and one nutritional to highly assist math-anxious college students (Brunye et al., 2013, p. 1). The three behavioral interventions were related to mindfulness. They required students to both focus and unfocused on their breathing as well as participate in a worry exercise (Brunye et al., 2013, p. 1). Brunye et al. (2013) utilized the *Attentional Control Theory* as the foundation for the mindfulness exercises; *Attentional Control Theory* proposed examining individuals' impairments in anxious situations (Eysenck et al., 2007; as cited by Brunye et al., 2013, p. 2). Mindfulness provides a method in which to address and alleviate anxiety; "brief bouts of mindfulness exercises (such as focused breathing) may hold promise for reducing anxious worry and enhancing test performance” (Brunye et al., 2013, p. 2). The nutritional intervention required participants to consume teas containing the amino acid l-theanine as it is “historically associated with relaxing properties” as well as the potential to enhance “e-effortful control of attention” (Brunye et al., 2013 p. 2).

Practices

Practices are implemented in the classroom and are based on an educator’s instructional strategies, which affects instruction implementation within the classroom or instructional environments. Educators are engaging in various strategies and practices in developing interventions to address their students’ math anxiety. The National Academies of Sciences, Engineering, and Medicine (2019) held a conference in which the proceedings contained research on “building capacity to meet the needs of students” (The National Academies, 2019, p. 47). Several panelists presented and promoted the reformation of instructional practices. A panelist stated that the foundation for instructional design reform is an understanding of high-quality instruction (The National Academies, 2019, p. 47). Additionally, the panelist stated that high-quality instruction included active learning components, problem conceptualization, and "student-led solution methods” (Ruschow, 2019 as cited The National Academies, 2019, p. 27). Ruschow (2019) included the Mathematical Association America (MAA) Instructional Practices Guide, and the seven themes encompassed in the “MAA’s Common Vision Project” (Mathematical Association of America, 2018; The National Academics, 2019, p. 47). The seven themes include the following:

- status quo unacceptable, (p. 48).

- less traditional lecturing and more “active learning” techniques, develop students’ communication skills, (p. 48).
- curricula development with partner disciplines, (p. 48).
- more modeling, (p. 48).
- multiple pathways, (p. 48).
- the increasing role of two-year colleges, and (p. 48).
- technology to enhance student learning (p. 48).

The current study included an examination of additional strategies and practices used to mitigate math anxiety in remedial math.

Theoretical Framework

The instructional triangle was adopted as a theoretical lens to examine remedial math instruction, strategies, and practices used by educators to mitigate math anxiety. The instructional triangle (Ball & Forzani, 2009), originally represented as bidirectional connections between teacher, student, and content, served as a tool throughout data collection and analysis to discuss connection and disconnection as related to math anxiety. This framework provided language to describe both the teacher and student perspective of remedial math instruction as interpreted from interviews, observations, and review of documents.

Instructional Triangle

Ball and Forzani (2009) examined professional development for educators and the impact it had on both strategies (teachers’ relationship to content) and practices (teachers’ relationship to students) (Ball & Forzani, 2009). Ball and Forzani (2009) stated that the “work of teaching” consists of the task necessary to help students learn (Ball & Forzani, 2009, p. 488). The following image is an illustration of the dynamics and relationships that are occurring in a mathematics learning environment. The image is an adaption of Cohen et al. (2003) *Instruction and Interactions*, which was later adapted and renamed to *The Instructional Triangle* (Ball & Forzani, 2009; Cohen et al., 2003). The researcher has adapted the image to reflect the "content" as mathematics.

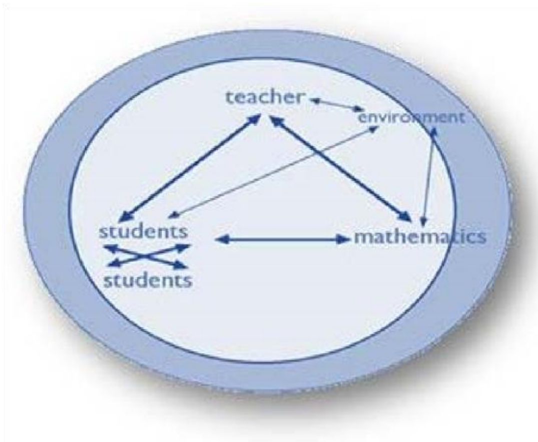


Figure 1 An Adaptation of Instruction and Interactions and The Instructional Triangle, (Ball & Forzani, 2009, p.499; Cohen et al., 2003, p. 124).,

The relationships of *The Instructional Triangle* include the following relationships: a) teacher to the content, b) teacher to students, c) student to teacher, d) student to other students, and most importantly e) student to content (Ball & Forzani, 2009, Cohen et al., 2003). For this study's scope, there will be an examination of the teacher-to-content (strategies) and the teacher-to-student relationships (practices). The teacher-to-content relationship highlights strategies defined as instructional preparations based on instructional beliefs, typically occurring outside of the classroom. More specifically, strategies entail teachers' educational background, teaching philosophy, teachers' beliefs, self-efficacy/teaching efficacy, math self-concept, and subject or teaching-related anxiety levels.

Additionally, the teacher-to-student relationship highlights practices based upon an educator's instructional strategies, which affects instructional implementation within the classroom or instructional environments. Practices include manipulatives, tools, supplemental materials, organization of content and students, and course delivery structure. Educators have various ways and environments for which to deliver content: face-to-face, online, hybrid (the combination of face-to-face and online), asynchronous, and distance learning. The mode of delivery may impact students' development of a relationship with the educator. For example, face-to-face delivery may be vastly different from online, and how students develop a relationship with their educator may also be different based on the mode of instruction delivery.

The Instructional Triangle served as the central theoretical framework for the study; as previously stated, the relationship that a teacher has with the content will impact the instructional design and delivery; thus, the relationships are interconnected (Ball & Forzani, 2009; Cohen et al., 2003). Additionally, research has shown that a teacher who experiences anxiety during their formal education may also pass that anxiety on to their students (Jackson & Leffingwell, 1999). Educators who struggle with teaching anxiety are said to teach less for depth of understanding and teach less content in shorter time frames (Geist, 2015).

Teacher-to-Content

The following are the teacher's components to the teacher to the content relationship: teachers' previous experience, mathematics anxiety, educational background, math self-concept, teaching efficacy, beliefs, instructional designs, and implementation. Teachers' beliefs, instructional design, strategies, and practices are informed by their previous experiences, math anxiety, and math self-concept level. As with the elements of students' mathematics anxiety, environmental factors serve as a component of educators' mathematics anxiety. Uusimaki and Nason (2004) examined teachers' beliefs and mathematics backgrounds and their impact on instruction and classroom practices. In essence, negative mathematics beliefs are manifestations of mathematics anxiety. Jackson and Leffingwell (1999) stated that some students have their first traumatic mathematics encounters as early as kindergarten or the first grade.

Teacher-to-Student

An educator's beliefs inform instructional design and implementation (Aguirre and Speer, 2000). Researchers Aguirre and Speer (2000) researched to ascertain the connection between teachers' beliefs, teachers' goals, and in-moment teaching practices. The researchers examined two secondary mathematics algebra teachers. The researchers analyzed classroom videos and personal interviews to compile the data set focused on beliefs, practices, and teachers' goal development and prioritization. Mathematics education literature focuses "primarily on how teachers think about the nature of mathematics, teaching, and learning" (p. 328). The teacher-to-content relationship becomes more of a priority within the classroom setting than the teacher-to-student relationship. A K-12 educator's connection to the mathematics content may differ from that of a college mathematics professor. Geist (2015) studied 31 preservice teachers who taught mathematics, but mathematics was not their area of expertise or concentration. Several pre-service teachers struggled with math anxiety; therefore, this is an area where more research is needed.

Although college mathematics educators may or may not struggle with math anxiety, they may lack an intentional focus on student-centered curriculum design and implementation. A student-centered approach is not an explicit job requirement. K-12 educators must undergo rigorous teaching training and pass teaching certification tests that support their practical teaching knowledge. Thus, students will have contrasting experiences in that they may have a teacher who struggles with math anxiety (slated to teach 50% less of the course materials) (Geist, 2015). Consequently, they may not be prepared for college education rigors wherein their educators are experts (with a strong connection to the content by possibly a minimum connection with students) (Geist, 2010).

Hughes et al. (1999) examined the teacher-student relationship as a pivotal influence on students' attachment theories as a predictive framework for students. Supportive teacher-student relationships affected students' achievement and academic motivation. The supportive teacher-student relationship's positive factors include more student exploration and curiosity, positive affect or mood, and substantial social interactions and exchanges with others.

The educator's anxiety is also a component of the teacher-to-student relationship. The delivery of instruction occurs when teachers may have to negotiate their strategies for in-the-moment practices (Aguirre & Speer, 2000). Additionally, Geist (2015) illuminated the impact of both teachers' math anxiety and instructional anxiety on instructional design and delivery (Geist, 2015). Geist's (2015) emphasized intentionality toward educator training to lessen their anxiety.

Additionally, the teacher-to-student relationship provides educators with an opportunity to create expectations and norms of instruction. In setting expectations, educators may utilize established principles such as the FISH principles that aid classroom management. Pardieck et al. (2017) explored how FISH has been utilized in educational partnerships between a school and university to address administrative turnover. Additionally, the developers of F.I.S.H., Lundin et al. (2000), have developed educators' strategies and practices "ChartHouse" that can be implemented inside of the classroom (ChartHouse Learning, 2020; Lundin et al., 2000). Some components of the ChartHouse Learning (2020) training included ways in which educators can address "bullying, disruptive classroom behavior, and poor academic performance" (ChartHouse Learning, 2020). As imagination is key, educators may take the basic FISH principles and develop interventions, strategies, and practices centered around their educational philosophy, much like what the researcher has done (Lundin et al., 2000).

Student-to-Teacher

Creasey et al. (2009) developed an instrument to assess the student-teacher relationship. The researchers utilized the instrument to assess the student-teacher relationship's factors and the impact on "positive achievement orientations, academic progress, and success" (p. 1). Overall, stronger connectedness between teachers and students resulted in better learning outcomes and achievement. Additionally, researchers reported that the students who reported feeling more connected to the instructor also reported less anxiety than their less-connected counterparts. Therefore, institutions should create programs and services that focus on deepening the connections between students, educators, and institutions.

Student-to-Student

Peers are an environmental component of mathematics anxiety (Trujillo & Hadfield, 1999). Peers can serve as a factor that increases or decreases mathematics anxiety or connectivity with the content. The University of Missouri at Kansas City created the Supplemental Instruction (SI) Program in 1973 (UMKC, 2019). The SI program is one in which peer-to-peer education has proven benefits for self-efficacy and content confidence. As stated on the UMKC website, the SI Program was created to (2019):

- Increase retention within targeted historically difficult courses
- Improve student grades in targeted historically difficult courses
- Increase the graduation rates of students

Supplemental Instruction Leaders attend courses and develop out-of-class study group sessions. Supplemental Instruction Leaders are trained to encourage other students in collaborative learning techniques, which increase students' level of ownership of the course content. Supplemental Instruction is free and voluntary; thus, students' preparedness levels vary as well as their academic backgrounds (UMKC, 2019).

Supplemental Instruction Leaders avoid re-lecturing and are not the focal point of the session. Skoglund et al. (2018) emphasized that collaborative learning allows students to learn and apply concepts while developing into active learners. Supplemental Instruction Leaders develop environments and session plans that aid in content connection and checks for understanding. Supplemental Instruction attendance data serve as a predictor of students' course completion and retention within the course. Overall, Supplemental Instruction programs improve freshmen retention and help provide support for students "at-risk" (Skoglund et al., 2018, p. 131).

Student-to-Content

Many theories of cognition, critical thinking, and knowledge acquisition explore the student-to-content relationship. Schunk (2016) cited Gagne's three learning phases: preparation of learning, acquisition, and performance, and transfer of learning.

Students traverse the three phases of attending, expectancy, and retrieval during the learning phase preparation. The acquisition and performance phases include selection perception, semantic encoding, retrieval, response, and reinforcement. Transfer of learning is the last phase in which students develop skills to cue retrieval and to generalize (transfer) the knowledge and skills they are learning Schunk 2016).

Core Concepts and Factors

The study's core concepts include the components of anxiety (intellectual, personality, and environmental). Uusimaki and Nason (2004) stated the three components of math anxiety are: intellectual, personality, and environmental (p. 370). The intellectual factors include misalignment of learning styles and curriculum delivery, student attitude, lack of perseverance or Grit, lack of content confidence in mathematical abilities, and usefulness and impact of mathematics on their everyday lives (Duckworth, 2016; Trujillo & Hadfield, 1999; Uusimaki & Nason, 2004). The personality component of math anxiety includes self-esteem, a female’s perspective of math as a male domain, and an unwillingness to ask questions (Trujillo & Hadfield, 1999; Uusimaki & Nason, 2004). The environmental components of math anxiety include parental pressure, negative classroom experiences, curriculum design, delivery rigidity, and negative teacher behaviors (Trujillo & Hadfield, 1999; Uusimaki & Nason, 2004). Additionally, *The Instructional Triangle* illustrates the relationships between the environmental factors (teacher, students, other students, content, within a mathematical environment) (Ball & Forzani, 2009; Cohen et al., 2003).

The scope of the study focused on the teachers’ environmental elements of math anxiety, such as teachers’ math anxiety, teachers’ instructional anxiety, and teachers’ beliefs (teaching efficacy). Similarly, to students' math anxiety, teachers' math anxiety is attributed to early negative experiences within the classroom (Geist, 2015). Additionally, Geist (2015) stated that teachers struggling with math anxiety could impact students' achievement. Teachers' math anxiety impacts instructional design and delivery, in that those teachers with math or instructional anxiety employ avoidance as a means for which to deal with anxiety (Geist, 2015). Teachers who are anxious about math will spend 50% less time teaching (Geist, 2015, p. 330). Peker and Ertekin (2011) stated that teachers' math anxiety is interrelated to teachers' instructional anxiety (Geist, 2015; Peker & Ertekin, 2011).

Thus, teachers' math and instructional anxiety will impact instructional design and serve as a determinant of students' math anxiety (Geist, 2015). Additionally, there is a socialization component in which female students are impacted more by teachers' math anxiety (Geist, 2015). Beilock et al. (2010) stated that female teachers with math anxiety were negatively correlated to girls' math achievement (Beilock et al., 2010). Beilock et al. (2010) speculated that girl students having a highly anxious female teacher confirms the stereotype about math being a male domain (Beilock et al., 2010; Trujillo & Hadfield, 1999; Uusimaki & Nason, 2004). Consequently, teachers' math anxiety impacts teachers' instructional anxiety, showcases low teaching efficacy levels, and adversely impacts math achievement (especially for girls).

Secondary Concepts & Factors

Cognitive Consistency Theory

In understanding *The Instructional Triangle* and its relationships, it is essential to establish that each student will connect to their instructor, other students, and most importantly, the content (Ball & Forzani, 2009; Cohen et al., 2003). *The Instructional Triangle is* underpinned by Dale Schunk's theory (2016) *Cognitive Contingency Theory*, which illustrates the variations of relationships between teacher, student, and content (Ball and Forzani, 2009; Schunk, 2016). Schunk (2016) referenced Fritz Heider's (1958) theory of Balance combined the Balance Theory with the Cognitive Consistency theory and illustrated by way of the set of triangles below (Schunk cited Heider, 2016, p. 344):

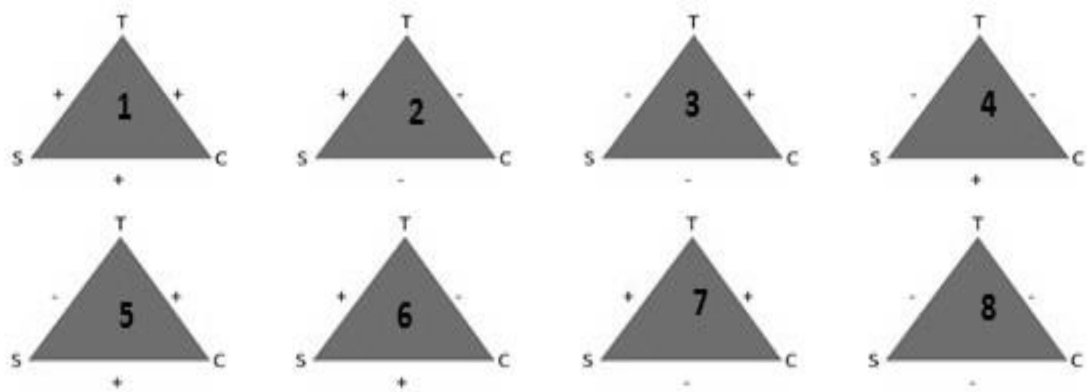


Figure 2 An Adaptation of the Prediction of Balance Theory (Schunk, 2016, p. 344).

The researcher adapted Schunk's (2016) image of the triangles by illustrating a T for teacher, an S for student, and a C for content (2016, p. 344). The triangle is very similar to *The Instructional Triangle* as depicted by Ball and Forzani (2009) and Cohen et al. (2003); however, Schunk's (2016) triangle depicts the types of relationships that could occur (2016, p. 344).

1. The first triangle illustrates a positive relationship between the teacher, student, content, and student's point of view, a positive relationship between the teacher and the content (Schunk, 2016). The teacher has a strong connection to the content and student; the triangle also depicts a strong student connection to both the teacher and content.
2. The second triangle is illustrated from the teacher’s point of view as a negative relationship with the content but a positive relationship with the student; from the student’s point of view, there is also a positive relationship between the teacher and a negative relationship to the content (Schunk, 2016). The teacher has a weak connection to the content and a strong connection to the student; the triangle depicts a strong student connection to the teacher and a weak connection with the content. What effect does the teacher’s relationship with the content has on the student’s relationship to content?
3. The third triangle is illustrated from the teacher’s point of view having a positive relationship with the content but a negative relationship with the student; please note from the student’s point of view there are negative relationships with the teacher and the content (Schunk, 2016). The teacher strongly connects to the content but has a weak connection with students; students have weak connections with both the teacher and the content. What is the effect of the teacher-to-student relationship on the student on the content relationship?
4. The fourth triangle illustrates that the teacher has a negative relationship with both the student and the content; please note that the student has a negative relationship with the teacher and a positive relationship with the content (Schunk,

2016). The triangle depicts a weak connection between teacher and content and teacher and student. Additionally, there is a weak relationship between the student and teacher and student and content. What factors help the student overcome their negative relationship with the teacher to have a strong connection to the content (prior learning, level of self-efficacy, and content confidence)?

5. The fifth triangle illustrates that both the teacher and the student have a positive relationship with the content. However, the teacher and the student have a negative relationship with each other (Schunk, 2016). What is the teacher's connection to content and the student's connection to content?
6. The sixth triangle illustrates that the teacher has a positive relationship with the student and a negative relationship with the content; however, the student has a positive relationship with both the teacher and the content (Schunk, 2016). What are the factors of the teacher-to-student relationship that affect the student-content relationship?
7. The seventh triangle illustrates a positive relationship between the teacher and content, while the student has a positive relationship with the teacher but a negative relationship with the content (Schunk, 2016). What are the factors of the teacher-to-student relationship that affect the student-content relationship? Does the student-content relationship have an impact on achievement or self-efficacy?
8. The eighth triangle illustrates a negative relationship between the teacher, student, and content, and a negative relationship between the student, the teacher, and the content (Schunk, 2016). What are the factors of the teacher-to-student relationship that affect the student-content relationship?

Overall, the study's purpose was to ascertain the effect of anxiety on the different teacher environmental elements or relationships of *The Instructional Triangle* (Ball & Forzani, 2009).

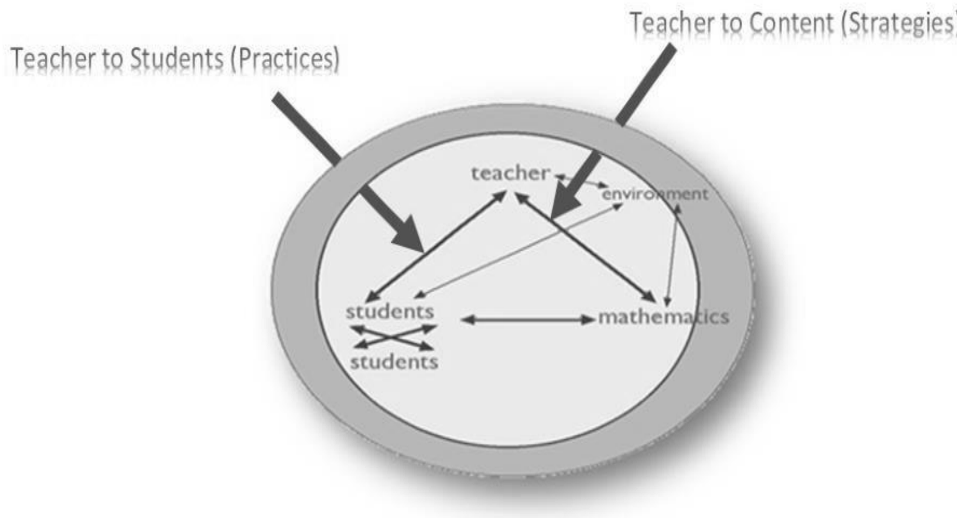


Figure 3 Purpose of Study Adaptation of The Instructional Triangle (Ball & Forzani, 2009, p.499; Cohen et al., 2003, p. 124)

Summary of Methodology

The researcher employed a case study design to discover which strategies and practices educators used to mitigate math anxiety when teaching remedial students. Using a grounded theory approach, the researcher utilized the findings to propose an adaptation of the instructional triangle, which accounts for both educator and student perspectives. The data collection required the inclusion of several sites with several educators surveyed, interviewed, and observed. The study was suited for a multiple-embedded case study design. The researcher gained institutional approval for each of the participant sites and gained permission from the Mathematics Department Administrators at each institution.

The researcher then sent remedial mathematics educators an invitation email. The purpose of the research study was thoroughly explained, and informed consent was solicited from each participant. The invitation email contained a link to the survey and an instructor's code. The code was utilized to help maintain confidentiality throughout the process. The researcher utilized the instructor's code when collecting data to ensure that the survey, interview, observation, and document data were connected in association with each participant.

The invitation email also informed the participant of the study's interview and observational components. Each participant had a total of two interviews and each participant was observed twice throughout the study. Lastly, the researcher collected any pertinent documents and or supplemental materials that characterized the educator's relationship to content (strategies) and or their relationship to students (practices) when delivering mathematics instruction. Using multiple data sources helped to triangulate findings for the study. The researcher organized, coded, and summarized themes that emerged from the data. Data were analyzed to answer the following research questions:

1. What are the life and career experiences of educators who teach remedial mathematics at identified post-secondary institutions in South Georgia?
2. What are the strategies used by these educators to mitigate math anxiety?
3. What are the practices used by these educators to mitigate math anxiety?

To examine remedial math instruction, as well as strategies and practices used by educators to mitigate math anxiety, the following theoretical lens was adopted. The *Instructional Triangle* (Ball & Forzani, 2009), originally represented as bidirectional connections between teacher, student, and content, served as a tool throughout data collection and analysis to discuss connection and disconnection as related to math anxiety. This framework provided language to describe both the teacher and student perspective of remedial math instruction as interpreted from interviews, observations, and review of documents.

In the following chapter, the researcher has outlined the methods used to answer the research questions. In particular, the sites, sample selection, data collection, data analysis, and reporting methods are described. Additionally, the researcher has included a method of establishing trustworthiness and generalizability through several methods within the research design.

Chapter III

METHODOLOGY

Problem

Math anxiety is very prevalent and poses a barrier to successful completion of mathematics courses necessary to graduate from college. Approximately 80% of community college students and 25% of four-year college students taking mathematics courses struggle with moderate to high math anxiety (Beilock & Willingham, 2014). Additionally, 67% of two-year and 44% of four-year students are remedial non-completers "no degree and not enrolled" (Chen, 2016, p. 35). Math anxiety is a barrier to math performance, remedial math instruction should be examined for mitigating factors.

Purpose

To further understand how to mitigate the role of math anxiety in college student math performance, this study focused on remedial math instruction. The purpose of this study was to determine the strategies and practices to mitigate math anxiety used by educators who teach remedial mathematics courses at identified postsecondary institutions in South Georgia. Based on the literature, students in remedial mathematics are likely to experience moderate to high math anxiety and are unlikely to graduate.

Research Questions

1. What are the life and career experiences of educators who teach remedial mathematics at identified at post-secondary institutions in South Georgia?

2. What are the strategies used by these educators to mitigate anxiety?
3. What are the practices used by these educators to mitigate anxiety?

Significance of Study

Mathematics anxiety has been examined as a factor in students' mathematics achievement (Beilock, et al., 2010). Mathematic anxiety is comprised of a number of environmental factors that serve as components for anxiety (peers, parents, and teachers) (Uusimaki, & Nason, 2004). Jackson and Leffingwell (1999) reported that teachers can exacerbate or increase anxiety in their students. Currently, there is a gap in research as it relates to the effect of anxiety on remedial mathematics students. However, the rates of low completion rates of remedial mathematics and graduation rates prompts legislation, education systems, and educators to examine all possible factors. As reported by the *Complete College Georgia*, 93% of two-year and 75% of four-year students enrolled in learning support/remediation fail to graduate (University System of Georgia, 2018). The purpose of this study was to determine the strategies and practices used by educators who teach remedial mathematics students with math anxiety who are at risk of course failure at identified postsecondary institutions in South Georgia. The study may have value for educators at any level as they may develop and implement instruction to address anxiety.

Additionally, the study merges discoveries of math anxiety with the application of curriculum changes to adjust and update instructional practices. Particularly, institutions of higher education and their pedagogical programs and classes may apply the findings of this study to help the retention and matriculation of students. Increased retention and graduation rates could increase revenue, allowing institutions to increase hiring opportunities, course and degree offerings, and student financial aid access (Broton, 2019).

Rationale

Qualitative research complements quantitative research in that qualitative research humanizes and brings the researcher closer to the actual place of study. The researcher becomes an integral part of the study and must create safeguards to ensure that bias (influence) is accounted for by the researcher and the subject (Maxwell, 2013, p.124). Qualitative research allows the researcher to “address a research problem in which” the researcher does not know all of “the variables needed to explorer” (Creswell & Gutterman, 2019, p. 16). The current research problem and examination of mathematics anxiety from within the context of practices and strategies enacted within the classroom have several variables to explore. The number of variables and or factors that influence or impact students’ mathematics anxiety levels are numerous. Several personalities, intellectual, and environmental factors comprise students’ mathematics anxiety (Uusimaki & Nason, 2004). Thus, a qualitative design gave the researcher a broader plan to approach the problem and discover solutions or interventions. Additionally, mathematics anxiety is not a student’s problem alone. Educators are confronted with the need to make instructional adjustments in addressing the issues associated with mathematics anxiety.

Additionally, a qualitative research design allowed the researcher to examine problems wherein the literature has not provided an adequate range of solution options or a thorough enough understanding of the phenomenon (Creswell & Gutterman, 2019,

p. 16). Qualitative research includes such research designs as case studies, grounded theory, phenomenological, ethnographic, and narrative analysis (Downey, 2016, p.2). Qualitative research design provides a structure or configuration that allows the researchers to pose questions, search out answers, examine problems, and propose solutions. The differences among qualitative research types may seem subtle in some cases but are substantial in differentiating designs and results.

One example would be the differences between case studies and phenomenological models; phenomenological designs are unique for phenomena with specific parameters designated for a particular population. In thinking about case study designs, they have more generalizability than phenomenological designs. Phenomenological research design primarily allows the researcher to focus on the phenomenon and not the individual experiencing the phenomenon (Downey, 2016, p.4). The case study design moves beyond just examining the problem but to examining a problem within its context (Downey, 2016, p. 7). The case study design requires the researcher to conduct an in-depth collection of data including "(documents, artifacts, and interviews)" about all aspects of the system being studied (Downey, 2016, p. 7).

Additionally, ethnographic models may include more cultural aspects and utilize either the emic or etic points of view, depending on how the researchers position themselves within the study. When researchers are "outside of the experience" (researcher relaying what the participants said or did as an observer), this is the etic viewpoint (Creswell & Gutterman, 2019, p. 483). Conversely, when the researcher takes on the position of "being inside" (relying on what the participants said or did from within the experience), this demonstrates the emic viewpoint (Creswell &

Gutterman, 2019, p. 483). The emic points of view embed the researcher more into the experience, and he or she no longer acts as just an observer but becomes a co-participant with those within the sample population (Creswell & Gutterman, 2019, p. 483).

A difference between qualitative and quantitative research is that qualitative is emergent, and the design has a little more fluidity and flexibility and can account for changes within the study. Quantitative research design is a little more rigid, and perimeters are established at the beginning of the study (Patton, 2002, p. 40). Both research methodologies require reliability or validity tests. There are guidelines for checking internal, and external validity, and reliability (to ensure that results are trustworthy even if they cannot be generalized to a large population) (Maxwell, 2013, p. 79).

Joseph Maxwell (2013) provided an example in which the researcher can confidently collect data to answer the research questions. Still, the answers are specific to the sample as they represent a "case" (p.79). Thus, the case study design allows the researcher to gather answers for problems specifically related to the elements of being in a specific sample, even if that sample is a subset of a larger population. For instance, a college mathematics teacher at a specific institution will provide specifications for that teacher within that institution's context. If that same teacher also worked at a different institution, data would show variation as the teacher works within two different contexts. The individual is still a teacher within the structure of two college environments; however, his or her experience serves as a case within each given environment or context and may not be generalizable to all of the participants within the sample or population of college mathematics teachers.

Another example of the differences between quantitative and qualitative is the sampling guidelines or requirements. In quantitative research design, such as experimental, the population must be random for a true experimental design (Ary et al., 2014, p. 292). Purposeful sampling methods may result in the researcher creating a code as a way to which to assign a given population (Ary et al., 2014, p. 169). Additionally, the types of data collected have to speak to an individual design. Several quantitative models are configured such that researchers are required to utilize ratio data. Simultaneously, other designs are set up such that researchers may have some restrictions on the usage of categorical data (Ary et al., 2014, pp. 113-15).

Research Design

Grounded Theory Approach

The researcher employed a combined qualitative design of grounded theory and a case study design. Ary et al. (2014) defined grounded theory design as a method by which a researcher can develop a theory concerning a social phenomenon based on the data collected (Ary et al., 2014, p. 33). The theory development was inductive and emergent from analyzing research questions and findings (Ary et al., 2014, p. 33). For this study, the theory was developed from the exploration of the relationships of *The Instructional Triangle* (teacher to content, teacher to student, student to teacher, student to peer, and student to content) (Ball & Forzani, 2009, p. 499; Cohen et al., 2003, p. 124). Although this model guided the data analysis, an interactive coding process was utilized to create a theory specific to the phenomenon of remedial math instruction in addressing math anxiety. Lastly, as the study's basis in examining connections and disconnections of the relationships, the theory developed proposes a mechanism to assess connections and disconnections in developing strategies and practices to mitigate mathematics anxiety within the classroom.

Theory Influences Over Design Choice

Yin (2018) stated a need to have a theoretical framework to decide about site selection, sampling procedures, data collection, and data analysis processes. Yin (2018) proposed that the theoretical framework can be simple or complex but that a literature review equipped the researcher to make such a decision. The following theories provide the range of types of theoretical frameworks (Yin, 2018, pp. 36-7):

- Individual theories – for example, theories of individual development, cognitive behavior, personality, learning and disability, individual perception, and interpersonal interactions (pp. 36-7).
- Group theories – for example, theories of family functioning, informal groups, work teams, supervisory-employee relations, and interpersonal networks;
- Organizational theories – for example, theories of bureaucracies, organizational structure and functions, excellence in organizational performance, and interorganizational partnerships; and (pp. 36-7).
- For example, social justice theories include housing segregation, international conflict, cultural assimilation, uneven access to technologies, and marketplace inequities (pp. 36-7).

The researcher used more of the individual theories within a group theories framework. Thus, cognition and anxiety-related theories are individual theories. However, the group aspect is the lens of relationships displayed within *The Instructional Triangle* (Ball & Forzani, 2009). What factors of anxiety and cognitive development impact the teacher's relationships to the student or the student’s to content relationships? Researching the effect of teaching strategies and practices on students struggling with mathematics anxiety is a combination of several individual theories. For instance, mathematics anxiety has three components (intellectual, personality, and environmental).

All three mathematics anxiety components were examined, emphasizing environmental factors (peers, parents, and teachers). For this study's scope, examining the teacher's environmental factor served as the element for selecting the theoretical framework. This study's theoretical framework was *The Instructional Triangle,* which illustrates the following relationships teacher to content, teacher to student, student to teacher, student to other students, and student to content (Ball & Forzani, 2009). The examination of the relationships of *The Instructional Triangle* was expounded on through Schunk’s (2016) illustration of the eight different types of *Instructional Triangles* that can occur in any given course environment (Ball & Forzani, 2009; Schunk, 2016).

Educators and students construct meaning from each of the relationships depicted within *The Instructional Triangle* (Ball & Forzani, 2009). Constructivism served as the foundation of understanding *The Instructional Triangle* and the different types of relationships that can occur within the classroom are depicted by the *Cognitive Consistency Theory* (Ball & Forzani, 2009; Schunk, 2016). The researcher used a qualitative design with a multiple-embedded case study structure. The multiple-embedded case study structure is an idea for conducting interviews and observations at multiple institutions with multiple educators. The multiple-embedded case study method allowed the researcher to collect data to answer the research questions.

Case Study Research

This research used a case study design. Robert Yin (2018) made a distinction between case study research, case studies, and case(s); case study research mode of inquiry, case studies method of inquiry, and case(s) the unit of inquiry (p. xx). Yin (2018) examined the elements as a trilogy and exemplified the concepts in the following manner: "social science research is experimental (method), experiments (methods) and subjects (units); or survey research (mode), surveys (method), and respondents (units); or historical research (mode), histories (method), and human events (units)" (Yin, 2018, p. xx). Yin (2018) established the relationship between case study research and qualitative research by examining the methods of selecting case studies as the method of inquiry.

Yin (2018) provided three criteria in the selection of case study research (p.2):

1. Main research questions are "how" or "why" questions (p.2):
2. Little or no control over behavioral events (p.2):
3. Focus of the study is contemporary (as opposed to entirely historical) phenomenon – a "case" (p.2):

In making the selection of utilizing case study research as the method, the current study does have elements of how or why. Additionally, the study aligned with the case study method. The research questions posed concerning what strategies and practices are educators utilizing when teaching students with moderate to high mathematics anxiety? Additionally, the researcher had little or no control over the observable behavioral events, and the research was to speak to a present gap within the literature. The questions were what strategies and practices are utilized in addressing students with moderate to high mathematics anxiety, and how (why) they were acquired through interviews and observations.

Explanatory Descriptive, and Exploratory Case Studies

Yin (2018) defined three different types of case study research: explanatory case studies, descriptive case studies, and exploratory case studies (p. 9). Explanatory case studies are defined as “a case study whose purpose is to explain how or why a condition came to be (e.g., how or why some sequence of events occurred or did not occur)” (Yin, 2018, p. 287). Descriptive case studies are defined as “a case study whose purpose is to describe a phenomenon (the “case”) in its real-world context” (Yin, 2018, p. 286). Lastly, exploratory case studies are defined as “a case study whose purpose is to identify the research questions or procedures to be used in a subsequent research study, which might or might not be a case study” (Yin, 2018, p. 287). Examining what, why, and how strategies and practices are implemented in addressing students struggling with mathematics anxiety is exploratory. For instance, each educator did not utilize the same instructional design (strategies) nor implement the same practices when addressing their student participants.

Types of Case Study Designs

Yin (2018) described four different case study designs (2018, p. 48): The researcher considered two of the four designs; the single case study (holistic-single unit analysis) and the multiple case design (holistic single unit analysis). The single case study design is exhibited by one case embedded within one context (Yin, 2018, p. 48). The multiple-case design has several cases within their respective contexts (Yin, 2018,

p. 48). The research design is one in which three different institutions served as the sites for collection with one to three participants at each institution; thus, both the single and the multiple-case designs seem suitable for the design (Yin, 2018, p. 48). As data was analyzed across all cases, the single case design was utilized for this study.

Settings

Currently, there are 22 colleges within the Technical College System of Georgia (TCSG, 2018). The University System of Georgia is a merging and changing system; however, there were 15 colleges categorized as two-year institutions (University System of Georgia, 2018). The University System of Georgia has categorized nine of those institutions as "state" institutions and has reassigned each one as a four-year institution (University System of Georgia, 2018). The study sites were chosen to provide data from the various types of institutions within South Georgia. The current site criteria requirements included accreditation, two-year, technical college or four-year higher education institution, accredited, institutional status, with course offerings of remedial or development studies mathematics during the time of the study.

Community College

The liberal arts institution was more than 100 years old established through legislation and has undergone many reorganizations throughout its history. The multi-campus institution served a population of more than 8000 dual enrolled, online, traditional, and non-traditional students. The student population consisted of approximately sixty percent female to approximately forty percent male. Additionally, the population was approximately 40% White, 40% Black or African American, six percent Hispanic, and six percent other minorities. The college offers 27 Associate of

Arts or Associate of Sciences degrees and served as a bridging institution. Most students attended to gain their requisite core requirements and then transfer to other institutions to complete their studies.

State Institution

The state institution enrollment was more than 4000 students from various parts of the state. The state institution was a residential campus and can house up to over 1400 residents. The state institution offered 30 degrees, including Associate of Sciences, Associate of Art, and Bachelor of Science. The core curriculum included quantitative reasoning and mathematics modeling and or college algebra. Obtaining instructional approval required the researcher to establish a report or relationship with the gatekeepers at each institution.

Regional Institution

The regional institution site had an enrollment size of a little more than eleven thousand. There were a little over eight thousand undergraduate and a little over 2500 graduate students in attendance. The site offered 64 undergraduate majors, 44 master's degrees, seven educational specialist's degrees, and six doctorates in education. The institution had been reorganized over the 100+ years of existence, including the populations that were served by the institution. Since mathematics was a core course that was a requirement of most major degrees, most enrollees will have to take some form of mathematics. Mathematics course offerings were separated into "mathematics for nonmajors" and "mathematics for majors." Mathematics for non-major courses was designed differently and met different mathematic requirements for the program of study. For instance, statistics for non-majors was designed to test for different competencies than statistics for majors.

Role of the Researcher

The researcher's role was to examine the literature to discover a gap or further examine a significant problem for the researcher and the field. The researcher was then responsible for gaining knowledge of research designs and determining the most suitable design for the study. After which, the researcher decided on site selection, sampling strategies, data collection and analysis, and ethical responsibilities to ensure the participants' protection. The researcher was responsible for ensuring the validity and reliability of the practices throughout the conceptualization, design, implementation, analysis, and reporting of the data to provide answers that served to fill the knowledge gap related to the problem.

The internal work of both the researcher and participants informed external processes underway in executing the research protocol. In other words, the internal work of discovering where and how the researcher fits into the story and if the researcher was actually in the story or just helping give voice to the participants. The researcher examined the why, how, who, and what, and examined the blinders or biases that may impact the research project's validity or reliability. Thus, a level of self-awareness about maintaining the research protocol to its truest form while fully acknowledging the limitations was pivotal for the researcher.

The greatest challenge is not knowing what is unknown. The research can be an isolating journey; however, to tackle the new problem, the researcher must seek connections that deepen the understanding of the problem, people, and answers in a more meaningful way. Throughout the research, the researcher had a deep and expanded understanding that solutions are found through connections. Thus, throughout the process, the researcher's role will be to safeguard the voices and stories that emerge while implementing trustworthy procedures that will yield reliable results. Such results can impact teachers and students who seek to thrive in mathematics courses, graduate college, and build a life beyond college. Additionally, the researcher used knowledge about the population when making decisions for sample selection.

Purposeful Sampling Techniques

The researcher utilized purposeful sampling for participant selection. Creswell and Gutterman (2019) defined purposeful sampling as the method that a researcher uses to "intentionally select individuals and sites to learn or understand the central phenomenon" (Creswell & Gutterman, 2019, p. 206). Several subtypes of purposeful sampling are available: maximal variation sampling, critical sampling, extreme case sampling, homogeneous sampling, opportunistic sampling, confirming/disconfirming sampling, typical sampling, and theory or concept sampling (Creswell & Gutterman, 2019, p. 207). Several sampling methods are used after the research data collection stage is underway, such as opportunistic, snowballing, or confirming/disconfirming sampling methods (Creswell & Gutterman, 2019, p. 208).

Maximal variation is a sampling method that allows the researcher to sample based upon the variance of one or several particular traits and or characteristics (Creswell & Gutterman, 2019, p. 208). Some examples of different traits and or characteristics may include race, socioeconomic background, educational background, and beliefs, to list a few. The typical sampling method allows the researcher to sample individuals and or sites that are "typical" or "normal" central to the studied phenomenon (Creswell & Gutterman, 2019, p. 208). Theory or concept sampling allows the researcher to sample individuals or sites that allow for discovering different theories within the researcher's theoretical framework (Creswell & Gutterman, 2019, p. 208). The researcher needed to identify or clarify the concepts of the existing theory and emergent theoretical concepts. Maximal variation is suited for the study participant selection; as there is a general criterion (full-time or part-time, taught remedial or developmental education, and bachelor's in mathematics or master in Higher Education or related degree from accredited institutions)

Sample Size

In examining the number of needed participants, the researcher utilized Creswell and Gutterman (2019) guidelines. The researcher did obtain an in-depth understanding of the site and participants; thus, the researcher maintained a manageable sample size to ensure that understanding is maintained (Creswell & Gutterman, 2019, pp. 209-210). In the case of studies, the availability of participants who match the study's criteria may be limited. For example, if the study criterion included characteristics such as male African American and President of the United States, currently, there is only one individual who matched the study criterion.

Conversely, for the study's scope, participants must be part-time, or full-time mathematics educators at one of the three selected higher education institutions in South Georgia. The inclusion of three sites enhanced the researcher's ability to maintain a manageable size while also providing an opportunity to understand the educators' strategies and practices. The institutions' selection was based upon the data outlined in the University System of Georgia's (2016) *Complete College Georgia*: *Transforming Remediation* (University System of Georgia, 2018).

As the study participants had to meet a predetermined criterion, this is a form of purposeful sampling. Purposeful sampling is suited for this study in that the first criteria is a limit. Participants were part-time or full-time educators at community, two-year, or four-year institutions within South Georgia. The second criterion required participants to teach remedial, developmental, or learning support mathematics. As an embedded requirement or as a by-product of their employment status, each participant had a minimum requirement of a bachelor’s degree in mathematics or accrediting certification such as a master’s degree or higher in Education.

Participants

The researcher interviewed six participants, three participants at a liberal arts college, two at a state college, and one at a four-year university. Each of the participants has taught or will teach either a particular course offering of remedial mathematics, concurrent core (course credit portion), or concurrent remedial (remediation component) course during the 2019-2020 academic year. The demographic characteristics of the participants are illustrated below:

Table 1: Demographic Characteristics of Participants

Pseudo Name	Ethnic	Gender	Group Type of Courses	Types of Environments	Years of Teaching Experience	Education
Brenda	CA	Female	Single	k-12, College	9	Masters
Harry	CA	Male	Single	Middle, High, College	2	Bachelors
Sarah	CA	Female	Concurrent /core	5, 7-12th grades, College	20+	Masters
LeAnn	CI	Female	Concurrent /core	High school, online, college	19	Masters
Penny	CA	Female	Concurrent /core	College	20	Masters
Joy	AA	Female	Concurrent /remedial	k-12, online for profit, College	30+	ABD

Note. AA=African American; CA =Caucasian, CI=Caucasian Immigrant

Data Collection

The researcher collected data via instructor's survey, interviews, observations, and documents (See Appendix B). Creswell and Gutterman (2019) provided some guidelines and examples for collecting each type of data. In conducting observations, a researcher will need to decide whether to conduct the observations as a participant or non-participant observer (Creswell & Gutterman, 2019, p. 213). Interviews were audio-recorded and transcribed. The researcher utilized the Mathematics Classroom Observation Protocol for Practice (MCOP2) to conduct the observations and later uploaded the data into a database for comparison (Gleason et al., 2017). Instructors shared documents from the course for context.

Interviews

Creswell and Gutterman (2019) stated that structuring, recording, and memoing are components of the interview protocol. Creswell and Gutterman (2019) defined interview protocol as an instrument that "serves the purpose of reminding you of the questions and provides means for the process of the interview, the questions to be asked, and space to take notes of responses from the interviewee" (Creswell & Gutterman, 2019, p. 226). Irving Seidman (2006) examined the three-part interview series focusing on the first interview on life's history, the second the detailed experience, and the third on how the participants make meaning of their experiences (Seidman, 2006, p. 17).

The researcher adapted the three-part interview to be a two-part interview. The two-part interview allowed the researcher to collect depth of experience from the interviewees. For this study, there was a two-part interview, with the history interview being the first interview. The history interview was used to provide data for RQ1: What are the life and career experiences of educators who teach identified remedial mathematics students with moderate to high math anxiety at identified postsecondary institutions in South Georgia? As Seidman (2006) outlined, the second interview provides data and details concerning an interviewee's experience (p. 18). Seidman (2006) stated that this interview allows the researcher to "put their experience within the context of the social setting" (p. 18). Data from the second interviews were used to answer RQ2: What are educators' strategies? and RQ3: What are the practices used by educators?

Seidman (2006) admonished researchers to stick to the structure of the three interviews. For this study's scope, two sixty-minute individual interviews served as methods to collect data on history and details of experience (Seidman, 2006, pp.178).

However, as the researcher also observed each participant, the two-part interview was the best option. Lastly, the two observations reflected a demonstration of meaning in discovering educators' strategies and practices while teaching students struggling with moderate to high mathematics anxiety.

Observations

Creswell and Gutterman (2019) classified observation as unstructured data in that the researcher will collect data through documentation (field notes), visual representation, and (drawings and or photos). They defined observation as the "process of gathering open-ended, firsthand information by observing people" (p. 214). Some of the advantages of observations included capturing the actual behavior within the content. The researchers did overcome vocalization/verbalization issues related to age or ability (p., 214). The disadvantages of observation are limitations due to access and possibly the limited ability to build a "rapport" with participants (p. 214). Observations required that the researcher have "good listening skills," and the researcher had to be detailed-oriented as this ensures good data collection (p. 214). The researcher also had to be able to "manage" situations, including but not limited to participant's deception (p. 214).

Creswell and Gutterman (2019) outlined the possible roles that the researcher maintained while observing, the participant-observer or nonparticipant observer (pp. 214-15). For this study's scope, it was beneficial for the researcher to be a participant-observer in that this allowed the researcher to understand the role of the educator. Most importantly, the participant-observer role allowed the researcher to understand how students implement an educator's instructional practices. In the participant-observer role, the researcher did not interrupt the class's flow; instead, the researcher followed the instruction by taking the same notes and problems that the students were given during the observation time frame.

The researcher employed the *Mathematics Classroom Observation Protocol for Practice* (MCOP2) for classroom observations (Gleason, Livers, & Zelkowski, 2017). Gleason, Livers, and Zelkowski (2017) developed the protocol to measure “the practices within the mathematics classroom for teaching lessons that are goal-oriented toward conceptual understanding” (Gleason, Livers, & Zelkowski, 2017, p. 3). The protocol was based upon standardization practices and documentation as outlined by the following authorities: National Council of Teachers and Mathematics, American Mathematical Association of Two-Year Colleges, Mathematical Association of America, Conference Board of Mathematical Sciences, National Research Council, and National Governors Association for Best Practices of the Council of Chief State School Officers (Gleason, Livers, Zelkowski, 2017, p. 3).

The protocol has *The Instructional Triangle* or *Instruction as Interaction* as the theoretical framework (Ball & Forzani, 2009, p. 499; Cohen, Raudenbush, & Ball, 2003). The protocol allowed the observer to examine the interactions between the relationships of *The Instructional Triangle* (teacher to content, teacher to student, student to other students, student to teacher, and student to content) (Ball & Forzani, 2009, p. 499). Gleason et al. (2017) expanded the theoretical framework on the relationships of *The Instructional Triangle* to discover the classroom practices that facilitate the teacher-student engagement throughout the class (Ball & Forzani, 2009, p. 499; Gleason et al., 2017, p. 3). The protocol elements are categorized as “lesson implementation” and indicate educational strategies and practices (Gleason et al., 2017,

p. 3). With the use of the protocol, the researcher examined educators as facilitators who empower collaborative learning among peers, critical thinking, and communication (Gleason, Livers, & Zelkowski, 2017, p. 4).

Documents

Creswell and Gutterman (2019) defined documents as “public or private records that qualitative researchers obtain about a site or participants in a study and can include newspapers, minutes of meetings, personal journals, and letters” (2019, p. 223). The scope of this study documents included any useful documents that informed the participants’ strategies and in-class practices as a remedial mathematics educator. Such documents included educational philosophies, vitae/resumes, job descriptions, course descriptions, textbooks, supplemental materials, syllabi, assignments, tests, and in-class exercises. Additionally, documents included feedback to students, feedback from students, video lessons (that can be transcribed), lesson plans, and classroom presentations (PowerPoints). Participants were permitted to submit student evaluations, tips for students, common generalized/specific communications with students, personnel evaluation, self-evaluation, and presentation (locally or nationally).

Creswell and Gutterman (2019) reported the benefits of using documents such as text-based data, in the language of participants, and analysis-ready (p. 223). The disadvantages of document data include issues related to accessibility, such as document data unavailability to the general public or inaccessible archived data (p. 223). Additional issues that can occur with document data collection include those related to the researcher's travel, such as time and expenses (p. 223). Document data could also be “incomplete, inauthentic, or inaccurate” (p. 223). The various text types such as “handwritten, typewriter typed, computer typed” could have issues related to each type (Creswell & Gutterman, 2019, p. 223). There may be issues related to the type of text; for example, handwriting could have errors and can be difficult to read. Conversely, typewriter text is unavailable electronically, so there may be missing pages or writer errors. Lastly, computer-typed issues may have typewritten text issues such as unavailable electronically, missing pages, or writer errors.

Creswell and Gutterman (2019) provided six steps to collect document data (2019, p. 224):

1. Identify the types of documents that can provide useful information to answer your qualitative research questions.
2. Consider both public (e.g., school board minutes) and private documents (e.g., personal diaries) as sources of information for your research.
3. Once the documents are located, seek permission to use them from the appropriate individuals in charge of the materials.
4. If you ask participants to keep a journal, provide specific instructions about the procedure. These guidelines might include topics, format, and the length of entries.

For the study's scope, the researcher asked for any documents or supplemental materials utilized to implement a lesson, such as but not limited to PowerPoint presentations, study guides, homework assignments, and mock tests. Each document is an example of an educator’s strategies. The instruction or the usage of the documents become examples of the educator’s practices. Thus, if an educator developed a PowerPoint and the PowerPoint has embedded video, voice recording, practice problems, hints, and strategies for students, these examples serve as vehicles for delivering the educator's strategy.

Data Storage

The instructor's survey data is stored on the study's host site's secured server within the Qualtrics system. Data was exported to a password-protected electronic file also on a secured One Drive service. All interviewers were audio-recorded on a digital device. The electronic file was uploaded to a secure device and sent to a transcription service. The transcriptionist completed the CITI certification training. The audio file is stored in a password-protected cloud service. Observations were recorded digitally; the researcher uploaded an electronic file to a secured storage device.

Additionally, the observation data was organized by utilizing a Google form to streamline the data into an Excel format. The audio file was sent to a transcription service and deleted from the digital device. Physical copies of interviewers, observations, and document data were either 1) stored within a locked cabinet or 2) kept on the researcher's person. All electronic data is password protected. The data will be kept the customary seven years after use and then destroyed.

Coding and Data Analysis Procedures

The researcher utilized available, selective, and axial coding methods to code each interview for underlying concepts (Merriam et al., 2002, pp. 148-9). The researcher grouped codes related to each RQ. Thus, the researcher discovered connections and themes of "connections" and "disconnections" within strategy and practice development and employment. The coding process allowed the researcher to discover each educator's perspective-taking ability within a mathematic environment. Data analysis happened concurrently with data collection. Thus, the researcher employed the method wherein the survey, interview, and observation data were collected from each participant. The researcher had the interviews, and observations data transcribed and read and reviewed the transcriptions for errors or inaccuracies. The researcher uploaded the survey (excel data), audio files of interviews, uploaded the observations into a Google form/spreadsheet, transcribed interviews, observations, and uploaded scanned copies of any documents stored within MAX-QDA (VERBI Software, 2019).

MAX-QDA is a data storage and analysis software wherein the researcher developed codes and descriptors within and across the embedded cases (VERBI Software, 2020). Thus, as the researcher collected the units (individual educator's survey, interview, observations, and document data) for each case (each institution), the researcher wrote an individual case report for each case within a unit and utilized Yin's (2018) method for

1. Putting information into different thematic arrays,
2. Organizing the data in a matrix for comparison of similarities and differences,
3. Developing visualization of data as a method to prepare data for interpretation,
4. Develop frequency tables,
5. Reorganize data in chronological order (Yin, 2018, p. 167).

Yin (2018) further developed the "iterative nature of explanation building" as it is important for the researcher to compare the data within the context of the conceptual framework of *The Instructional Triangle*; teacher content – strategies, and teacher to content – practices (Ball & Forzani, 2009, p. 499; Cohen et al., 2003, p. 124). Thus, an overall case within a unit will be examined multiple times. The number of observations and interview contacts allowed the researcher to make revisions and examine the data concerning teachers' strategies. Teachers' practices were employed while teaching remedial students with moderate to high mathematics anxiety.

Data Analysis

Yin (2018) offered analytic techniques to ensure both internal and external validity, including pattern matching, explanation building, and cross-case synthesis (p. 175). The utilization of the pattern matching techniques helps the researcher utilize the base cases as predictors while examining the rival cases; if there are some similarities between predictor cases and the rival cases, this "strengthens" internal validity (Yin, 2018, p. 175). As previously stated, explanation building allowed the researcher to examine and reexamine the data within cases continually. Additionally, explanation building allowed the researcher to examine each case within the theoretical framework context and were deemed exploratory (Yin, 2018, p. 179). Lastly, cross-case synthesis was a method that allows the researcher the ability to aggregate findings cases or even units (Yin, 2018).

These are the techniques that the researcher employed within this multiple-embedded case study design. Additionally, each method allowed for the triangulation of the data, thus improving transferability and internal and external validity. Thus, examining interviews, observations, and document data allowed the researcher to examine an educator's perceived strategies and compare them with the classroom's implemented practices.

Reporting Case Studies

Yin (2018) proposed that the report contain the following: 1) research questions, 2) design, 3) overview of the methodology, 4) data collected, 5) analysis methods, and 6) caveats about the study (p. 234). Additionally, the researcher created profiles of each case and explained each of the descriptors, codes, and themes (Chapter 4). The researcher provided visualizations and logic models for pattern matching and case synthesis (Chapter 3: Open, Axial Coding; Chapter 5, Selection Coding). The researcher utilized field notes/ researcher's journal to explain any caveats and or issues that had any bearing on data collection and analysis.

Issues of Trustworthiness/Validity

Nastasi (2013) stated that trustworthiness has the following components: credibility, transferability, dependability, and confirmability (p. 1). Nastasi (2013) defined credibility as the "findings and interpretations are plausible to the "researched" (the participants)" (p. 1). Nastasi (2013) stated that transferability is the ability to apply the findings in comparative contexts; thus, transferability is generalizability within a qualitative study (Nastasi, 2013, p. 1). Leung (2015) provided an approach for assessing generalizability (p., 326). Leung (2015) stated that there must be an adoption of the same criteria: "systematic sampling, triangulation, constant comparison, proper audit and documentation, and multi-dimensional theory" (p. 326). Nastasi (2013) defined dependability as the researcher accounting for factors that lead to instability and change within the execution of the study's protocols (2013, p. 1). Lastly, confirmability is the "capacity to authenticate the internal coherence of data, findings, interpretations, and recommendations" (Nastasi, 2013, p. 1).

The researcher gained permission to reprint Nastasi (2013) illustration of issues that can impact trustworthiness along with the actions that the researcher utilized to combat each (p. 2): For the study, many assurances were employed to maintain credibility, transferability, dependability, and confirmability. The assurances included prolonged engagement, persistent observation, triangulation, peer debriefing, member check, thick description, audit trail, negative case analysis, reflexive journal, and referential adequacy (Nastasi, 2013, pp. 2-3). Prolonged engagement and persistent observation are a by-product of an interview's data collection methods, a follow-up interview, and two observations.

Additionally, triangulation was achieved using data from the survey, interviews, observations, and documents. The research questions allowed the researcher to ask about specific strategies and practices to address or aid students struggling with mathematics anxiety. The observations allowed the researcher the opportunity to observe said practices enacted within the classroom context.

The researcher participated in a university-sponsored Dissertation, Dive-In. An English faculty member coordinated the Dissertation Dive. Several doctoral students submitted, reviewed, and provided feedback on research designs, literature reviews, data collection and analysis protocols, IRB applications, and the proposal and dissertation defense documentation. The researcher received feedback on several of the components mentioned above in the research execution process. The researcher partnered with a Psychology professor and the Director of the Academic Support Center with whom the researcher has developed and practiced the interview questions/protocol. Additionally, the researcher received permission to utilize an established Mathematics Classroom Observation Protocol that accounts for the standards outlined by the National Council of Teachers of Mathematics (Gleason, Livers, & Zelkowski, 2017, p. 3).

The researcher provided each participant with the details recording within the interview and the observations as a form of member check. The researcher had trusted doctoral cohort members to provide peer debriefing. The researcher developed thick descriptions of participants and sites as a way in which other researchers may choose to “recreate” research conditions. The researcher developed an audit trail as the research was developed and implemented. Every draft was maintained with the date as the research's evolution can be observed by comparing the drafts and the research design throughout implementation. The referential adequacy and negative case analysis were compared in the process and the data was examined for abnormalities and or verification or normative portrayal (Nastasi, 2013, p. 2). Lastly, the researcher utilized a reflexive journal that was carried out through voice recordings that were later transcribed as a portion of the data analysis process.

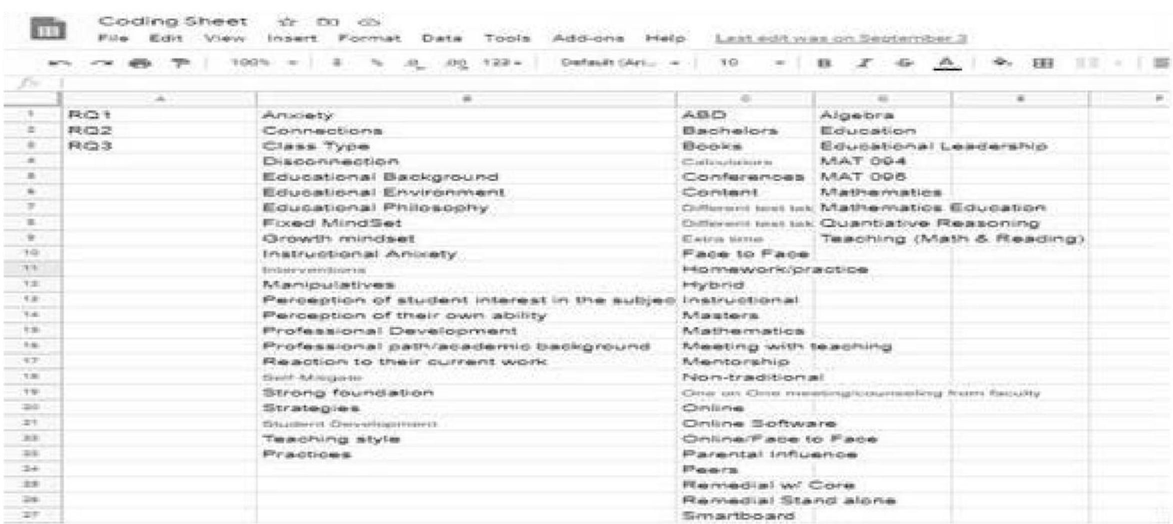
Table 2: Issuing Trustworthiness – An Adaption (Nastasi, 2013, pp.2-3).

Action	Description	Assurances	Researcher's Assurances Tasks
Prolonged Engagement	Investing sufficient time to learn the culture, build trust with stakeholders, understand the scope of target phenomena, and test for misinformation/misinterpretation due to distortion by the researcher or informant	Credibility (internal validity)	The researcher conducted two interviews and two observations.
Persistent observation	Continuing data collection process to permit identification and assessment of salient factors, and investigation in sufficient detail to separate relevant (typical) from irrelevant (atypical)	Credibility (internal validity)	The researcher conducted two observations utilizing the MCOPP (Gleason et al., 2017).
Triangulation	Data collection, analysis interpretation based on multiple sources, methods, investigators, and theories	Credibility (internal validity)	The researcher utilized the instructor's survey data, two observations, and two interviews to triangulate the data (Instructional documents and tools were also supplied). The researcher showcase triangulation with the framework in Chapter 5
Peer debriefing	Engage in analytic discussions with a neutral peer (e.g., colleague not involved in the project)	Credibility (internal validity)	The researcher actively participated in semesterly dissertation accountability groups that were led by a faculty member. The researcher submitted several parts of her research for peer review. The researcher had an experienced coder to conduct two iterations of coding on "Brenda."
Member checks	Test integrity of the data, analytic categories (e.g., codes) interpretations, and conclusions with stakeholders to ensure an accurate representation of emic perspectives	Credibility (internal validity)	The researcher sent each participant their interviews and observation data and asked to provide feedback on their data set's alignment or misalignment.
Thick description	Describe procedures, context, and participants in sufficient detail to permit judgment by others of the similarity to potential application sites; specific minimum elements necessary to "recreate" findings	Transferability (external validity)	Chapter 3 details the study's methodology with information related to sampling, site selection, data collection, data analysis, storage, and reporting. Additionally, Chapter 4 Participant Profiles are a dense response to RQs for each participant, while Chapter 5 is a cross-analysis of data for major themes and patterns.

Action	Description	Assurances	Researcher's Assurances Tasks
Audit Trail	Records that include raw data, documentation of process and products of data reduction, analysis, and synthesis; methodological process notes; reflexive notes; and instrument development/piloting techniques	Dependability Confirmability (Reliability and objectivity)	The researcher has the audio/transcribe interviews password protected and a digital upload of the observation data/description. The researcher has also kept a dissertation To-Do List/Journal.
Negative cases analysis	Investigate "disconfirming" instance or outlier; continue the investigation until all known cases are accounted for so that data reflects the range of variation (vs. Normative portrayal)	Credibility (internal validity)	For this study, there are no negative cases.
Reflexive journal	Researcher's notes; documentation of the researcher's thinking throughout the research process	Credibility (internal validity) Transferability (external validity) Dependability Confirmability (Reliability and objectivity)	The Researcher has maintained a To-Do List/Journal that is available to her committee. Additionally, the researcher created a hyperlinked dissertation plan in which all materials related to the study have been included.
Referential adequacy	Archiving of a portion of the raw data for subsequent analysis and interpretation, for verification of initial findings and conclusions	Credibility (internal validity)	As MAX-QDA allows for multiply projects to be conducted simultaneously, the researcher can upload the raw data into the software and recode participants' data to verify the initial findings. The researcher also conducted an excel coding exercise for "Brenda" with the experienced coder.

Peer Briefing

The researcher also engaged in peer briefing as the researcher worked with an experienced coder (Scott-pseudo) to code an iteration of participant Brenda. The initial coding was coded within a Word document and labeled as soft coding. Scott did a second iteration of coding within an Excel document, where the general themes could be selected from a dropdown menu. The Excel coding utilized themes and codes that Scott discovered during his initial code within the Word document. The coder could first select which RQ was associated with the quote, which 1 level code (L1), 2nd level code (L2), and lastly 3rd level code (L3) that was associated with the quote. The following image is an image of the raw codes in RQ, L1, L2, L3, and Quote formation:


Coding Sheet
File Edit View Insert Format Data Tools Add-ons Help Last edit was on September 3

	A	B	C	D
1	RQ1	Anxiety	ABD	Algebra
2	RQ2	Connections	Bachelors	Education
3	RQ3	Class Type	Books	Educational Leadership
4		Disconnection	Calculators	MAT 094
5		Educational Background	Conferences	MAT 095
6		Educational Environment	Content	Mathematics
7		Educational Philosophy	Different test tak	Mathematics Education
8		Fixed MindSet	Different test tak	Quantitative Reasoning
9		Growth mindset	Extra time	Teaching (Math & Reading)
10		Instructional Anxiety	Face to Face	
11		Interventions	Homework/practice	
12		Manipulatives	Hybrid	
13		Perception of student interest in the subjec	Instructional	
14		Perception of their own ability	Masters	
15		Professional Development	Mathematics	
16		Professional path/academic background	Meeting with teaching	
17		Reaction to their current work	Mentorship	
18		Self Mitigate	Non-traditional	
19		Strong foundation	One on One meeting/counseling from faculty	
20		Strategies	Online	
21		Student Development	Online Software	
22		Teaching style	Online/Face to Face	
23		Practices	Parental influence	
24			Peers	
25			Remedial w/ Core	
26			Remedial Stand alone	
27			Smartboard	

Figure 4 Excel Coding

Scott analyzed Brenda's interview for codes related to educational and career background, teacher facilitation, student engagement, teacher's perception of ability, teacher's perception of students' ability, teacher's belief, strategies, practices, learning environments, and supplemental materials. The researcher then conducted two additional iterations of coding for participant Brenda (one within Excel using the same codes as Scott) and one more extensive analysis within MAX-QDA with the same codes across all participants (VERBI Software, 2019).

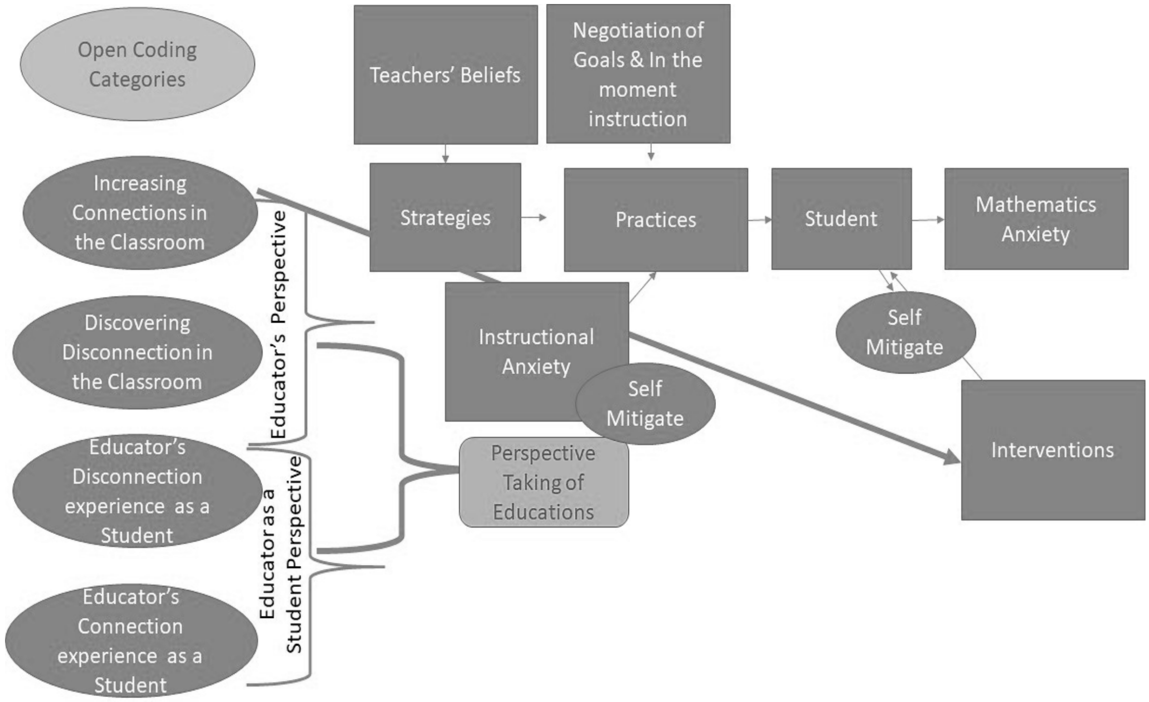


Figure 5 Axial Coding for Connection and Disconnection with Mathematics(Possibly anxious educator or anxious student)

In conceptualizing this study, the researcher would often muse that "all problems are housed in disconnection, and all solutions are housed in connection." Anxiety serves as a disconnection. Several emerging thoughts can be observed in examining axial coding, as connection and disconnection will impact educators' strategies and practice development and implementation. Thus, classes can become connection-centered and not teacher, content, or student-centered. Teachers can be trained or empowered to utilize their assessing skills for connections and disconnections. As a framework, teachers' experience can be observed from a pyramid instead of the two-dimensional *The Instructional Triangle* (Ball & Forzani, 2009;

Cohen et al., 2003, p. 124). Teachers can recall their student connection and disconnection experiences, strategies, and practices employed by their connection and disconnection educators, their strategies and practices, and how they drive connection or disconnection. The most stable element of the pyramid is content; teachers and peers are unstable elements (in an ideal situation, teachers would be the more stable between peers and can serve as a bridge between the two elements content and peers.

Ethical Issues

The researcher obtained IRB approval through the Valdosta State University Institutional Research Board (See Appendix A). An important prerequisite to obtaining IRB approval was completing the Collaborative Institutional Training Initiative (The CITI Program, 2019).

Basic Institutional Review (IRB) Regulations and Review Process & Assessing Risk

In adhering to the VSU IRB standards, several criteria were met to be approved as an exempt study. Does the research meet the research condition as defined by Valdosta State University which is, “a systemic investigation, including research development, testing, and evaluation designed to develop or contribute to generalizable knowledge” (Valdosta State University, 2019)? The study investigated the strategies and practices of remedial mathematics educators, teaching students with moderate to high mathematics anxiety, and meeting the research criteria.

The study contained human participants as the participants were mathematics educators; however, all collected information maintains a minimal risk of harm. As the study does not pose any physical, psychological, emotional, or behavioral risk to the “employability, economic well-being, social standing, and risk of civil criminal liability” for participants, it is deemed minimal risk (Valdosta State University, 2019). All information collected was kept confidential and followed the FERPA and HIPPAA to ensure the participants' safety.

Financial Conflicts

The researcher was not in partnership with any organization and did not receive any financial gain from the study results. Thus, there was no conflict of interest, and the study was not compromised due to the design and implementation of the research protocols.

Federal Regulations, Informed Consent, Privacy and Confidentiality

The study met the Federal Regulations for a Category 2 exemption as the sample did not contain any minors (Valdosta State University, 2019). The research data collection methods did include instructions, procedures, and protocols. The survey procedures included a detailed email to participants, which outlined voluntary consent, types and duration of data collection methods, VSU Institutional contact information, Chair's contact information, and the researcher's contact information. Additionally, the interview and observations were consensual as the researcher received permission from both the Institution, the Mathematics Department of Oversight, and the educators regarding when and where data collection occurred. The researcher gained institutional consent from each of the participating institutions (See Appendix B). Additionally, the Mathematics Department administration received an Administrative Permission request, wherein the researcher outlined the purpose of the research along with the data collection procedures and protocols (See Appendix B).

Participants were informed of voluntary consent. Additionally, participants were informed that their identities and institutions were kept confidential throughout and beyond the study. The Participant's Invitation email contained details on the number of contacts (60-minute Focus Group, 60-minute interview, two in-class observations, and survey) (Appendix B). Each participant was given an Instructor's Code to maintain confidentiality. This code was utilized in the survey, observations, focus group, and interviews; thus, ensuring that no identifiable information was connected with the participant's data.

Summary

The researcher engaged current remedial mathematics educators as participants, thus, employing purposeful sampling. The participants were selected from postsecondary institutions in South Georgia, wherein single or concurrent remedial mathematics courses were taught. The researcher utilized a survey, interviews, and observations to understand the strategies and practices employed by educators who taught remedial students with moderate to high mathematics anxiety. The researcher constructed the research design based upon the understanding of the relationships of *The Instructional Triangle*, as outlined by Ball and Forzani (2009). Although *The Instructional Triangle* depicts the following relationships (teacher to content, teacher to student, student to student, student to teacher, and student to content); this study only focused on the relationships of the teacher to content (strategies) and teacher to student in classroom (practices) (Ball & Forzani, 2009, p. 499).

The researcher gained permission from Sasser (2010) in designing and implementing the Remedial Mathematics Educator's Practices and Strategies Survey (Sasser, 2010). The instrument was utilized to get the participants' basic demographic, career, educational background, and professional development. Additionally, the researcher employed Irving Seidman's (2006) approach in designing and conducting the individual interviews. Lastly, the researcher gained permission to utilize the Mathematics Classroom Observation Protocol developed by Gleason et al. (2017). The Mathematics Classroom Observation Protocol for Practices (MCOP2) utilizes *The Instructional Triangle* as a framework for observing classroom practices that facilitate teacher to student engagement and student-to-content engagement (Gleason et al., 2017, p. 3). The researcher employed the six steps of Creswell and Gutterman (2019) in data collection and utilized Yin's (2018) pattern matching, logic models, and case synthesis in analyzing the data. The researcher developed profiles, visualization of codes, patterns, and themes to explain the logic and synthesis across cases and units.

In Chapter 4, the researcher presented profiles for each case. These represented the analysis of each participant's data individually to answer the three research questions. In Chapter 5, the researcher presented the themes that emerged across cases to answer the following three research questions.

Research Questions

1. What are the life and career experiences of educators who teach remedial mathematics at identified at post-secondary institutions in South Georgia?
2. What are the strategies used by these educators to mitigate anxiety?
3. What are the practices used by these educators to mitigate anxiety?

Chapter IV

PARTICIPANT PROFILES

Problem

Math anxiety is very prevalent and poses a barrier to the successful completion of mathematics courses necessary to graduate from college. Approximately 80% of community college students and 25% of four-year college students taking mathematics courses struggle with moderate to high math anxiety (Beilock & Willingham, 2014). Additionally, 67% of two-year and 44% of four-year students are remedial non-completers “no degree and not enrolled” (Chen, 2016, p. 35). Given that math anxiety is a barrier to math performance, remedial math instruction should be examined for mitigating factors.

Purpose

To further understand how to mitigate the role of math anxiety in college student math performance, this study focuses on remedial math instruction. The purpose of this study was to determine the strategies and practices to mitigate math anxiety used by educators who teach remedial mathematics courses at identified postsecondary institutions in South Georgia. Based on the literature, students in remedial mathematics are likely to experience moderate to high math anxiety and are unlikely to graduate.

Research Questions

1. What are the life and career experiences of educators who teach remedial mathematics at identified at post-secondary institutions in South Georgia?

2. What are the strategies used by these educators to mitigate anxiety?
3. What are the practices used by these educators to mitigate anxiety?

Significance of the Study

Mathematics anxiety has been examined as a factor in students' mathematics achievement (Beilock, et al., 2010). Mathematic anxiety is composed of a number of environmental factors that serve as components for anxiety (peers, parents, and teachers) (Uusimaki, & Nason, 2004). Jackson and Leffingwell (1999) reported that teachers can exacerbate or increase anxiety in their students. Currently, there is a gap in research as it relates to the effect of anxiety on remedial mathematics students. However, the rates of low completion rates of remedial mathematics and graduation rates prompts legislation, education systems, and educators to examine all possible factors. As reported by the *Complete College Georgia*, 93% of two-year and 75% of four-year students enrolled in learning support/remediation fail to graduate (University System of Georgia, 2018).

The purpose of this study was to determine the strategies and practices used by educators who teach remedial mathematics students with math anxiety who are at risk of course failure at identified postsecondary institutions in South Georgia. The study may have value for educators at any level as they may develop and implement instruction to address anxiety. Additionally, the study merged discoveries of math anxiety with the application of curriculum changes to adjust and update instructional practices. Particularly, institutions of higher education and their pedagogical programs and classes may apply the findings of this study to help the retention and matriculation of students. Increased retention and graduation rates could increase revenue, allowing institutions to increase hiring opportunities, course and degree offerings, and student financial aid access (Broton, 2019).

Overview of data sources for participant profiles

Each of the participant profiles consist of four types of data: survey, interviews, observations, and documents. The survey was developed and sent to the participant within the participant invitation email (Participant's Invitation, See Appendix B; interviews, See Appendix B; observations, See Appendix B). The researcher gained permission from the institutions and the department heads at each of the participants' institutions. Each participant was contacted via email and provided an instructor's code to ensure their anonymity. Additionally, the researcher provided each participant with is a pseudonym to protect both the institution and participants. Each participant agreed to share their teaching and professional development experiences throughout the two interviews (one follow-up interview) and two observations. Their submission of the survey was an indicator of consent to the two interviews and two observations.

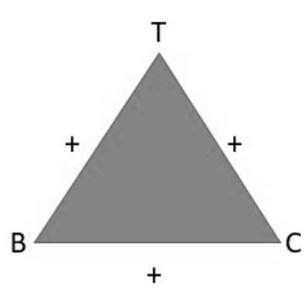
Participants' Profiles

In order to gain a greater understanding of each participant's career and life experiences as a student and a teacher (RQ1), the researcher posed several questions to explore each participant's past experiences. Several of the questions helped explore the participant's *Instructional Triangle* as a student and a teacher. As a student, the discussion included an examination of each participant's relationships with their peers, teacher, and the content. Additionally, as the teacher, the discussion included an examination of each participant's relationships with the content (strategies- RQ2) and their relationships with students (practices-RQ3), as well as, their students' connection to the content.

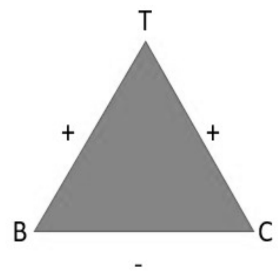
Brenda's 1st & 2nd Interview (Combined) - RQ 1

Brenda's first observation was conducted on December 2, 2019 in her classroom followed by an interview. The second interview and follow-up interviews were conducted in Brenda's office. At the time of the interview, Brenda was in her early forties and had nine years of teaching experience as a college remedial mathematics instructor. She had also served as the Learning Support Mathematics coordinator, concurrent with her teaching. Brenda graduated with her undergraduate degree in Speech Pathology. However, Brenda stated that her educational background was a winding road, as she did not pursue a profession within Speech Pathology. For a time, Brenda became interested in the medical field and pursued nursing. She later realized that it was not the best fit. She commented, "it didn't click with me" (Brenda 1st interview, 2019). She elaborated that "I wish I had done the math; I wish I had gone and done that to begin with" (Brenda 1st interview, 2019). After a time of reflection, Brenda pursued and graduated with her Master of Arts in Teaching with an emphasis in Mathematics and Reading from a local regional university.

Brenda as a student – RQ 1



The researcher was interested in the origins of Brenda's interest and love for math. Additionally, it was important to explore how and when Brenda developed a strong connection with mathematics and moments when she experienced a disconnection with the subject. "So, I always like math, it was my favorite subject in school, and especially algebra, I just loved algebra" (Brenda 1st interview, 2019). Brenda stated that she realized in middle school that math was the thing that she liked to do. In middle school, Brenda was in a class wherein she and four other students were able to complete the course through self-pacing. The self-paced course provided Brenda with confidence in her abilities. Additionally, in middle school, teachers confirmed Brenda's abilities. "So middle school was when I first identified that I like it and other people kind of confirmed that. Yeah, you're good at it" (Brenda's 1st interview, 2019). *The Instructional Triangle* to the left depicts strong connections between teacher and content, teacher and student, and student and content (Ball & Forzani, 2009). However, based on Brenda's illustration she had the strongest connection with the content.



It is evident from Brenda's responses that she developed strong connections with the content and her teachers. However, it is also important to understand how disconnections work within *The Instructional Triangle* (Ball & Forzani, 2009, Cohen et al., 2003). As connections are important within *The Instructional Triangle* to the left, there were two positive relationships between the teacher and content and the teacher and the student (Ball & Forzani, 2009; Cohen et al., 2003). However, it should be noted that Brenda had a negative connection with the content the discovery of disconnections is just as important. Brenda discussed an experience when she was disconnected from the mathematics content of a course. Brenda experienced a great deal of frustration and anxiousness in a high school geometry math class. She expressed her confusion as after her middle school experiences she considered herself a math person. "I think, more upsetting because it was a math topic and I thought I was good at math that when I got to geometry I just could not understand" (Brenda's 2nd Interview, 2019). Brenda stated the difference between her previous math courses and geometry, was that geometry was more abstract and algebra seemed to be a little more straightforward.

Brenda was able to be successful in the course, but this was the first time that she felt an extreme disconnection from the content. Looking "back on that and I think it's kind of embarrassing to tell people that you know hey I didn't do very well in geometry, I passed it but I didn't make A's in it" (Brenda's 2nd Interview, 2019). Brenda expressed the feeling of struggle, "you're expected to be good at it, and to like it and I didn't like it and I wasn't good at it" (Brenda 2nd Interview, 2019). In her describing this experience, the researcher could observe the conflicting emotions that Brenda was experiencing. She discussed how this time made her second guess or rethink her identity as a good math student. The researcher was interested if Brenda had experienced any type of mathematics anxiety.

Brenda stated that she experienced anxiety in the same geometry course that served as her first experience of "disconnection." She felt as if everyone knew what was going on in the course except her. She stated that this anxious encounter occurred in high school. Brenda stated that she was frustrated because the content did not make sense. The researcher explained the differences between general, testing, and mathematics anxiety to get a distinction of which type of anxiety Brenda's was experiencing. Brenda stated that she had not experienced any test anxiety in any other courses, but that she was experiencing some level of anxiousness and frustration in the geometry class. She did that her disconnection experience informs her teaching as she can empathize with students in her class who are experiencing some level of frustration or anxiety.

Brenda as a teacher - RQ2

Strategies are defined as instructional preparations that are based upon instructional beliefs, typically occurring outside of the classroom. Brenda discussed her educational background, training, as well as ongoing professional development as strategies that she consistently engages in delivering content. In response to the interview question, "what are some things that your academic background did not prepare you for when teaching math," Brenda replied that students' motivation levels and students' college readiness are factors that her educational background did not prepare her to address.

The researcher asked Brenda other questions related to training, education, and preparation in teaching remedial mathematics courses. Brenda state that when hired she was given some guidance but noted the difference between her k-12 training and collegiate level training. She described her first experience teaching collegiately, she was provided with the book and learning objectives. She was not necessarily given training on instruction, as within the college environment professors are deemed the content experts. Content experts are not synonymous with teaching experts.

As a college professor, Brenda was and is given a great deal of autonomy to decide how she designs and delivers instruction. Brenda was provided opportunities to attend conferences and learn about instructional design, issues related to retention and course completion, and similar teaching and learning strategies.

Additionally, she attended yearly meetings for mathematics instructors at her flagship institution. Periodically, the institution provided suggested readings that enhance instructional delivery and design. “So, you know, along the way you do get tips and ideas of how to teach certain things, but you know initially it's this is what you need to teach your students” (Brenda 1st interview, 2019).

Brenda spoke about autonomy at the collegiate level and stated that it was good to have. During the prompt of this question the researcher spoke about the depth of training at the k-12 level versus that at the collegiate level and based upon Brenda’s response the objectives and accountability measures are different at each of the levels.

Teaching Philosophy and Components of Good Math Lessons - RQ2

Teaching philosophy or teachers’ beliefs impact strategies and instructional implementation. The researcher explained an educational philosophy as “core values in teaching” (Researcher 1st interview, 2019). Brenda stated that her goal was for every student to learn the content that she was trying to teach. Brenda stated that her desire for her students to learn takes into account the various levels of acquisition and comprehension levels. “My goal is for every student to learn what I'm trying to teach, whatever level they're starting at that for every student in my classroom will learn something and hopefully they will learn what they need to pass the class” (Brenda 1st Interview, 2019). Additionally, Brenda stated that her course can serve as a way for students to do a needs assessment and identify their needs.

Brenda stated that sometimes students just needed a "little bit of encouragement to say they don't believe that can do it but you know if some students just seem to need that little bit of, you can do this, it's, it's within you" (Brenda 1st Interview, 2019). Brenda understood that some students need more than encouragement. "You know, some students need a whole lot more" (Brenda 1st Interview, 2019). She spoke about the need for habit and knowledge development through practice. "Some students need practice and practice and practice" (Brenda 1st Interview, 2019). Brenda spoke of the challenge of discerning students' needs as they are all at various levels of their understanding, however, she quickly stated that her goal for everyone is the same. The goal is that "everybody learns enough to be successful in my classes really" (Brenda 1st Interview, 2019). Brenda did not limit her methods in achieving these goals, she stated that she is willing to "whatever it takes" (Brenda 1st Interview, 2019). Brenda described the cycle of learning and improvements "I can learn a little bit every time I teach it, and identify, you know, what can I do, that students seem to do a little bit better if I do it this way, so that I can teach that they'll learn, and that I can learn how to best teach them"(Brenda 1st Interview, 2019). Brenda informed the researcher that she is both the teacher and the student, she is constantly learning how to teach and reach her students better.

In the discovery of Brenda's instructional strategies and practices, the researcher inquired about "what consists of a good math lesson" (Researcher, Brenda's 1st interview, 2019). Brenda explained her process, she stated that the process is cylindrical in that she is learning as she is teaching. Brenda stated that a good math lesson starts with the teacher letting the students know what is being taught. She stated that also creating connections between previous materials to ensure that students are becoming aware of the building blocks of their learning. Brenda provided a good example of this "So, if we're factoring that I'm going to go back to the ball method you know I'm going to always go back to what they know and try to pull them into how it relates to what we're going to do, and hopefully they make that connection and it makes it easier for them to do the lesson that we're about today" (Brenda 1st interview, 2019). Brenda stated that it is important to provide enough examples so that students feel confident in their attempts at applying what they are learning.

Brenda described this process in a way that seems like steps of comprehension. She thinks that it is very important to reference previous materials and provide examples so that students can build their confidence. She stressed the importance of covering the materials gradually as students then can see the building nature of the materials. She also gradually allows the students to take more ownership of the materials and switch roles by asking students to direct how she should complete the problems (teaching from their seats). Afterward, she asks students to do some individual work as this will be a good check for understanding. If students are struggling this is a time that they can troubleshoot together, she gives them prompts to help them out. The overall goal of the course is that they have enough examples and notes in which they can go home and work on some problems on their own.

Strategies & Evolution of Teaching Practices (teacher to content) - RQ2

As strategies include a teacher's educational background, teachers' beliefs, instructional design, relationship with the content, etc. The researcher sought to understand' s Brenda's strategies and how they have changed over time. Brenda stated that one overriding component that is different between her first time and her current time teaching the course is her confidence. Brenda stated that time has given her more understanding of the most common mistakes and questions guiding her implementation of the content. Brenda was conscious of the pitfalls and worked hard to help students avoid them. She often says in class "Don't do that. Don't make this mistake, you know, this is important" (Brenda 1st interview, 2019). Brenda stated that the second component that has improved over time has been her teaching skill level. Thus, she continuously revised her instructional practices.

> And then I've tweaked and definitely changed, you know, when I found a better way when I find something I like you know what works better than I've gradually change, you know it. Every time I make changes constantly looking for ways to make it better and for students to understand, you know the same content of course but just a different approach (Brenda 1st interview, 2019).

Brenda stated that she learned several strategies from books and other teaching videos. She stated that she makes several of those videos available to students who may be struggling with a particular concept. Brenda researched to find easier ways to complete problems.

Teaching strategies to address students' mathematic anxiety (teacher to student) - RQ2

The researcher asked Brenda if the strategies that she employs are curtailed to students who may have been struggling with moderate to high anxiety? Brenda stated that a number of students are afraid that they are not good in math, and they have proof in their previous failures. Brenda stated that students have informed her when they were struggling with testing anxiety, or they stated that they are just not good in math. Typically, students informed Brenda on the first day of class. She has responded to everyone in the course with “you know, you may not like math, you may not have ever been good at math and my job is that I'm going to get my goal is to get everybody in here ready for the next class so I'm going to do everything I can to teach you to the best of my ability” (Brenda’s 2nd interview, 2019). She admonished students to do their part by taking notes and practicing problems at home. She explained the importance of asking for help. Brenda stated that the combination of notes, homework, and help will ensure students’ success in her class. Brenda did a great deal to reassure students that she would make the concept easier to grasp and move into the more difficult concepts. Thus, she stated that she will utilize building blocks to build their grasp of the materials. She stressed the importance of building a work ethic and consistency. Brenda and the researcher discussed her use of personally developed concept videos.

Teaching Practices - (Teacher to Student and Student to Content) - RQ3

Educational practices are defined as an educator’s instructional strategies, which affect instruction implementation within the classroom or instructional environments. Brenda explained that one of her go-to practices is questions, she stated that she "never stop asking questions” (Brenda 2nd Interview, 2019). The questions serve as prompts for learning and assessment or checks for understanding. Brenda provided some examples “I'm just like, what kind of equation is this it you know, now you know I mean it's like it, day after day, I feel like come on if you're sitting in this classroom and I'm asking the same questions” (Brenda 1st Interview, 2019). Brenda spoke about being intentional about repetition in utilizing probing questions to increase students’ connection to the content. Brenda stated that the probing question methods often allow students to see, experience, and speak the information repeatedly so that they can get it. Brenda stated that her courses are college-level and that it is important to build a strong foundation. Brenda stated that her ultimate goal was to ensure that students were successful and that they built a strong foundation in the course.

Brenda had a strong belief that anyone can be successful in college algebra and her goal was to provide them with a good foundation despite their k-12 mathematic experiences and knowledge level. Brenda taught both the basic remediation and the more advanced final remediation courses. Both courses individually presented the foundational knowledge necessary to complete the subsequent college algebra course. She understood that she had students who did not have a foundational understanding of the materials, as well as non-traditional students who may not have seen the materials in a while. Brenda spoke of the differences in content design and delivery for a nontraditional student as she explained that some students say “I don't remember, or they never got it, they say they didn't have this class I didn't have to take this kind of math” (Brenda 1st Interview, 2019). Brenda spoke to students lack college readiness, as well as the lack of habit development to help them be successful in college.

Students' interaction with Mathematics (student to content) - RQ3

Brenda provided tangible examples of how she has learned new strategies that impacted her in-class practices. Additionally, the researcher asked Brenda “how would her classroom look if students were interacting with math in the same manner as she does?' Brenda responded that she has students who engage in the matter in a very knowledgeable way. They demonstrated their knowledge by answering and asking questions. However, Brenda got more satisfaction from students that came in with little understanding of the materials and left the course with a greater understanding of the materials. “I feel like I get a lot of satisfaction from the students that come in with not much knowledge and leave and say, I learned a lot” (Brenda’s 2nd interview, 2019). Brenda acknowledged that some students came to her class with a strong background from high school; however, the students built their knowledge base for subsequent courses. Overall, Brenda desired that students develop a passion for learning at any ability level at which they encounter the material

Students’ Anxiety and Brenda’s Response’s to Students’ Anxiety - RQ3

The researcher asked Brenda “if you had to give a percentage of how many students you think struggle with anxiety some form of anxiety be social, just general math anxiety test anxiety in your class what would that percentage?” Brenda stated about 50% of her students struggled with some type of anxiety. She stated that indicators of anxiety for her are avoidance. She stated that she feels as if students were utilizing avoidance to deal with their anxiety. The researcher asked Brenda if there were any other indicators that a student maybe struggle with some type of anxiety, including but not limited to some physical indicators. Brenda stated that some students have cried, while others have had nervous twitching and fiddling. She stated that she has seen students shaking in class, at which time she tried to comfort them. Brenda said that “I mean, it's just, it's kind of bad to see students feel like it's that bad that has taken that kind of physical toll on them that they're so stressed or anxious about math” (Brenda’s 2nd Interview, 2019).

The researcher asked Brenda what was her response given the range of demonstrations of anxiety or fear? Brenda stated that when someone is avoiding doing their work, she goes over the problem with them to get them engaged again in the problem-solving process. Brenda compared or illustrated another form of avoidance with instances of "fiddling" (Brenda 1st interview, 2019). Brenda and the interviewer recognized this as a form of self-mitigating but stated that she aimed to jumpstart them in the process. She stated that it was important to give those students some "success" as they worked through the problem (Brenda's 1st Interview, 2019). Brenda stated that normally when people cried it was typically after class or in her office. She normally tells the students that she is available during office hours, refers them to tutoring, and informs them that she will be dropping the lowest quiz grade. Overall, Brenda stated that her response was individualistic and not scripted. She stated that when students took her advice, she saw improvements and students stated that when students did not take her advice that she understood that students were in different phases of development.

> Unsolicited advice to the students that don't ask but I know they need my help. You know, they might not be ready for my help. And if they don't like it then. A lot of times they have to repeat the course, you know, sometimes they'll squeak by but that's not necessarily good either if they have a subsequent math course, because they usually struggle, it's like move on" (Brenda's 2nd Interview, 2019).

Brenda goes on to describe the changes in students over semesters. She said some people "don't get it and don't ask for help" during one term may fail and come back with a new commitment to learning the following semester. She also stated that some students may have failed one semester and was not engage in asking questions and seeking help. However, upon repeating the course, they are more responsive and engaged. The researcher asked Brenda if she had been trained in assessing mathematics anxiety and developing interventions? Additionally, the researcher asked Brenda if there were any strategies and practices in which to mitigate students ‘anxiety? Brenda stated that she does not recall any direct training or resources addressing mathematics anxiety. She did state that there were stressors and barriers associated with socioeconomic disparities (e.g., calculators, technology, computers, and the internet). Thus, Brenda would provide her students with calculators throughout the semester. Brenda stated that students’ anxiety is not an element of her formal or informal training. She stated that the emotional, specifically anxious component of students is not readily spoken or trained on.

Traditional vs. Non-traditional Teaching Styles (Teacher to Student), Preferred learning environments, Manipulatives, Worksheets, Software, and Videos - RQ3

The researcher asked Brenda if she considered herself to be a traditional or nontraditional educator, additionally, the researcher asked Brenda to define what those terms meant to her. Brenda stated that she is traditional and that the structure mostly is lecture-based. Brenda said that she tries to engage students, “I try to pull stuff out of students” (Brenda 1st interview, 2019). Based upon Brenda’s description of a nontraditional educator lecture, she stated that she does not “flip the classroom” (Brenda 1st interview, 2019). Overall, Brenda stated that she engages in what she perceived to be nontraditional and traditional practices within the classroom. “Yah, so at times I do some different activities where it's kind of, you know, not as traditional but most of the time, you know, its traditional it's me teaching” (Brenda 1st interview, 2019).

The researcher asked Brenda what is her preferred learning environments (face-to-face, hybrid, online, asynchronous, synchronous, distance learning)? Brenda responded that she has only taught in face-to-face and hybrid environments and stated that her preference is face-to-face. She stated that she needs to see students work on their problems and hear what students have to say about the math problems. In the hybrid course, the materials are condensed and lacks the ability to impart all of the tips and tools that help students succeed. She stated that unlike history or other courses that relies on independent reading, math needs demonstration. She stated that as a remedial math teacher, her students are already behind, so she needs to be able to catch them up (this seemed to be difficult for Brenda in an online environment). Brenda stated that she needs to see her students as much as possible. She stated that remedial students are not motivated to work independently, and this may be a limitation of the hybrid class format.

The researcher asked Brenda what type of manipulatives that she used in either learning environment? She responded that she used videos, smartboards, and worksheets. Brenda has done a number of videos that provide demonstrations for students who may need extra support for specific topics. She also utilized videos developed by Khan's Academy. She discussed the development of manipulatives that allow students to grasp the concepts of negative, non-negative, and positive numbers.

Instructional Anxiety - RQ3

The researcher and Brenda discussed topics such as instructional anxiety. Brenda stated that she has experienced instructional anxiety especially when implementing new course materials, Brenda in turn stated that she has not been in a course wherein her professor exhibited signs of instructional anxiety. However, Brenda agreed that instructional anxiety would impact the instructional design and delivery. The exchange with Brenda can be viewed through the lens of the Instructional Triangle (Ball & Forzani, 2009). Brenda's experience as a student, allows us to see two different relationships with the content; one in which she had a strong connection and one in which she experienced a strong disconnection. Both of her student experiences provided insight into the relationships that she had with her teachers. Brenda stated that her student and educational experience provides a basis for her teaching philosophy, strategies, and in-class practices. Brenda's teaching strategies and practices provided insight into her continued connection with the content, how she fosters a connection with students; and in turn, how she assists students in making a connection with the content. Lastly, she stated that both her connection and disconnection (anxious) experiences help her to be intentional about her inactions with students and her instructional development and delivery.

Brenda's Advice to Colleagues Struggling with Instructional Anxiety

Brenda stated that she would advise her colleagues who struggle with instructional anxiety to "prepare, prepare, prepare to study the material" (Brenda 2019). Additionally, Brenda stated that she wrote down practice problems and worked through them to familiarize herself with the materials and build her confidence in both her ability to do and teach the material. Brenda prescribed a type of mock session in which the educator would do "whatever it is you're doing that you're going to have to do in front of them" (Brenda, 2019). She thought it very important that the educator "write it down and say it out loud" (Brenda, 2019). As Brenda is the only participant who developed her self-demonstrating videos for her students, this is appropriate advice.

Brenda stated that she felt as if they were not good when first making her videos but that she has built up a library of video resources available to students and colleagues. The mock session provides the educator with an understanding of the flow of the content and the materials, including where practice problems and additional demonstrations may be needed. Brenda's final advice was "fake it till you make it" (Brenda, 2019). Amy Cuddy (2012) would say, "fake it until you become it," as she also taught the public how to address fear in highly evaluative situations, power posing (Cuddy, 2012).

Observations – Mathematics Classroom Observation Protocol for Practices (MCOPP)

The observation protocol also included the MCOPP, an observation protocol for mathematics (Gleason et al., 2017, See Appendix B). The MCOPP has the Instructional Triangle as a component of the theoretical framework (Ball & Forzani, 2009; Gleason et al., 2017). Both the Instructional Triangle and the MCOPP have relational components that examine the teacher to content, teacher to student, and student to teacher and student to content interactions within a classroom. The MCOPP has a sixteen-item assessment that the researcher used to observe the teacher facilitation activities and student engagement over both class periods (See Table 3).

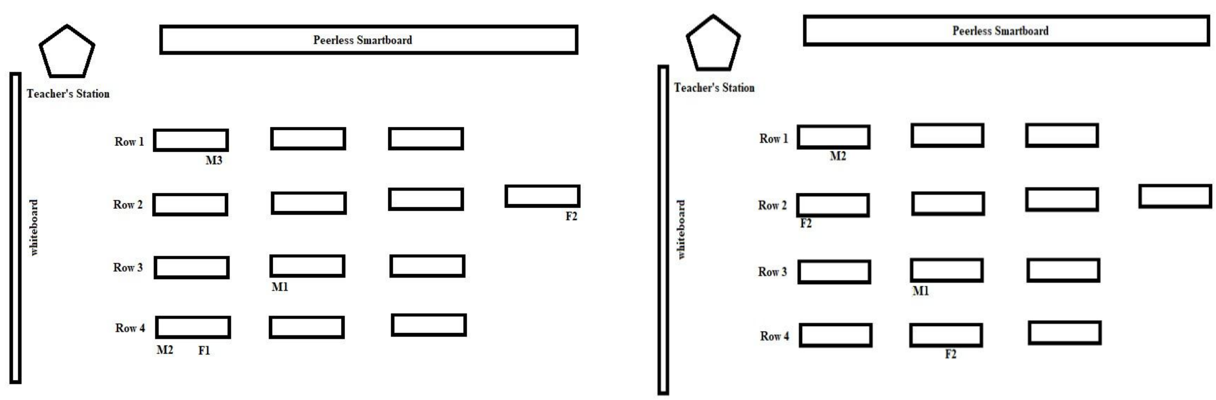


Figure 6 Brenda's Class Layout for 1st & 2nd Observations

*Ta*ble 3: Brenda's MCOPP (Gleason, Livers, & Zelkowski, 2017).

		1st Observation				**2nd Observation**			
Item #	Item	Student ID #	SE	TF	Problem or concept related to interaction	Student ID #	SE	TF	Problem or concept related to the interaction
1	Students Engaged in Exploration/investigation/problem solving	M1, F2, M3	✓	✓		M1,F1, F2, M2	✓	✓	
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.		✓	✓		M1, F1, M2, F2	✓	✓	
3	Students were engaged in mathematical activities		✓	✓			✓	✓	
4	Students critically assessed mathematical strategies.		✓	✓		M1	✓	✓	
5	Students preserved in problem solving		✓	✓			✓	✓	
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.			✓			✓	✓	Review previous material
7	The lesson promoted modeling with mathematics.			✓			✓	✓	graphing
8	The lesson provided opportunities to examine mathematical structure. (Symbolic notation, patterns, generalizations, conjectures, etc.).			✓				✓	
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.			✓				✓	
10	The lesson promoted precision of mathematical language.		✓	✓	Parabola/Axis of Symmetry	M1, F1	✓	✓	Parabola/axi s of symmetry, quadratic equation
11	The teacher's talk encouraged student thinking.		✓	✓			✓	✓	
12	There were a high proportion of students talking related to mathematics.	M1, F2		X					
13	There was a climate of respect for what others had to say.		✓	✓			✓	✓	
14	In general, the teacher provided wait time.			✓				✓	
15	Students were involved in the communication of their ideas to others (peer to peer).		X	X					
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.	M1, F2	✓	✓	Shape of parabola pg 585	M1		✓	

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Brenda’s Observations Summary

Brenda engaged in all, but two of the 16 items, and those two items were related to peer-to-peer engagement. During her interview, Brenda did state that she does not build in a great deal of peer-to-peer interactions throughout the course. She stated that a number of students are uncomfortable with the ideal of working with their peers, but admittedly Brenda also stated that as a student she preferred to work alone. Thus, Brenda's belief in content acquisition as an individual endeavor can be observed throughout her instructional design and delivery. Students’ proximity to one another in the classroom also did not lend itself for a great deal of peer-to-peer interactions.

Brenda’s instructional design and implementation allowed students to really engage in math modeling, problem solving, personal assessment, and connection to previous materials. The researcher observed that students who were vocal seemed to be conducting a verbal check for understanding. Conversely, students that were less vocal tend to have some issues with the material. Brenda availed herself to those students intentionally with the goal of identifying and alleviating the holes in their understanding. Brenda allowed for self-pacing as a way to ensure that students who grasped the materials could move on and those who did not could spend more time with the content. Although, there was little peer to peer engagement, peers serving as a component of anxiety are not removed from the class in that the student may feel pressure based upon another student’s ability or inability to grasp the concepts.

Brenda utilized a number of scaffolding techniques to ensure that she was making connections with previously taught materials and introducing the new material. She often presented the problems in steps and/or processes to ensure and check for understanding at each level of problem solving. An example would be when Brenda put an equation on the board and asked her students what the type of equation was and how to solve it. Next, she reminded her students of factoring and was able to introduce the concepts of x-intercepts on the parabola. Brenda consistently did this form of facilitation throughout the class periods.

Harry's 1st & 2nd Interview (Combined) - RQ1

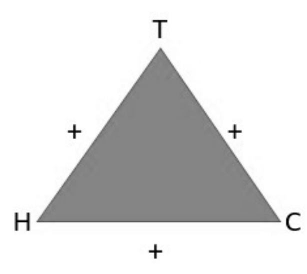
Harry's first observation was conducted on December 4, 2019; his second observation was conducted on December 5, 2019, followed by his first interview. His second interview and follow-up interviews were conducted in the campus tutoring center. At the time of the interview, Harry was in her mid to late twenties and had two years of teaching experience as a college remedial mathematics instructor. He also served as one of the main math tutors in the tutoring center. Harry graduated with his undergraduate degree in Mathematics from the local, regional university. Harry discussed that his entry into teaching was accidental as he had previously served as a tutor in the AVID program. He stated that the AVID program allowed students to utilize collaborative learning techniques to discover better study skills and habits. Harry described the program.

"Avid is a tutoring program designed to help students reach their answers rather than leading them to the answer; we're asking them leading questions to for them to guide themselves to the answers and make them at least feel like, you know, to build more confidence in themselves" (Harry's 1st interview, 2019). Harry discussed how his work in AVID provided him with some of the skillsets necessary to teach remedial mathematics.

Harry as a student – RQ1

The researcher was interested in the origins of Harry's strong interest or connection with a teacher, peer, or academic content. Harry stated that it was in high school that he made a strong connection with his History Teacher. He stated that his History teacher taught a cross-section of subjects (history, geography, economics, and drama). He had battles with insecurities and shyness and did not have any friends (as he was a transplant, he did not have carryover friends from middle school). Harry's history teacher introduced him to drama and changed his school and personal experience. By way of drama, Harry made friends and possibly learned more about himself. Harry also stressed that he had struggled with social anxiety; thus, the drama helped him in this area. Thus, his high school History teacher was the first memory in which Har made a strong connection with an educator. Harry also discussed times in which he made strong connections with academic content.

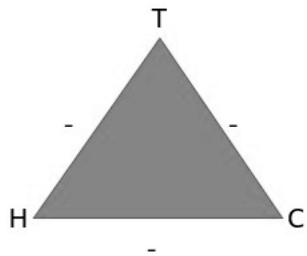
Calculus III was the first time in which Harry made a strong connection with the content. The course placement is very important as Calculus I was the first time he felt a strong disconnection with math-related content. Harry's connection to Calculus III was by way of a professor who was very enthusiastic and passionate about the subject matter.



The professor was very good at teaching and would later become Harry's guide (as Harry would seek a mathematics degree, the professor taught most of the required courses – 7 times throughout Harry's academic tenure). Throughout the completion of the courses, Harry developed a love of the material. Thus, Harry developed a strong connection by way of professor made a strong connection with the content. In looking at the complete environmental factors, the researcher asked Harry about his connection with his peers. *The Instructional Triangle* to the left illustrates that Harry's teacher had a good connection with the content and Harry; additionally, Harry also developed a good connection with the content (Ball & Forzani, 2009).

Harry stated that it took him a while to speak with other students in the classes. Much like entering High School again, until his peers found out that he made a perfect score on a very difficult test. Harry stated that "suddenly everyone wanted to be my friend. And, yeah, I ended up making friends with a few students in my math class, some friends I, we are still friends with today" (Harry's 1st interview, 2019). As making strong connections with a teacher, peers, and academic content is important, equally important is the understanding disconnection with the teacher, peers, and academic content.

Harry stated that the first time that he had strong disconnection was Calculus I during his freshmen year. For Harry, this was both a strong disconnection between the teacher and the content. He stated that he felt as if the professor did not enjoy the content or his job. Harry stated that because he did not make a stable enough connection with Calculus I, Calculus II was very difficult. He stated that his Calculus I teacher's method was reading out of the book, and often he would ramble to everyone's confusion. Harry's Calculus experience was teaching him that" this is college." He was building a perspective that college is difficult and that his academic achievement standards must be lowered. He stated that his Calculus II professor was better, but he did not possess the



knowledge and skillset to succeed in the course. *The Instructional Triangle* showcases negative relationships between Harry's teacher and the content, Harry and his Teacher, and Harry and the content (Ball & Forzani, 2009). As Harry had experienced a strong disconnection with the teacher and the content, the researcher was interested in his relationship with his peers.

Harry stated that he limited contact within those courses, as he experienced a negative encounter with another student. He avoided confrontation of any kind; thus, he also disconnected from his period through his Calculus I and II experiences. Harry thought that if he "just lay low and get in anyone's way, and I don't have any problem" (Harry's 1st interview, 2019). He stated that he had also been annoyed with distracting students but did not count that as a major issue. Harry's interactions with educators, peers, and the content will inform his development as a teacher. *The Instructional Triangle* illustrates that Harry's teacher had positive relationships with both the content and Harry; however, Harry had a negative relationship with the content (Ball & Forzani, 2009).

The researcher asked Harry if he had experienced some level of anxiety as a student. "Yes, most definitely" (Harry's 2nd interview, 2019). He spoke of his easy connection with mathematics and other subjects where testing was required; however, he could remember when he encountered some difficulties. Harry stated that "my anxiety" would go through the roof (Harry's 2nd Interview,2019). He stated that he was not used to experiencing difficulties; he had some difficult high school experiences. Harry had bodily and visible signs of distress; Harry stated that he would sweat, and he was sure that his facial features demonstrated his distress. He stated that he had cried during a test. The researcher asked Harry if he could distinguish between general mathematics and testing anxiety, to which he stated that he was unsure and thought it could be both. He stated that he would feel a level of anxiety with both tests and homework (but homework was lessened as he could “figure” it out) (Harry 2nd Interview, 2019). He also stated that his anxiety was his perception of expectations leveled against his ability. Harry’s perceived expectations were also a subcomponent of his identity as an achiever; thus, he likens some of his anxiousness to performance anxiety.

Harry as a teacher - RQ2

Strategies are defined as instructional preparations based on instructional beliefs, typically occurring outside of the classroom. Harry discussed his educational background, training, and ongoing professional development as strategies that he consistently engages in delivering content. In response to the interview question, 'what are some things that your academic background did not prepare you for when teaching math,' Harry replied that his educational background did not equip him with patience; however, he stated the AVID program assisted him in this area. When he first was working with students, he stated that if they struggle, that will lead to frustration. Harry fully understood that his outward display of frustration hindered his ability to help students who were struggling.

The researcher asked Harry other questions about training, education, and preparation in teaching remedial mathematics courses. Harry stated that when hired, he was given some guidance from the Chair of the Learning Support Service (LSS) department. The Chair provided Harry with a syllabus and provided ongoing advice.

Harry stated that he would seek the Chair out daily as his previous tutoring experience had not prepared him for teaching. The tutoring experience is a program in which a tutor oversees supplemental scheduled engagement. Harry stated that the program allows the students to discuss their holes in their understanding. He stated that the tutoring program's differences and teaching remedial mathematics were the levels of dedication and. Teaching is not supplementary in that it is the primary form by which information is disseminated to students. Harry connected the remedial foundation course as one in which students are equipped to engage College Algebra course material. The students' standing provides a filter for which to obtain new mathematics knowledge. Harry speaks about the interconnected nature of learning and how remedial mathematics fills in necessary gaps in understanding.

Harry stated that social interaction had impacted his ability to be effective in teaching. Previously, he stated that he struggled with social anxiety and stated that it is "very noticeable sometimes" (Harry's 1st interview, 2019). Harry stated that he had made a great improvement in this area. Harry stated that improvisation has allowed him to challenge himself to "get out there" (Harry's 1st interview, 2019). He stated that his organizational skills were lacking but that it is a new skill that he has cultivated to be effective in class. Harry stated that he had good mathematics skills, which have led to good logical and decision-making skills. Although he stated that he was good at mathematics, he never thought that he could teach math. His previous tutoring experience and his first two years teaching remedial mathematics have given him a positive outlook on his teaching ability.

In discovering Harry's teaching ability and skills, the researcher also explored nontraditional or traditional teaching concepts. Harry stated that he was a traditional teacher in that he moved through the material chapter by chapter. Additionally, he utilizes lectures mostly to disseminated course materials and utilizes formal assessments to ascertain students' achievement and knowledge levels. Harry stated that he tries unique methods of teaching when reviewing for tests. If he has success with a review technique, then he can incorporate it into his instruction delivery. The materials that are given during class sessions are also posted online.

Teaching Philosophy and Components of Good Math Lessons - RQ2

Teaching philosophy or teachers' beliefs impact strategies and instructional implementation. The researcher explained an educational philosophy as "core values in teaching" (Researcher 2nd interview, 2019). Harry stated that he does not think about the ideas of a teaching philosophies; however, is the idea that when one "knows the content should pass" (Harry's 2nd interview, 2019). Additionally, he stated that GPA is not necessarily a reflection of work ethic. Additionally, Harry thinks that the development of work ethic, discipline, or habit development should not necessarily be tied to grades. One practice that exemplifies this value is that Harry does not penalize students for submission of late assignments. Thus, Harry is unclear on how to holistically develop students without impacting their grades, but he holds this value as a component of the educational philosophy. Additionally, Harry stated that the distraction is a function of ownership, thus, if students are disengaged in class than they are responsible for their lack of learning.

In the discovery of Harry's instructional strategies and practices, the researcher made an inquiry of "what consist of a good math lesson" (Researcher, Harry's

2nd interview, 2019). Harry stated that class participation is a huge component of a good math lesson. “Whenever the class is involved and interested and curious, like, that’s, the main thing if you can get the class interested in what you’re talking about” (Harry’s 2nd interview, 2019). Harry compared an engaged class versus a non-engaged class with students’ interest in the phone as a gauge. He stated that he does not take on the authority nature of enforcing rules and or policies that are written in the syllabus. He will only intervene in disruptive behaviors when they are distracting other students.

Harry appreciates the level of engagement and works to make connections with real-life examples. He intentionally asks students what their majors are to help make relevant real-life examples. Harry proposed that there was more real-life application for the math that his students were learning as opposed to more theoretical-based math. He prompted students to ask him how math is related or connected to their field of study, if he was unaware of the connection, he did research and relied on his findings to the student.

Strategies & Evolution of Teaching Practices - (teacher to Content) - RQ2

One of Harry’s go-to educational strategies is also an educational practice, for every test and quiz, he wrote a detailed explanation for each of the problems. He then would scan the document and upload it so that students could gain a greater understanding of where the holes were in their understanding. Harry also prepared PowerPoints for each of his lessons as he found earlier on that he could not wing it and be effective. He would upload the documents to the course shell so that students could easily access and review them. Harry stated that he learned most of the strategies that he employed on the job, and he sought advice from his mother as she works in education as well. Harry's mother is an Associate Superintendent and had previously been a principal, thus, she had a background knowledge of what strategies should be employed in the classroom.

Additionally, she earned her doctoral degree in Education Administration.

Teaching strategies to address students' mathematic anxiety (teacher to student) - RQ2

The researcher asked Harry if he sensed that a student had moderate or high anxiety did his strategies or practices change? Harry first discussed how he unofficially assesses if a student has anxiety. He stated that one of the indicators of students' anxiety was their test and or quiz grades (Harry's 1st interview, 2019). He stated that this is "a big sign to me" as he does a comparison of the student's ability outside of the testing situation (Harry's 1st interview, 2019). An additional sign of anxiety is when students visibly struggle without asking for help. Lastly, Harry stated that when students work alone while doing group work can be another indicator of anxiety and makes a distinction between the type of anxiety (social anxiety). Harry admitted that he is still learning how to address students' anxiety; however, he does offer to test students in a different environment as a support in addressing test anxiety. Additionally, he also helped students one one-on-one, and Harry also worked in the tutoring center and provided tutoring hours (he sometimes worked with his students during his tutoring hours).

Teaching Practices - (Teacher to Student and Student to Content) - RQ3

Harry utilized several techniques and practices when helping students make connections with the content. He used varied colors on the board as the provide visual stimulation, he purchased extra as to ensure variation and possibly distinction in problem execution. Additionally, made sure that all of the course materials were uploaded into the course shell. He also utilized the SMART board as it makes graphing related topics easier, he used a smartphone application that allows him to draw on the SMART board. Harry allotted some time within the class period for hands-on practice. He stated that some of the students are afraid of asking questions aloud in class, thus, he walks around to assist them within them having to call attention to themselves (Harry1st Interview, 2019).

Students' interaction with Mathematics (student to content) - *RQ3*

The researcher made an inquiry about students' interaction with math if it were to match Harry's interaction with math. Harry responded that math is "relatively easy to me". Harry stated that he has figured out the logic behind math and that makes everything else easy to follow. Harry has a desire to quantify or more specifically transfer his ability to learn math to his students. If students were interacting with math in the manner that Harry does, then students would understand the logic behind math. Harry eluded to his students have both inductive and deductive reasoning, he stated that his students

struggled with materials not represented in the same exact manner in which it was taught. Harry provided an example:

> Yeah, like, yeah, the ones who struggled the most are the ones who have it the least. Okay. Like I can tell them that x plus nine x equals. 10 X. But if they see it vertically now, they think it's something different, but it's still the same. It's still the same problem, and that's the problem that I see a lot is like; whenever I change the way something looks still, they don't understand that it's the same problem if I use a division sign versus a division bar. It's the same problem, and I

try, that's what I try and establish as a teacher is that things can look multiple ways, multiple different ways. There are multiple different ways to solve problems. I want to teach you both ways, and you use it, whichever way you prefer in whatever scenario you prefer (Harry, 2019).

Students' Anxiety & Harry's response to students' anxiety - RQ3

Harry has had no formal training on how to assess students' anxiety nor on how to create interventions by which to address students' anxiety. Harry made an estimation that approximately a "strong 20%" of his students struggled with some type of anxiety (Harry's 2nd interview, 2019). As previously stated Harry utilized the test grades as an indicator of students' anxiety. Additionally, he stated that most students struggling with anxiety are less likely to seek help, thus, he makes himself readily available by making tours of the classroom and providing one-on-one tutor hours. Testing also allowed Harry to observe physical displays of anxiety or frustration, he stated that he has witnessed students "making pain expressions" (Harry's 2nd interview, 2019). He stated that some of those students have even resorted to checking, which he indicated was "out of character" (Harry 2nd interview, 2019).

He stated that students rarely told him that they were struggling with anxiety, but if they did, he would encourage them to get tutoring. He typically individualized his advice concerning ways to mitigate anxiety with any students who were forthcoming with the issue. He has often advised students on how to take better notes and for others, he had advised that they work on practice as opposed to memorization. Harry has also given test-specific advice such as skipping problems that may stress students out. Additionally, he advised that they time themselves if they speak "10 minutes" or more then it was probably a good idea to skip it and do the problems that they were able to complete and then circle back to the difficult one (Harry's 2nd interview, 2019). He also cautioned students to make sure to circle back as it is important not to leave blank space, but as a mechanism to get them through the stressful situation, skipping is advisable. Harry was able to make a distinction between students struggling with anxiety and those who may be experiencing some personal issues that are impeding their progress in the course. Harry employed some additional practices to address anxiety, such as unlimited time on tests (as he allows students to come to the tutoring center to finish their tests if they exceed the class period). Additionally, if students exceed their class period, Harry also provided excuses for students' next class professors.

Traditional vs. Non-traditional Teaching Styles (Teacher to Student), Preferred learning environments, Manipulatives, Worksheets, Software, and Videos - RQ3

Harry considered himself a traditional educator. He stated that he does not go too far outside of the box. At the time of the interview, Harry stated that he was trying to adjust to teaching requiring a ridge regiment. As a new educator, Harry was very conscious of not making mistakes that would negatively impact the students. He stated that he developed his lesson with advice from experienced teachers. At the time of the interview, he was beginning to expand and think about incorporating some peer-to-peer learning activities. In defining a traditional educator, Harry stated that educators went from chapter to chapter with mostly lectures, quizzes, graded assignments, and a test for each chapter. Harry did think that he did his test reviews differently to experiment with methods of teaching that may work. He later defined non-traditional education as one in which an educator taught online. He felt as if he then skillset was inefficient to be considered a non-traditional educator.

The researcher asked Harry what is his preferred learning environments (face-to-face, hybrid, online, asynchronous, synchronous, distance learning)? Harry responded that he has only taught in face-to-face and hybrid environments and stated that his preference is face-to-face. He stated that he did not have experience teaching via live stream. Harry stated that he utilized the following manipulatives or instructional tools when teaching: worksheets, journals, PowerPoints, and Smartboard videos. The videos were not self-made (Khan's Academy), however, Harry did demonstrations in class. He often utilized a Smartboard, however, if the classroom was not equipped, he utilized the projector along with worksheets. Harry develops the worksheets as a preview of the test. The intentional development of the worksheets allowed students to get familiar with the structure of the tests and the types of problems that they would be evaluated. Harry made the worksheets harder and allowed students access to their course materials. The desired goal is to make the actual test less intimidating, and students' confidence is boosted because of their success on the preview.

Instructional Anxiety - RQ3

Harry had experienced instructional anxiety. It was very difficult for Harry to get in front of the classroom. He stated that it was "extremely difficult" the first time and he contrasted it to his experience tutoring. The one-on-one structure of tutoring was a stark contrast to lecturing in a room of several students. He stated that walking in the level of authority that "the educator" was lofty and made him feel awkward. Harry stated that awkwardness is expected when you are not used to it, at the time of the interview, he stated that was still not used to the authority and or central role. Harry stated that the component of teaching that increased his anxiety was the discipline aspect of his new role. He stated that he is not really good at the disciplinary component of his role and stated his previous wherein he had to be firm. Harry stated that creating PowerPoint diminished his anxiety as it allowed him to focus and give clear direction to his students. Overall, the PowerPoints keep Harry and his students on track, prior to using the PowerPoint he used his notebook. The lesson plans allow him to focus on instruction and he allowed others to "handle" the discipline "stuff" (Harry's follow-up interview, 2019).

Harry stated that some of the resources that allowed him to address instructional anxiety were just confronting his fear. He forced himself to get out of his comfort zone. He took acting classes to create opportunities to be "in front of people" (Harry's follow-up interview, 2019). He treats class as a type of show as if he is putting on the caricature of an educator. Harry did think that early on students have been negatively impacted by his instructional anxiety. He stated that during his first quarter, he was "definitely rough and very noticeable" (Harry's follow-up interview, 2019).

Harry's Advice to Colleagues Struggling with Instructional Anxiety

As Harry was the only participant to state that he struggles with social anxiety, his social and instructional anxiety was compounded. He stated that he utilized several methods to help him get comfortable in front of people. One method forced him out of his comfort zone. Harry worked within drama troupes; he stated that he works on improvisations. He utilized skills that he developed within the drama experience in the classroom. Harry treated instruction like he was "putting on a show" (Harry, 2019). He stated that he treats instruction like role-playing, “I don't necessarily have to be myself” (Harry, 2019). Harry stated that “being myself is what makes me nervous and being someone else that kind of helps” (Harry, 2019).

Observations – Mathematics Classroom Observation Protocol for Practices (MCOPP)

Below is Harry’s MCOPP has a sixteen-item assessment for both class periods (See Table 4). Harry’s observations occurred with two periods of test reviews and final exam preparation. Throughout the two observations, Harry tried to incorporate some peer to peer learning activities; this was a new endeavor for him.

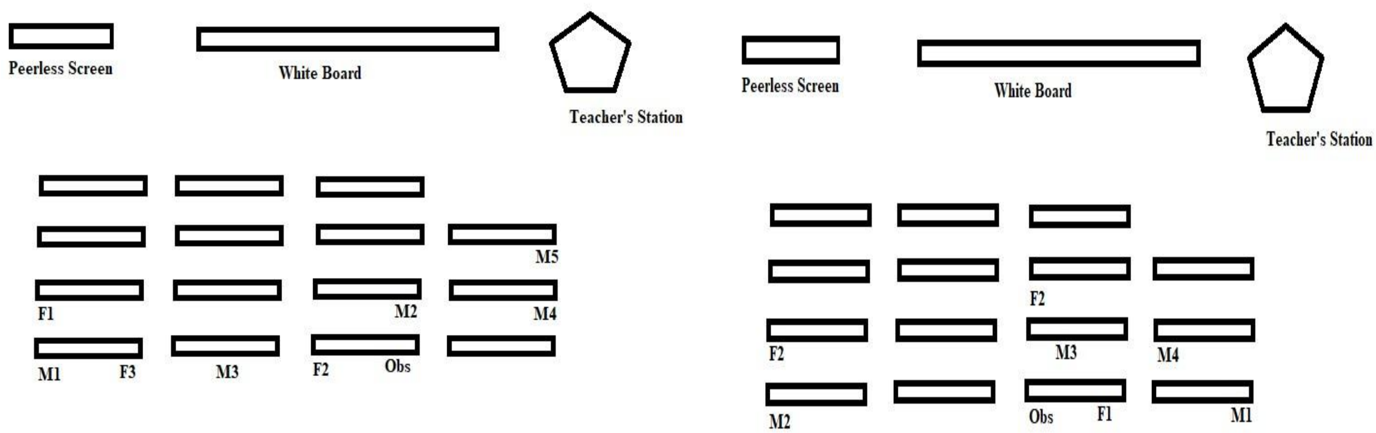


Figure 7 Harry’s Class Layout for 1st & 2nd Observations

Table 4: Harry's MCOPP (Gleason, Livers, & Zelkowski, 2017).

		1st Observation				**2nd Observation**			
Item #	Item	Student ID #	SE	TF	Problem or concept related to interaction	Student ID #	SE	TF	Problem or concept related to the interaction
1	Students Engaged in Exploration/investigation/problem solving	F1	✓	✓	Distribution property 2x^4(3x^2+2x-5)		✓	✓	
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.		✓	✓			✓	✓	
3	Students were engaged in mathematical activities		✓	✓			✓	✓	
4	Students critically assessed mathematical strategies.		✓	✓			✓	✓	
5	Students preserved in problem solving		✓	✓			✓	✓	
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.		✓	✓			✓	✓	
7	The lesson promoted modeling with mathematics.		✓	✓			✓	✓	
8	The lesson provided opportunities to examine mathematical structure. (Symbolic notation, patterns, generalizations, conjectures, etc.).		✓	✓			✓	✓	
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.		✓	✓			✓	✓	
10	The lesson promoted precision of mathematical language.		✓	✓			✓	✓	
11	The teacher's talk encouraged student thinking.		✓	✓				✓	
12	There were a high proportion of students talking related to mathematics.		✓	✓					
13	There was a climate of respect for what others had to say.		✓	✓			✓	✓	
14	In general, the teacher provided wait time.		✓	✓			✓	✓	
15	Students were involved in the communication of their ideas to others (peer to peer).		✓	✓			✓		
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.			✓		M1/M3	✓	✓	negative exponents/rocket problem

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Harry's Observations Summary

Harry engaged in all, but two of the 16 items (for both observation periods), and those two items were related to peer-to-peer engagement. During his interview, Harry stated that he was working on incorporating peer-to-peer learning activities. In one of the observations peers, he attempted to organize the students in groups, so groups organized and work more effectively together. Some students had not been fully incorporated into a group. As the concept of group work within the class was a novice endeavor both Harry and the students needed time to adjust.

Harry's instructional design and implementation allowed students to really engage in math modeling, problem solving, personal assessment, and connection to previous materials. The researcher observed that students who were vocal seemed to be conducting a verbal check for understanding. Conversely, students who were less vocal tended to have some issues with the material. Harry availed himself to those students intentionally with the goal of identifying and alleviating the holes in their understanding. It should be noted that sometimes Harry's tone and his anxiousness to move on did not "invite" group questions, however, his tone and manner slowed during one-on-one tutoring.

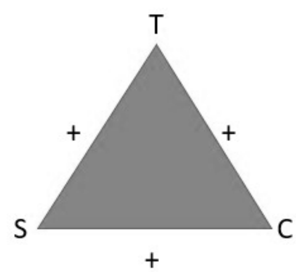
Harry utilized a number of scaffolding techniques to ensure that he was making connections with previously taught materials and introducing the new material. He revisited key tenets, rules, and procedures covered in previous classes. He would ask students to demonstrate their understanding by working and teaching their problems. If students demonstrated some issues while working and or teaching, he would allow for peer assistance, which increased peer-to-peer connection and the connection to the content.

Sarah's 1st & 2nd Interview (Combined) - RQ1

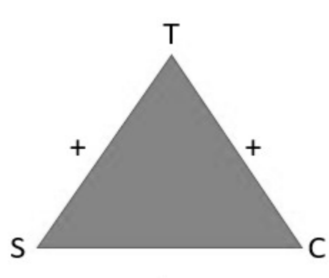
Sarah's interviews and observations were completed over several weeks in November and December, as Sarah taught an evening course and consented to morning interviews. At the initial interview, Sarah was in her mid to late-fifties and had thirteen years of teaching experience as a college remedial mathematics instructor at her current institution. In addition to her thirteen years of teaching experience, Sarah had teaching experience within the k-12 system, totaling up to 24 years of teaching experience. She had also served as the Learning Support Mathematics coordinator for several years. Sarah graduated with her undergraduate degree in Education with a concentration in Mathematics. She worked for several decades before pursuing her Master of Science in Mathematics Education. Throughout her career, Sarah traveled and taught in many different places as her husband was in the Air Force.

Sarah grew up in a household where education, specifically, mathematics education was important and applied continuously. Sarah's father was a math teacher, and early on, he would engage Sarah in mathematical principles and practices. Often Sarah's father would have her work problems, and if she got any wrong, her father always encouraged her to discover and correct her mistakes. Sarah credits her father as the origin or the start of her love of math. After high school graduation, she substituted at her local high school. Shortly afterward, she acquired a full-time job at a rival high school, and she taught there for a year and a half before getting married. Once married, Sarah moved to a southwest state where she worked as a substitute again before moving to England. Once in England, Sarah worked full-time for about five years as an elementary math teacher.

Sarah as a student – RQ1



Sarah made a strong connection with a teacher in the fifth grade, the pseudonym Mrs. Lee. Sarah only had Mrs. Lee for a short period as Mrs. Lee had to leave on maternity leave within six months. However, in that short time, she taught Sarah every subject. Although Sarah had two teachers during this period, Sarah admits to not remembering the other teacher. Sarah attributed the strong connection to Mrs. Lee's motherliness. Mrs. Lee also made the class both safe and exciting; she ignited Sarah's love for learning. Sarah made a strong connection with her peers during the same grade and kept them throughout her k-12 education. She made her strongest connection with math in the eighth-grade geometry class. Sarah said, "I just fell in love with geometry proofs. I love doing proofs, even though, you know, the teacher would do it in four steps, I would do it in 24 steps, but I did it" (Sarah's 1st interview, 2019). Throughout her k-12 experience, Sarah made very strong connections with her teacher, peers, and content. Sarah's *Instructional Triangle* showcases positive relationships between Sarah and her teacher, Sarah's teacher and the content, and Sarah and the content (Ball & Forzani, 2009). Sarah's disconnection *Instructional Triangle* depicts positive relationships between Sarah's teacher and



the content, Sarah and her teacher, and Sarah and the content (Ball & Forzani, 2009). However, during college, Sarah experienced very distressing anxiety ridding disconnection with mathematics. Sarah stated that she was lost and did not understand what her teacher and peers were doing. She would go home and attempt the work; she would read, and she would cry. She stated that she was in such distress, and although she never would attempt suicide, she thought that death would be easier. She struggled with thoughts of being a failure, and she did not have a backup plan. Sarah said, “I was struggling, and that was a terrible feeling” (Sarah’s 1st interview, 2019). Sarah did inform her professors that she was struggling in the courses. Her professors told her to “just stick with it,” and they also explained her problems.

She did not have this same experience with every difficult class; some professors did not offer extra support. She stated that one of her professors was a really smart man who talks theoretically or lofty, and he wrote fast. Typically, he erased the board in the same fast manner as he wrote. Sarah said, “he was erasing the board before I even got through the first part of it” (Sarah’s 1st interview, 2019). Although there was a level of intimidation of this professor, Sarah had great admiration for him, and he was very influential in her desire to teach algebra. After successfully navigating her first course, Sarah took additional courses with Calculus(s), Differential Equations, Linear Algebra, and Abstract mathematics courses. He was always willing to help her.

Sarah said that she mitigated her fear, anxiety, and stress by forming connections with other students. She became fast friends with the “smartest girl in the class” (Sarah’s 1st interview, 2019). The girl would tutor Sarah, and Sarah also went to academic tutoring. Sarah describes the anxiety as not having as much impact during homework as it did during the test. Sarah's understanding that only tests and quizzes served as her grade impacted her connection to the content. Sarah felt as if she was an anomaly; she felt as if everyone else knew what was happening in the course. Sarah felt that a pivotal understanding that she gained from the stressful or anxiety-related experience was not realized until she went to get her Master's degree at 48. She overcame anxiety and discovered that she had a strong math self-concept as she was a straight-A student throughout her program. Sarah stated that her experience, both the successes and the challenges informed how she teaches.

Sarah as a teacher - RQ2

Prep work is a pivotal strategy that Sarah engaged in when developing and engaging the course materials. She typically reviewed the course book, studied it, and worked to develop her examples. Additionally, she examined the homework problems to devise a plan for her students. Sarah stated that this exercise of prep work is essential to her comfortability of orienting students with the course materials. "if I'm not prepared then I can't feel that I can prepare them" (Sarah's 2nd Interview, 2019). The course book is a foundational element in Sarah's preparation, once this prep work is done it provides Sarah with the freedom to "change" things up later (Sarah's 2nd Interview, 2019). She stated that she makes up a "zillion" test each quarter (Sarah's 2nd Interview, 2019). Sarah spends a good deal of time working on class material.

Teaching Philosophy and Components of Good Math Lessons - RQ2

Sarah's teaching philosophy is that all students can learn. Furthermore, if students have any kind of struggle, there is a reason for the struggle. The statement and thought that there is a reason, lends itself to assessing the cause for students' struggles. Sarah states that there could be many reasons that students struggle, including but not limited to not putting in enough time, or there is a disconnect from the materials (a struggle similar to her disconnection experience). Sarah did try to ascertain what students struggled with and provide a solution. Sarah's assessment even allowed her to discover if students are struggling with laziness. She did not explicitly share her philosophy that if there is a struggle, there is a reason and solution that would allow students to learn. She did share her willingness to help students during the first day of class.

At the time of the interview, Sarah taught full-time and conducted office hours. In providing support for students, Sarah discussed how she tries to meet students at their point of need. Additionally, Sarah practiced a balanced life to ensure that she was maintaining self-care. Thus, when office hours were over, Sarah went home to her husband and their dogs.

Sarah stated that one component of a good lesson is to inform students of what they will be doing during each class period. Additionally, writing everything down to provide a framework for which students can follow along. Putting a clean copy of problems on the board and then rewriting the problems to work through the process and or steps. The clean copy allows students who write slower to have the initial start to any problem. Sarah learned this tip at a conference. Sarah stated that another component would be to show every step, this allowed students who may get lost while working on a problem to pinpoint an area of concern.

Strategies & Evolution of Teaching Practices - (teacher to Content) - RQ2

Sarah discussed the advancement in the materials that she has taught. She stated that earlier on she was primarily teaching courses that may not be as rigorous and complex as the courses she has taught most recently. Additionally, Sarah discussed the coverage of material, previous she felt as if more material was covered (as she eluded to the level of preparedness of the students as an agent in that). Currently, Sarah has had to make adaptations to ensure that content is covered, she stated that this is a real struggle. Sarah made her adaptations to the needs of the students and eliminated some of the extraneous materials as she wanted to ensure that her students were equipped with the necessary skills and knowledge that they would utilize in their upcoming courses.

Teaching strategies to address students' mathematic anxiety (teacher to student) - RQ2

The researcher asked Sarah if the strategies that she employs are curtailed to students who may be struggling with moderate to high anxiety. Sarah stated that she came up with different ways in which to present the problem. She worked the problem in a number of ways, and she tried a number of problem-solving techniques. One problem solving technique is to engage the students in their own problem-solving processes. Sarah does subscribe to peer-to-peer learning engagement. She stated that she has to be intentional about this endeavor as she is a "traditionalist" and leaned more towards lecturing (Sarah's 2nd Interview, 2019).

Teaching Practices - (Teacher to Student and Student to Content) - RQ3

Sarah put students into groups and then allowed students to teach. The method of group problem solving is much like Think-Pair-Share whereby students engage and then teach to the collective. Additionally, she had other groups work on the same problem and make distinctions between processes and the correct solutions. If the solutions were incorrect, Sarah engaged the class in a search to figure out what went wrong. Sarah stated that she learned most of her go-to practices at conferences and talking to other colleagues. She also read different educational articles and prescribed educational books.

Students' interaction with Mathematics (student to content) - RQ3

If students were interacting with math in the manner that Sarah's interacts with math, students would be empowered. Sarah stated that she would have students develop consistency with class attendance. Additionally, those students would be going to see their professor and going to tutoring to ensure that they "don't fall behind". If students were to interact with math in the same way as Sarah, they would also utilize their textbook and search out the examples and write them down. If students in Sarah's class were interacting with math in the same manner as Sarah, they would be studious, prepared, and take ownership of their learning experience.

Students' Anxiety and Sarah's Responses to Students' Anxiety- RQ3

Sarah stated that 50% of her students struggle with some type of anxiety. She stated that one indicator of anxiety for her was avoidance. Sarah stated that she had not received any formal training on how to assess and create interventions to address students' anxiety. She stated that some students are forthcoming with their anxiety, frustration, and or concerns. She provided an example of a student that struggled with dyslexia, the student emailed her to state her concerns of falling behind. The student proposed a weekly meeting in which, Sarah reviewed the proposed times that would work for them both. Additionally, Sarah informed the student of the tutoring services and the available times of services. Sarah referred the student to the Success Center to ensure that the student has all of the accommodation services available for every one of the student's classes. Lastly, Sarah advised the student to choose courses that met every day as opposed to a hybrid (self-paced) course that met fewer times.

Sarah stated that she believed that some of her students struggled with text anxiety, however, there are some students who just needed to study more. For those who struggled, she stated that they often preferred to email her with their concerns. Typically, students who struggled emailed after they got their first test back. She stated that often times when students have been extremely shy in class, they would have in-depth conversations via email. She worked to alleviate their stress by showcasing her willingness to help them. She was conscious of their needs during instruction, she placed emphasis of test items. She provided methods for studying and retention of formulas and other important information. Overall, she worked to calm them as much as she could, some of her attempts worked and some did not. Sarah provided several examples by which students who took her advice succeeded and those that failed to take her advice did not fare so well. One student who struggled with test anxiety visited Sarah prior to each class and she successfully passed the course with a B.

Traditional vs. Non-traditional Teaching Styles (Teacher to Student), Preferred learning environments, Manipulatives, Worksheets, Software, and Videos - RQ3

Sarah stated that she was both traditional and non-traditional in her teaching methodology and style. She lectured but also engaged students in their own problem solving. She ascribed to student-centered learning and having group work allowed the students to teach and figure things out on their own. Sarah stated that refraining and allowing students to "teach" is a non-traditional approach. She stated that some time there is an inner conflict "sometimes I fight with that, you know, like I'm okay, anybody can do it it's better as good as me, that's not true, you know there's a lot of times where a student will say it so much better" (Sarah's 2nd Interview, 2019).

The researcher asked Sarah what is his preferred learning environments (face-to-face, hybrid, online, asynchronous, synchronous, distance learning)? Sarah responded that she likes both face-to-face and hybrid course frameworks. She stated that she utilized the following manipulatives or instructional tools when teaching: videos, worksheets, and videos. The videos were not self-made (Mr. Wit with Fort Bend Tutoring). Sarah noted that Mr. Wit teaches much in the same way that she does, as with hybrid classes this may be very important for students with limited face time with their instructor (Sarah's 2nd Interview, 2019).

Instructional Anxiety - RQ3

Sarah had experienced instructional anxiety. Typically, she experienced instructional anxiety when teaching a class for the first time. She stated that she is not comfortable with the materials and questions if she is presenting them correctly. Sarah stated that she does not like to read off of notes and would prefer that it is more organic. Thus, because the first class required Sarah to read and follow a type of script it caused her stress. The researcher asked Sarah to think back to the first time that she ever felt instructional anxiety, she stated that it was the first time that she taught at or in a community college. She stated that she was extremely nervous, and she attributed it to the "college" environment. Sarah mitigated the anxiety by acquainting herself with and making stronger connections with students. Sarah explained a most recent account by which she had to teach quantitative reasoning which has a subset of probability and statistics. She stated that she is not good at stats and probability and was "freaking out" that she had to reach it and was not comfortable with it (Sarah's 2nd Interview, 2019). Preparation work allows Sarah to get familiar with and work on her discomfort and anxiety.

Sarah's Advice to Colleagues Struggling with Instructional Anxiety

Sarah stated that she would provide her colleague with some reading materials that she has acquired through institutional and departmental readings, meetings, and conferences. She stated that she does not necessarily do a deep reading of the materials, but she used useful information. Sarah has used information related to "student-centered learning" (Sarah, 2019). She stated she has gleaned from the *Small Teaching* book by James Lang (2016).

Observations – Mathematics Classroom Observation Protocol for Practices (MCOPP)

Below is Sarah's MCOPP has a sixteen-item assessment for both class periods (See Table 4). Sarah's observations occurred with two periods of test reviews and final exam preparation. Students were asked to bring in their old test, and Sarah highlighted problems on each test that would appear on the Final Exam. Here are layouts of Sarah's class

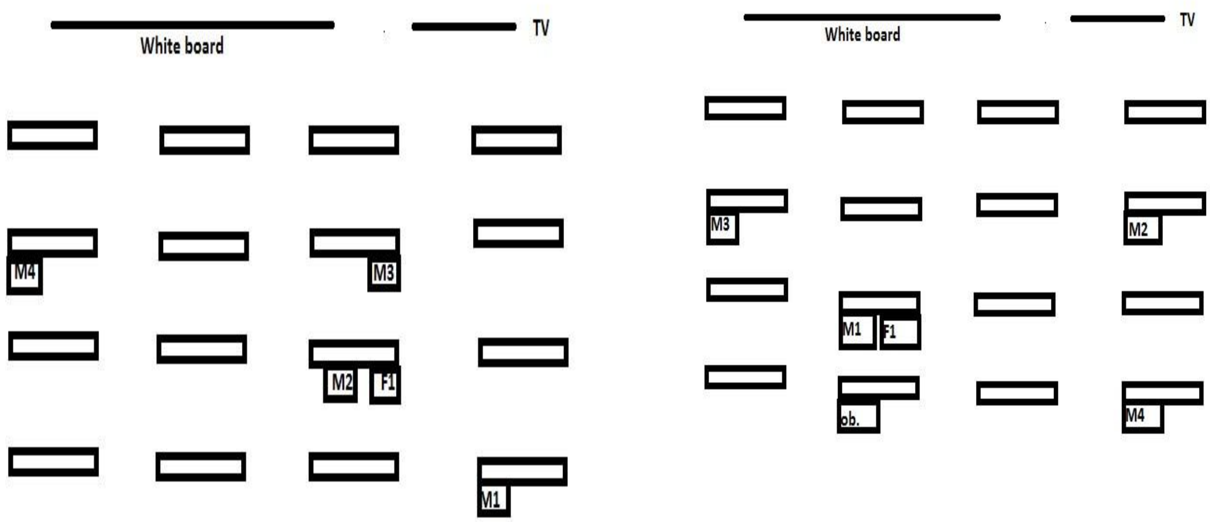


Figure 8 Sarah's Class Layout for 1st and 2nd Observati

Table 5:Sarah's MCOPP (Gleason, Livers, & Zelkowski, 2017).

		1st Observation				**2nd Observation**			
Item #	Item	Student ID #	SE	TF	Problem or concept related to interaction	Student ID #	SE	TF	Problem or concept related to the interaction
1	Students Engaged in Exploration/investigation/problem solving		✓	✓			✓	✓	
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.		✓	✓			✓	✓	
3	Students were engaged in mathematical activities		✓	✓				✓	
4	Students critically assessed mathematical strategies.		✓	✓					
5	Students preserved in problem solving		✓	✓			✓	✓	
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.		✓	✓			✓	✓	
7	The lesson promoted modeling with mathematics.		✓	✓			✓	✓	
8	The lesson provided opportunities to examine mathematical structure. (symbolic notation, patterns, generalizations, conjectures, etc.).		✓	✓			✓	✓	
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.		✓	✓			✓		
10	The lesson promoted precision of mathematical language.		✓	✓			✓	✓	
11	The teacher's talk encouraged student thinking.			✓			✓	✓	
12	There were a high proportion of students talking related to mathematics.								
13	There was a climate of respect for what others had to say.		✓	✓					
14	In general, the teacher provided wait time.		✓	✓				✓	
15	Students were involved in the communication of their ideas to others (peer to peer).		✓				✓		not planned but occurs.
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.	M1/M3	✓	✓	negative exponents/rocket problem			✓	

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Sarah's Observations Summary

Sarah engaged in most of the 16 items (for both observation periods), and both of observation periods were test reviews. Thus, items that engage students in materials in a "new" manner were not optional. For example, the item "preserving in problem solving" is rather difficult when the instructor is just going over a problem (Gleason, Livers, & Zelkowski, 2017). Sarah reviewed and reworked several problems and provided an opportunity to 1) check for students' holes in their understanding, 2) have students "teach" the portion that they knew, and 3) ensure students' comfortability level in completing similar problems on the test. Sarah did not "organize" peer-to-peer engagement; however, it did occur organically while students were "teaching."

Sarah's instructional design and implementation allowed students to really engage in math modeling, problem solving, personal assessment, and connection to previous materials. The researcher observed that students who were vocal seemed to be conducting a verbal check for understanding. Sarah utilized a number of scaffolding techniques to ensure that she was making connections with previously taught materials. She revisited key tenets, rules, and procedures covered in previous classes. She asked students to demonstrate their understanding by working and teaching their problems.

LeAnn's 1st & 2nd Interview (Combined) - RQ1

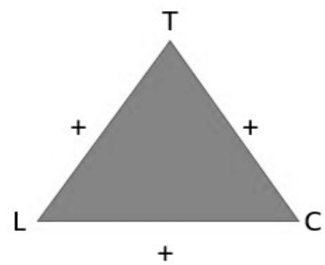
LeAnn is the only internationally born participant and the only participant to work at three institutions simultaneously. LeAnn's interviews and observations were completed over the span of several weeks. At the time of the initial interview, LeAnn was in her early to mid-forties had nineteen years of teaching experience as a college mathematics instructor, and had at some point worked at two to three institutions concurrently. One of her positions also worked in tandem with a High School, thus, LeAnn could at any given semester be teaching within 4 different educational environments. at her current institution. LeAnn received all of her formal education in Russia, she graduated with both her two undergraduate degrees (Mathematics and Education) and a graduate degree in Mathematics. After completing her education, she worked in a high school teaching mathematics. After a year, LeAnn joined a travel business company wherein she did quantitative work which also required her to understand computer coding. As LeAnn made the transition professionally, she also got married, her husband was an American scientist. She worked for the travel company for sixteen years and decided to return to math. She worked as a private tutor, tutoring different mathematics topics including algebra and calculus.

Consequently, LeAnn's husband's job was transferred back to America. LeAnn enrolled as a student at a technical college, where she was learning English. She took several English and professional development courses and later served as a tutor. After observing LeAnn's skills, she was offered an Adjunct Mathematics Instructor position the following semester. Initially, LeAnn taught only one course, during that time she was mentored and would routinely observe her mentor's teaching strategies and practices.

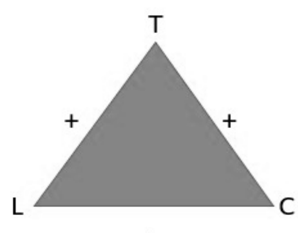
She taught Learning Support mathematics the first year and then started teaching College Algebra. Her initial teaching experience allowed her to expand her employment to other local institutions. Just prior to the interview, LeAnn had at some point worked at three colleges or universities and a few high schools. She would go on to be hired full-time at the local university, where she taught the learning support course, as well as College

Algebra.

LeAnn as a student – RQ1



The image to the left is an *Instructional Triangle*, which depicts positive relationships among all the elements (Ball & Forzani, 2009). LeAnn's 5th – 9th-grade teacher had a very strong impact on LeAnn and LeAnn's love of math. LeAnn stated that her teacher said that she needed to "do math" (LeAnn's 1st Interview, 2020). Her teacher encouraged her to enter academic competitions such as the Olympics where LeAnn won a number of medals. Her teacher also encouraged her to attend math clubs. Eventually, LeAnn's teacher encouraged her to pursue a career as a Math Teacher.



The image to the left is an *Instructional Triangle* which depicts positive relationships of the teacher to content and the teacher to students, however, it also depicts a negative relationship between the student and the content (Ball & Forzani, 2009). LeAnn stated that she did not have her first anxious, frustrating, or disconnection experience until she was in her graduate program. LeAnn was enrolled a multivariable calculus course. She was just pleased to pass the course as it was very difficult for her. LeAnn stated that she did not inform her professor that she was struggling in the course, when the researcher asked if she had a "do over" would she ask, she replied "no" (LeAnn's 1st Interview, 2020). She stated that she did not have a problem with the delivery of the materials, her greatest issue with the course was with the content itself. LeAnn stated that she self-mitigated her anxiety by exercising. She experienced very strong feelings of anxiety and stress while in the classroom; however, when she was home, she stated that those feelings would be abated. Studying really helped LeAnn stated that a key component of her success was studying intensely and consistently. She stated that her peers did not fare well in the class well, because the course and the program were “tough” (LeAnn’s 1st Interview, 2020).

LeAnn as a teacher - RQ2

LeAnn stated that she watched videos and prepared lecture notes. She utilized the textbook and always researched new changes in problem design and problem-solving techniques. In completing the lecture prep, she is very conscious of areas of potential challenge and or confusion for students. LeAnn stressed the importance of prep work as she utilized both PowerPoints and documents.

LeAnn stated that upon being employed full-time she was granted 3 mentors who guided her in learning strategies and practices. She also attended workshops offered to university employees. She also attended an Algebra Symposium sponsored by a math textbook publisher. She collaborated with other educators in presenting workshops for other educators. Additionally, she was able to work with other educators in developing potential math problems, as well as improve problem solving methods demonstrated within the textbooks. With the workshops, videos, and mentorship, LeAnn actively looked for ways by which to make learning more accessible to students.

Strategies and Evolution of Teaching Practices (teacher to content) – RQ2

LeAnn had a professional detour as she worked in travel for over 16 years, she returned to education through her employment as a private tutor in her home country. LeAnn married and later moved to the United States and began language and professional development classes at a local community college. She acquired a tutor's position at which time other professors saw her depth of knowledge and asked her to consider becoming an adjunct mathematics instructor. Thus, she served one semester as a tutor prior to acquiring an adjunct position. Initially, she was only asked to teach learning support or developmental classes; however, within a few semesters, she was asked to teach college algebra and more advanced mathematics classes. LeAnn felt that the greatest change or evolution in her strategy development and teaching practices was her
"experience".

LeAnn stated that she employed different techniques and different examples during her in-class practices. Additionally, LeAnn stated that she has also further developed more assignments that exemplify the content. Experience has allowed LeAnn to discover what worked well and what did not work well for both the students and her. In discovery, she sharpened her techniques which allowed her to help students make connections with the content. Additionally, LeAnn created systems that she used to develop strategies and practices, but she still utilized her course prep and notes. "Yeah, I love that little by little, getting better and better". LeAnn stated that this process starts over when she teaches a new class.

Teaching Strategies to address students' mathematics anxiety (teacher to student) – RQ2

LeAnn stated that when students have struggled with mathematics anxiety, she has sought solutions that make the lessons more accessible. Thus, as course preparation is very important to LeAnn, she used it to analyze techniques that were not working for students. She also brings supplies to class as support for students who may struggle with anxiety (bottled water, etc.).

Students' interaction with Mathematics (student to content) - *RQ3*

LeAnn stated that if students were interacting with math in the same way as she was, they would be feeling joy. LeAnn stated that she really enjoys doing math. Additionally, she stated that she thinks about "50%" of her students are enjoying it as well. LeAnn modeling her joy and connection with the content can be a way in which students can find that joy and connection for themselves. If is very difficult to learn from a teacher that is not enjoying their connection to the content or the students. LeAnn has stated that she enjoys both connections.

Teaching Practices (teacher to student) – RQ3

She normally provided students with practice tests that have 45 questions, 35 of which most likely will appear on the test. LeAnn provided students with a number of worksheets to practice, as well as directed them to assignments with the Pearson MyMathLab program (Trigsted, 2012). LeAnn stated that one of her go-to practices is to complete a review of previous problems from the last class. Additionally, she does a check for understanding through short quizzes at the start of class. She put a number of problems on the board some with multiple choices that are simple enough for students to solve. She was able to give students instant feedback and help them in the problem-solving process.

Students' Anxiety and LeAnn's Responses to Students' Anxiety- RQ3

LeAnn worked at 3 different institutions; thus, she had three different percentages of students who struggled with mathematics or test anxiety: 60%, 30%, and 30%. She stated that one indicator of anxiety for her was avoidance. LeAnn stated that she had not received any formal training on how to assess and create interventions to address students' anxiety. She did think that training would be beneficial for teachers to receive training on assessing anxiety and creating interventions. She stated that some students are forthcoming with their anxiety, frustration, and or concerns.

LeAnn contemplated ways in which to help her students. She advised the students to try their best and scheduled a makeup test for students who had a very difficult time during their tests. The aim of the rescheduled test is to help calm the students' nervousness and give them an option, "I think it's just because you offer them an alternative" (LeAnn's 1st Interview, 2020). Typically, LeAnn had conversations with the students privately as she knew that she could not accommodate every student. LeAnn stated that she does give advice to students, and students who take her advice fare well in the class. She stated that when students have failed her class, typically the reason is not related to school, or it could be a lack of preparation.

LeAnn provided an example of an incident with a student who informed her that he was anxious. During a test, one of LeAnn's male students had a panic attack and fell out of his seat. Fortunately, a fellow student was an RN and was able to provide some instant treatment for the student. LeAnn stated that this encounter is atypical, additionally, she mentioned that the student was on medication. As a result of this incident, LeAnn keeps additional water in the classroom to address some of these types of situations.

Traditional vs. Non-traditional - RQ3

LeAnn stated that she thought that she could be a good math teacher in high school. She considered herself to be a blend of a traditional and non-traditional teacher. LeAnn defined a traditional educator as an educator who uses books, papers, and lectures as the primary means for which to educate students. Additionally, she defined nontraditional educators as one in which an educator engages students with and through other mediums such as: "online assignments, videos," and assigned readings" (LeAnn's 2nd Interview, 2020). Overall, LeAnn believed that she relied on some of the traditional methods of teaching while she incorporated new techniques to ensure student engagement. LeAnn believed that traditional methods allowed her students to develop habits and modern techniques enabled her students' motivation. At the time of the interview, LeAnn was teaching several face-to-face classes and one online course. LeAnn stated that she utilized the following manipulatives or instructional tools when teaching: videos, worksheets, and videos. LeAnn used both third-party videos and self-made videos.

Instructional Anxiety – RQ3

LeAnn stated that she has struggled with instructional anxiety, particularly when she is teaching content for the first time. She stated that she thought that her instructional anxiety did have an impact on her students. She stated that she has used a number of techniques to self-mitigate instructional anxiety, normally an in-the-moment technique is to slow herself down while teaching. She slows herself down and then repeats the information. She also drinks coffee to keep her energy levels up. LeAnn also used course prep as another technique to self-mitigate instructional anxiety. She utilized the prep to practice and rebuild course materials. She paid attention to the course prep when she has to teach from a new textbook. LeAnn built her trust by teaching the subject matter repeatedly. LeAnn stated that she would advise other educators struggling with instructional anxiety to "breathe."

LeAnn's Advice to Colleagues Struggling with Instructional Anxiety

LeAnn stated that she would advise her colleague to engage in deep breathing exercises, as several resources state that breath can serve to relax and calm anxious individuals. During the interview, the researcher demonstrated a deep breathing technique that she learned while offering therapeutic services to individuals struggling with anger and anxiety. The technique asked participants to start breathing through their nose, hold for three counts, and then exhale through their mouths. Participants did five cycles of this before a new instruction was added. On their next inhale, the facilitator asked participants to tighten their feet muscles and hold for three counts and on the exhale then release. The facilitator will move throughout the entire body, including the face, at which point the participants are more relaxed. The facilitator informs the participants that they can use it before testing or just like to relax their bodies (also when they are angry). LeAnn also stated that she engages in breathing as well as exercise as a method of self-mitigating anxiety. She also spends an intensive amount of time in course preparation (word documents and textbook reviews).

Observations – Mathematics Classroom Observation Protocol for Practices (MCOPP)

Below is LeAnn's MCOPP has a sixteen-item assessment for both class periods (See Table 4) (Gleason et al., 2017). LeAnn covered radicals for the 1st observation and factoring for the 2nd observation. LeAnn highlighted problems on the worksheets, practice tests, and PowerPoint. She reviewed rules, procedures, and examples. She also provided students with an opportunity to practice. During one of the class periods, LeAnn allowed students to work on some sample problems together. The classes are rather large as it relates to other participants' class sizes. LeAnn's primary practice is lecture-based.

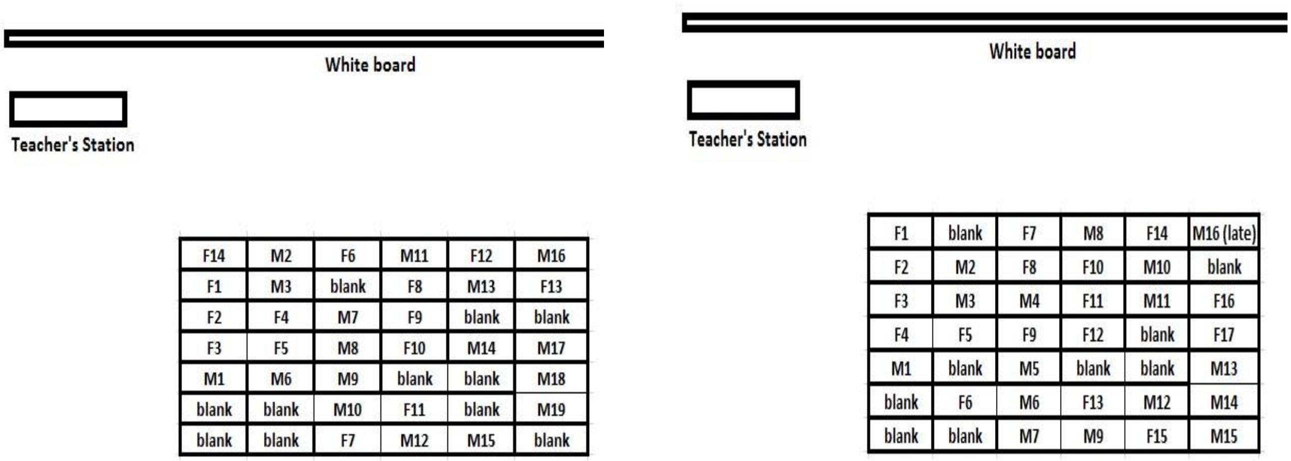


Figure 9 LeAnn's Class layout for the 1st & 2nd Observations

Table 6:LeAnn's MCOPP (Gleason, Livers, & Zelkowski, 2017).

		1st Observation				**2nd Observation**			
Item #	Item	Student ID #	SE	TF	Problem or concept related to interaction	Student ID #	SE	TF	Problem or concept related to the interaction
1	Students Engaged in Exploration/investigation/problem solving		✓	✓			✓	✓	
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.		✓	✓			✓		
3	Students were engaged in mathematical activities		✓	✓			✓	✓	
4	Students critically assessed mathematical strategies.		✓	✓			✓	✓	
5	Students preserved in problem solving		✓	✓			✓	✓	
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.		✓	✓			✓		
7	The lesson promoted modeling with mathematics.		✓	✓			✓	✓	
8	The lesson provided opportunities to examine mathematical structure. (Symbolic notation, patterns, generalizations, conjectures, etc.).		✓	✓			✓		
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.			✓			✓		
10	The lesson promoted precision of mathematical language.		✓	✓					
11	The teacher's talk encouraged student thinking.		✓	✓			✓	✓	
12	There were a high proportion of students talking related to mathematics.							✓	
13	There was a climate of respect for what others had to say.			✓				✓	
14	In general, the teacher provided wait time.			✓				✓	
15	Students were involved in the communication of their ideas to others (peer to peer).						✓		
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.						✓	✓	

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

LeAnn's Observations Summary

LeAnn engaged in a number of the 16 items (throughout both observation periods). Both observation periods were guided by PowerPoint presentations with board work examples. LeAnn is very soft-spoken in the class, thus, there is not a great deal of peer-to-peer interactions. Most of the students are very attentive to LeAnn's words and actions. LeAnn is very thorough in providing explanations for the rules and processes for each problem. She highlights problems on the practice exam and matches them with those on the homework assignment. Very few students were vocal in providing input when problem solving, there was also limited paired problem solving. The class periods are high lecture and demonstration. A few students asked questions, LeAnn is very attentive in answering the questions and testing the students for their understanding.

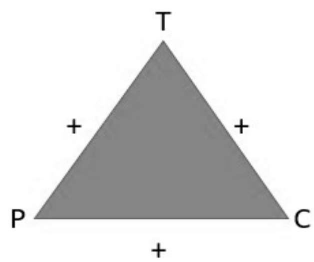
The class size is very large, and it would be difficult to have paired problem solving without noise becoming an issue. The class being loud could have also posed a problem for students who may struggle with anxiety as peers are also an environmental element of anxiety (Uusimamki & Nason, 2004). LeAnn provided students with practice tests and if other students were missing their hard copies, they were allowed to check one out from LeAnn. LeAnn did encourage the development of good note-taking and study skills. She encouraged students to build habits by way of practice, she was very intentional in connecting the in-class lectures with the students' MyMathLab homework (Trigsted, 2012). The worksheets actually included the homework section numbers so that students could both anticipate the type of problems and also have a solid example of how to solve them.

Penny's 1st & 2nd Interview (Combined) – RQ1

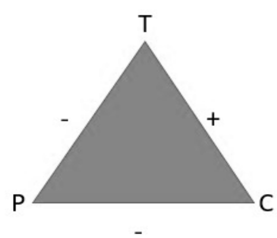
Penny's interviews and observations were completed over the span of several weeks. At the time of the initial interview, Penny was in her early to mid-fifties and had twenty years of teaching experience as a college mathematics instructor. She graduated with her bachelor's degree in Education and student taught in local Florida county. After which, she sought employment within both Florida and Georgia school systems. Penny made a decision to accept a position with the Department of Family and Children Services as she was unsuccessful in securing a job within either of the Georgia or Florida education systems. She worked with several different county DFACS departments for several years, until she was approached by a friend and asked if she would like to teach mathematics at a local community college.

Thus, after several years in DFACS, Penny returned to education and worked as an adjunct instructor. Initially, she worked on a part-time basis and was promoted to full-time (no tenure track). During her tenure, Penny pursued and obtained her master's degree in Educational Leadership. Penny has also served with the Faculty Senate and has influenced curriculum design for the Learning Support courses. The institutions that she was employed at the time of the interview, underwent a merger of several community colleges. She worked with leadership at both the satellite institutions and her locale to ensure seamless quality education for enrolled students.

Penny as a student – RQ1



Penny developed her love for learning from her parents. During her elementary and middle school education, Penny thrived and really made a connection with the teachers, content, and her peers. Penny recounted her connection with a teacher named Mrs. Darby (Pseudo). She had great relationships with her peers and would often work ahead of the class. She was enrolled in advanced classes and in high school was dual enrolled in several college classes. Penny's connection *Instructional Triangle* showcases positive relationships between Penny and her teacher, Penny's teacher and the



content, and Penny and the content (Ball & Forzani, 2009). Penny's disconnection *Instructional Triangle* depicts two negative relationships between Penny and her teacher and Penny and the content (Ball & Forzani, 2009). Penny's disconnection *Instructional Triangle* depicts one positive relationship between Penny's teacher and the content (Ball & Forzani, 2009). Penny revisited a time in which she felt a strong disconnection with the content, she was a college student, wife, and mother. The content was Linear Algebra, she experienced a disconnection with the teacher and the content. She explained that the course was lecture-centered and fast-paced. She often felt a spike in her anxiety when she had to take a test. Penny seemed to be intimidated by the faculty member. She did not ask her faculty member for help; however, she did seek assistance from her peer. She worked well with a peer in which he would reteach her concepts that she did not fully understand while in class. At the time of the interview, Penny stated that if she had a "do over" she still would not ask her faculty member for assistance. She stated that her courses taught a number of high-level courses with theory or history of mathematics, and she felt as if these classes did not especially prepare her to teach.

Penny as a teacher – RQ2

Penny stated that her disconnection experience informed her teaching practices, as she stated that it is very important to be aware that "life is happening" for her students (Penny's 1st Interview, 2020). She also acknowledged that even the best of students may struggle with anxiety when tested. Penny stated that she has attended conferences that inform some of her strategies. Additionally, she was mentored by a number of full-time faculty once she accepted her appointment. She now offers that mentorship to new incoming faculty members. She utilized some of those resources and information in preparing her lesson plans.

She worked with several other professors to create the math textbook that is utilized to teach Quantitative Reasoning at her institution. Additionally, she and others worked with a software company to develop a web-based program that provides students with built-in homework assistance such as: (help me solve, show me this in the book, ask my instructor). The system is also equipped with practice tests and a self-paced, auto-grading system. Penny normally prepared PowerPoint presentations of the lessons as she utilized a smartboard. She was very intentional about ensuring that her lesson spoke to diverse learning styles (especially visual learners) (Penny's 2nd Interview, 2020).

Teaching Philosophy and Components of Good Math Lessons - RQ2

A tenet of Penny's educational philosophy is that learning is something that "we should always strive to do" and 'we should never stop learning" (Penny's 2nd Interview, 2020). Essentially, she believed that life is about always learning. She stated that she does not directly share her teaching philosophy with students; however, she does intend to write it up and post it in her office. Penny has worked in both online and face-to-face environments, her preference is face-to-face. At the time of the interview, she taught Monday through Thursday. Penny felt that some components of a good math lesson include a review of previous math lessons, questions about homework, introduction of new topics, example problems, class problems, and homework. Penny also provided her students with practice tests and final exam preview problems.

Strategies and Evolution of Teaching Practices (teacher to content) – RQ2

Penny stated that the evolution of her teaching practices has a lot to do with systematic changes to the curriculum overall. Additionally, the courses have been redesigned to serve the co-requisite model of the institution. Lastly, Penny's institution went through a reorganization that also impacted the course design. Initially, the course covered a number of technical and business math concepts. Penny along with other instructors developed the course and the course materials. Thus, Penny along with the other instructors was able to streamline the materials to speak to the next course that students were slated to enroll in. She stated that course prep was very important. During the time of the interview, Penny relied heavily on technology and her students are now relying on technology as they utilized software to submit their assignments.

Teaching strategies to address students' mathematic anxiety (teacher to student) – RQ2

Penny stated that it is important to have foresight on how to navigate difficult materials, this is one of her strategies for lessening students' anxiety. She normally informed students of the difficult materials and strongly encouraged them by letting them know that would get through it together. Penny stressed- partnership allowed students to know that they would not struggle alone. As she encouraged them through the hard materials, she also stated that it would get easier afterward. Additionally, Penny gives some flexibility on tests and allows her students to complete test corrections, as a way in which to speak to test anxiety. She also utilized group work as it helps students figure out problems together.

Teaching Practices (teacher to student) – RQ3

Penny stated that one of her go-to practices is showing examples. She stated that she could not explain the topic without showing an example. Penny stated that she systematically approaches teaching the material by providing the context of how each variable will work separately and interconnectedly "give the general, this is how it's gonna work here with A's, and B's and C's in it". Additionally, Penny utilized corporately working through the plan of a problem and working problems together. She also had the class work in groups to figure out problems and then had a volunteer to teach it on the board. She stated that it was important for volunteers to know that it was safe and was very intentional about highlighting their good points.

Penny also scheduled practice days a day before the test wherein students would complete a practice quiz that was very similar to actual test. On practice day, Penny was intentional to go over every detail step by step. She would also give the students a hard copy of the practice test so they can continue their test preparation (this document would also be helpful if Penny gave cumulative final exams). Penny would stress to students that if they could "do these problems, you can ace the test". When assigning homework, Penny is very conscious of informing students of the topics and their alignment with the homework assignments. She was very conscious of presenting information in various ways to ensure that all of her learners were taken care of (visual, spatial, and tactile). She tried to make sure that the materials

Students' interaction with Mathematics (student to content) - RQ3

Penny discussed the joy that she gets when a student changes their mindset. Penny likes to see the transformation when students come to class with a fixed mindset, that they are not good in math (Dweck, 2006). Penny stated that this is one of her pet peeves as this is a self-defeating mindset, she encouraged students they change their words to "I'm not good at math yet but I'm going to get better". She was encouraged by students who gained the mindset of improvement and continuous work to get better. Penny believed that all students could improve from where they start with their desired goal in mind. She stated that even if students are the best, they can always get better "there's room for improvement for everybody". Penny stated that having the conversation with students prompts them to start thinking differently.

Students' Anxiety and Penny's Responses to Students' Anxiety- RQ3

Penny approximated that about half or 50% of her students struggled with mathematics or test anxiety. She thought that sometimes students developed anxiety because “they’re not good at math” (Penny’s 1st Interview, 2020). She stated that she would have liked to be instrumental in changing this for her students; however, most have had this struggle throughout “grade, middle school, and high school” (Penny’s 1st Interview, 2020). One of Penny’s greatest frustrations is when educators tell students that they are not good at math either as a child or an adult. She stated that she has seen the negative impact that those statements have on students long after they have graduated from grade, middle, or high school. As a result, Penny had a greater awareness of her students struggling with anxiety and her students felt comfortable telling her when they were struggling with the content. She often saw the displays of anxiety during testing, some notable attributes were students who were successfully in class freezing up on tests.

Penny stated that she has responded very empathetically, she walked around the room to see how she can assist students. She provided students with easier problems to build their confidence and skill level. Penny also was intentional about checking for understanding for every student, and not just the students who are vocal. One of Penny’s greatest joys is when a student overcomes their “self-defeating” mindset (Penny’s 2nd Interview, 2020).

She made herself available to her students outside of class and would often have conversations (individually or with the whole class) concerning their mindset. As Penny spoke to students who stated that they were struggling with anxiety, she would ask that they not put too much pressure on themselves. Additionally, she would ask those students she would ask that they treat the test as a “classroom activity” (Penny’s 2nd Interview, 2020). She often reminded students of their success on the homework and asked that they not mentally "game" themselves out (Penny's 2nd Interview, 2020). She also provided students with some deep breathing exercises that could deescalate the stress. Penny also asked students to put problems in their own words if it helps with the comprehension of how to complete the problem.

When working on problems with students, Penny made sure that she was very detailed and worked step by step. She also gave her students paper copies of the practice test and encouraged her students to come in and ask her questions from the practice test. Penny had seen the benefits of practice tests as a student, as the process of working and knowing the structure and problem-solving steps helped her be successful in her trigonometry and calculus classes. She also gave her students practice problems that appeared on the final exam. Thus, for Penny, it was very important for her to teach her students study skills and habits that enabled them to be successful. She understood in teaching a "gateway" course that it was pivotal to equip her students to create academic habits that would serve them well (Penny's 2nd Interview, 2020).

Traditional vs. Non-traditional Teaching Styles (Teacher to Student), Manipulatives, Worksheets, Software, and Video - RQ3

Penny considered herself to be both a traditional and nontraditional teacher. stated that she thought that she could be a good math teacher in high school. Penny defined traditional as a course that is "straight lecture" while having students put work on the board (Penny's 2nd Interview, 2020). She considered non-traditional educators to be those that are student-centered in that they develop activities that engage students. Additionally, nontraditional educators are concerned about students' motivation which helps students persist through difficult topics. She understood that she had to couple motivation with the remediation and building of her students' skill sets. Thus, some of Penny's exercises would have both foundational and engagement elements, such as her relay race problem solving activities. Penny often utilized the smartboard, workbooks, eBooks, videos, android trade courses, websites, online calculators, and mobile calculators.

Instructional Anxiety – RQ3

Penny stated that during the semester in which she was interviewed, she had experienced instructional anxiety. She stated that when working with technology, especially when technology does not work in the ways that it should she has experienced anxiety. Penny provided an example of an experience where the technology was not working in a distance learning type of class. Some students reported that they were experiencing technology issues on their end as well, she stated that she had to come up with a resolution on the spot. A way that she self-mitigated her anxiety was to utilize screenshots on her phone and share those with her class. Penny stated that she would advise educators who are struggling with instructional anxiety to watch videos of other educators and additionally, she would encourage them to be confident in the subject matter. She stated that confidence impacted presentation.

Penny's Advice to Colleagues Struggling with Instructional Anxiety

Penny stated that she would advise the educator to watch videos or observe another educator while he or she is delivering instruction. She stated that there several resources for advice via the Internet. Penny also thought that the educator must learn how to be confident in the subject matter; she felt that this confidence would be projected when the educator taught. Several participants stated that class preparation or deep understanding of the materials was a way to mitigate instructional anxiety, this is also how they build confidence about the materials and their presentation of the material.

Observations – Mathematics Classroom Observation Protocol for Practices (MCOPP)

Below is Penny's MCOPP has a sixteen-item assessment for both class periods (See Table 4). Penny covered solving system equations for the 1st observation and set theory for the 2nd observation. Penny highlighted problems on the worksheets, workbooks, practice tests, and PowerPoint. She reviewed rules, procedures, and examples and assisted students in getting and using the mobile calculator. She also provided students with an opportunity to practice in groups (if they chose to). Below is a layout of Penny's classes during the observations:

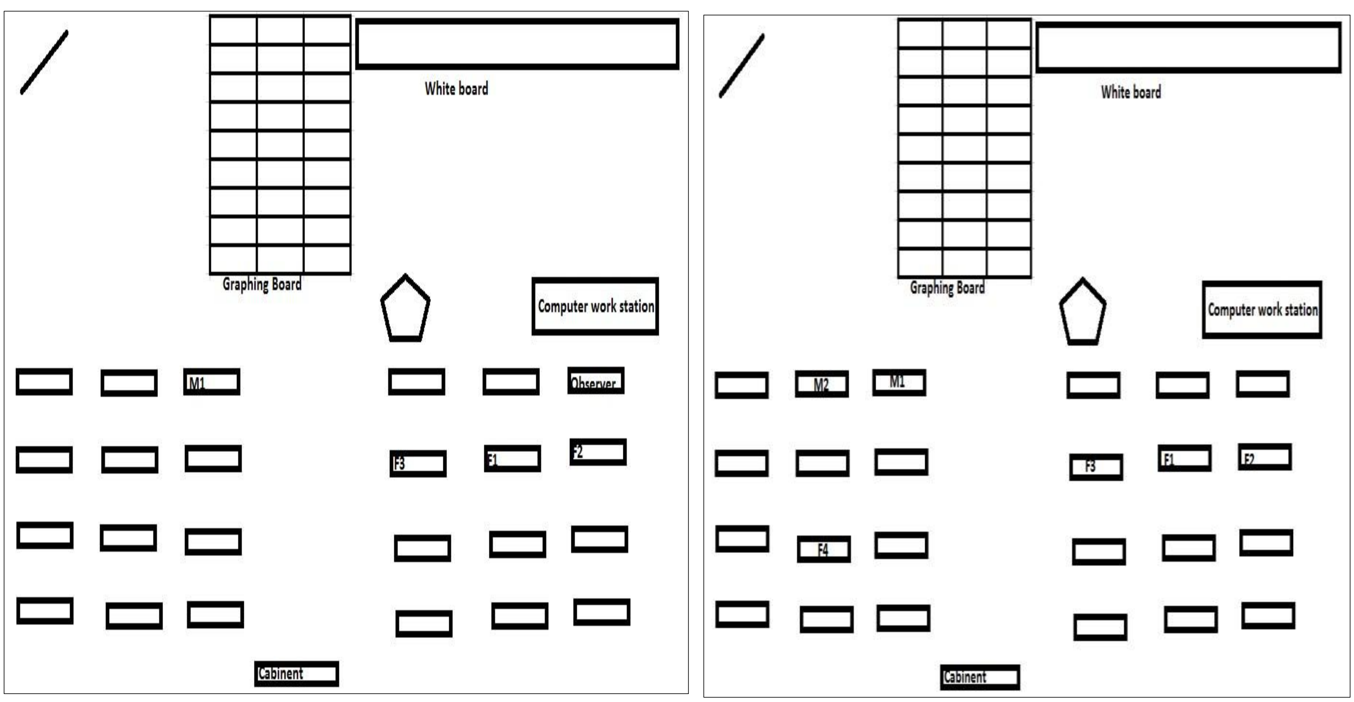


Figure 10 Penny's Class layout for the 1st & 2nd Observations

Table 7:Penny's MCOPP (Gleason, Livers, & Zelkowski, 2017).

		1st Observation				**2nd Observation**			
Item #	Item	Student ID #	SE	TF	Problem or concept related to interaction	Student ID #	SE	TF	Problem or concept related to the interaction
1	Students Engaged in Exploration/investigation/problem solving		✓	✓			✓	✓	
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.		✓	✓					
3	Students were engaged in mathematical activities		✓	✓			✓	✓	
4	Students critically assessed mathematical strategies.		✓	✓					
5	Students preserved in problem solving		✓	✓			✓	✓	
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.		✓	✓			✓	✓	
7	The lesson promoted modeling with mathematics.		✓	✓			✓	✓	
8	The lesson provided opportunities to examine mathematical structure. (symbolic notation, patterns, generalizations, conjectures, etc.).		✓	✓			✓	✓	
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.		✓	✓			✓	✓	
10	The lesson promoted precision of mathematical language.		✓	✓			✓	✓	
11	The teacher's talk encouraged student thinking.		✓	✓				✓	
12	There were a high proportion of students talking related to mathematics.								
13	There was a climate of respect for what others had to say.		✓				✓	✓	equivalent/equations/equality
14	In general, the teacher provided wait time.							✓	
15	Students were involved in the communication of their ideas to others (peer to peer).	F1/M1		✓					
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.	M1	✓	✓		F1	✓	✓	Test question/problem 6

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Penny's Observations Summary

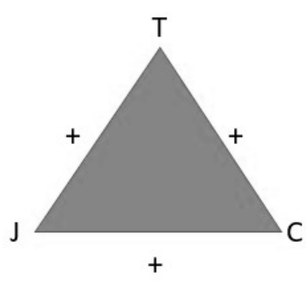
Penny engaged in a number of the 16 items (throughout both observation periods). Both observation periods were guided by PowerPoint presentations with board work examples. It should be noted that Penny's classroom is a computer lab, and this may impact peer-to-peer engagement. However, it should be noted that Penny did encourage students to work together, normally students did comply based on proximity (there was, however, one student that sat alone, so Penny went to assist that student). Penny anticipated areas of challenge especially when she taught set theory. She worked and reworked examples to ensure students understanding, and also referenced problems from the workbook and homework. She provided students with step-by-step instructions on how to utilize their calculators.

Joy's 1st and 2nd interview

Joy's interviews and observations were completed over the span of several weeks. At the time of the initial interview, Joy was in her mid to late sixties and had over thirty years of teaching experience as a mathematics educator. After she graduated with her bachelor's degree, Joy returned to her hometown and acquired her first teaching job. During her first year of teaching, Joy got engaged. As a first-year teacher, she taught 6 classes (5 of which were all boys), and the classes included 5 technical training math and 1 geometry course. After her first year, Joy got married and relocated as her husband was in the military.

She worked at a high school after the relocation. At the new location, Joy taught geometry, consumer math, and basic math. Over a ten-year span, Joy and her family would relocate several times, 2 more times stateside prior to being transferred to Germany. She did not teach while in Germany as she had two small children. When the family was transferred back stateside, she returned to the classroom teaching at both the middle and high school, where she taught consumer math, algebra I, and basic math. She took a sabbatical, after which, she began working at a local university. She taught learning support math for several years at the university and concurrently accepted a teaching position at a community college. She left the university to work at the community college full-time, the community college merged with another local college (this is where Joy was working at the time of the interview). At the time of the interview, she was teaching Quantitative Reasoning, College Algebra, and Elementary Statistics (for non-majors). During her tenure, Joy pursued and graduated with her Master's degree in Mathematics Education. Later, she would complete all the coursework for her doctoral degree in Curriculum and Instruction.

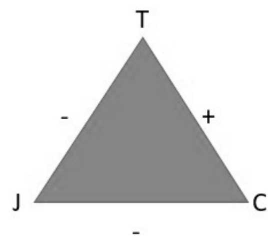
Joy did receive training upon acquiring her full-time position. Additionally, she was involved in learning communities, where the group read books that provided a better understanding of classroom management. She attended conferences on a yearly basis, in which she attended presentations that sharpened her strategies and practices. Additionally, the groups provided opportunities for educational professors to problem solve with issues concerning anxieties and the like.



Joy as a student – RQ1

Joy's *Instructional Triangle* showcases positive relationships between Joy and her teacher, Joy's teacher and the content, and Joy and the content (Ball & Forzani, 2009). Joy had a great connection with her high school teachers, the connection "made me love the subject" (Joy's 1st Interview, 2020). Mr. Bernard (Pseudo) was her Algebra teacher and Joy felt really special as she had to be "selected" to be enrolled in the class (Joy's 1st Interview, 2020). She appreciated that Mr. Bernard was straightforward and paid attention to details. Joy's connection was strong as she emphasis that Mr. Bernard demeanor spoke to "my whole spirit" (Joy 1st Interview, 2020). Mr. Bernard's influenced the manner in which Joy teaches (she often informed her students that the way in which she structures formula was a result of Mr. Bernard's instruction). In Mr. Bernard's class she made a strong connection with the teacher and the content. As Joy reflected on her time in Mr. Bernard's class, she stated that she chose to stay alone as she was really afraid to work with other students who may on "pull their weight" (Joy's 1st Interview, 2020). She stated that prior to Mr. Bernard's class that she had some bad experiences with group work and projects (she stated that at the time she did not have the communication skills to advocate for herself and be assertive when she was being taken advantage of). Joy did really well in high school, she graduated Valedictorian and received a full scholarship.

She discussed her transition to college, where she was 800 miles away from home. She left a place where she was the smartest person and she moved to a place "where you're note the brightest bulb" (Joy's 1st Interview, 2020). Joy explained the transition to college where she was in classes where she realized that there were things missing from her k-12 education. She stated that her college professor had expectations that students come with the baseline understanding, and to correct the deficiencies on their own. Joy discussed her disconnection or anxious related experience. Her first math course was Mathematics Analysis, she was placed in this higher-level course based upon her k-12 background.



Joy's disconnection *Instructional Triangle* depicts two negative relationships between Joy and her teacher and Joy and the content (Ball & Forzani, 2009). *The Instructional Triangle* depicts a positive relationship between Joy's teacher and the content (Ball & Forzani, 2009). In reflection, Joy thought that she should have been placed in College Algebra instead of math analysis. Her math analysis professor taught with his back to his students and often sneered and mumbled at them. Joy stated that the content was "formidable" but her disconnection with the content was exasperated by her disconnection with her professor. She went to discuss her problem with the professor, who was also her advisor. He sought to advise her out of her choice of major, he thought that she was wasting her time as a math education major. Additionally, he was not helpful with the content. Joy described him as not being warm nature and was not welcoming. She stated that she fought more anxiety as her professor was "going through the motions of helping" her (Joy's 1st Interview, 2020). Joy felt as if her cry for help was an interrogation, she stated that she was taking notes while he was asking her questions of what she did or did not do. She felt that it was a "weird confrontation," and expressed that she "never felt good in the meetings" (Joy's 1st Interview, 2020). Overall, Joy stated that she was disconnected from her professor and the content. She also reported that she did not have a real connection with her classmates, as she was a loner. Eventually, Joy decided to take the course with another professor, she reported that she was successful and had a different experience with her second professor.

Joy as a teacher– RQ2

The researcher asked Joy what strategies prepared her for her in-class practices. Joy stated that she worked on preparation for each particular lesson. Several of Joy's in-class practices included making announcements and outlining the course materials that were covered in the class sessions. Joy stated that she learned most of the strategies and practices she learned from on-the-job teaching. She stated that she assessed what worked and what did not work, and she stated that her knowledge was learned through "trial and error" (Joy's 2nd Interview, 2020). Joy's attitude was one of which she would try and if it did not work, she would try something new.

Joy described her students as goal-oriented. She worked with students of different majors and different educational goals. She imaged her students to be innovators, "and it's up to me to try to do the things to try to help them get to there, where they want to be" (Joy's 2nd Interview, 2020). She assisted students who may have been directionless or transitioning students. Joy asked students with different types of skill development, she gave an example of a student that has been homeschooled. She stated that the student needed to adapt to a new environment. Joy understood the humanity of their students and even the generation of students that she taught. She understood that her traditional students are attached to their phones and other technologies, "so I try not to criticize" (Joy's 2nd Interview, 2020). Additionally, she saw the benefits and the challenges of technology including speed of access as well as the disconnection of social connection. Joy accounted for her students' barriers, some of the barriers included learning disabilities. She worked really hard to connect her students to services and resources that address their needs.

Joy worked to increase the connection with her students by doing "engagement type things" (Joy's 2nd Interview, 2020). She stressed her office hours and made herself available virtually. Additionally, she offered study sessions to assist students in making a connection with her and "with the material too" (Joy's 2nd Interview, 2020). Joy stated that the study sessions were really beneficial to students and that they had a really strong connection with the content afterward. Lastly, Joy worked to help students engage with their peers. She is very aware of the "pace" of group work and understands that peer learning is very important.

Teaching Philosophy and Components of Good Math Lessons - RQ2

Joy's educational philosophy encompassed the thought that students are carrying baggage. She asked that her students "leave your baggage at the door" (Joy's 1st Interview, 2020). Additionally, she asked her students to not let what had or was happening inform or impact the work that they did in the classroom together. "Yes, you have a past we all we have baggage we have all have a past your past and all we have is today and the future…formulate our future" (Joy's 1st Interview, 2020). Joy described a student who explained to her that she had never seen this type of math, Joy responded that even learning language is an acquired skill, so she assured the student that learning is within her power. "If you think you can do it you can do everything in your power to make that happen" (Joy's 1st Interview, 2020). "That's my philosophy, is you can build from where you are, you can get better, you may not be 100% proficient but you can further than where you are" (Joy's 1st Interview, 2020).

Joy stated that a good component of a math lesson is that it should be engaging. Joy really appreciated students who participated by deepening their understanding of the materials by way of asking questions. Additionally, she thought it very essential to review previous materials and make a continuation flow into the new materials, thus, she thought it was pivotal to make connections and she thought it was important for her to have a connection with her students. She thought it important to make the material relatable to student, thus, speaking to the usability in their everyday lives or their majors. Thus, removing the mystery around the content material, thus, when she did in-class examples such as descriptive statistics (mean, median, mode) she asked that the students utilize their own sibling groups. She supported their in-class learning with homework within the course software and often mentioned the homework assignments while working the examples. She stated that she did not "want them to feel like they're on their own".

Strategies and Evolution of Teaching Practices (teacher to content) – RQ2

Joy stated that the difference between the first time when she taught the course to the time, she was teaching the course during the interview, is students 'comfortability. She stated that students seemed to be more familiar with and also know what to anticipate with the course design such as tests, homework, and the like. She stated this was different from the first time she taught the course in that she and the students were apprehensive. Joy was doubting her ability to deliver the content in the most effective manner. Joy stated that she was looking for ways to really support her students, she hosted weekend study sessions as one of her new initiatives.

Teaching Strategies to Address Students' Anxiety (teacher to student) – RQ2

If Joy felt that student was struggling with anxiety in the course, she would stress their understanding of necessary information. For instance, Joy gave her students tutorials on how to use the TI calculator. She stated that many of her students were intimidated by the functionality of the TI calculator. Additionally, Joy stated that she reaches out to students who are displaying some signs of anxiety. She requested a meeting with students, in an effort to provide them with strategies. She tried to assess the in-class dynamics to determine students' blockage or areas of challenge and frustration.

Teaching Practices (teacher to student) – RQ3

Joy liked to think of creative, innovative activities to do at the beginning of each chapter as a way to get her students engaged. Additionally, in addressing some of her student technological anxiety, Joy liked to demonstrate the use of the adaptive software that the students used to turn in their homework. She stated that students would get frustrated when the software would make them start over if they messed up during the solving of a problem. She often pulled the software up in class and asked that they walk her through the steps of solving as a way in which they address any of the questions that they may have later on their own. She stressed to them the importance of getting mastery. Joy also thought it very important to showcase the content usability. She also made use of group work, but she is very conscious of the pace of the class. She stated that she is going to start engaging in more group work. Joy has an interactive activity in which students are given a problem and are asked to solve as the problems are solved, they are deposited/given to another student. Students are able to add or change the work of the previous student, if the problem is correct once it is returned to Joy then a volunteer works it on the board. Joy stated that she learned some of her strategies and practices by attending conferences on a regular basis.

Students' interaction with Mathematics (student to content) - RQ3

Joy stated that over the years she has taught many different types of students, some students did connect to the content, and did not connect to the content. Joy developed a non-judgmental attitude towards all of her students. She stated that it would be ideal if students were connecting with the content in the same manner as she did; however, she said that it is more interesting to have the dynamic of different students connecting in different ways. Joy stated that a depth of teaching must be learned in order to teach it well to someone else. She really appreciated the light bulb moments that her struggling students experienced.

Students' Anxiety and Joy's Response to Student's Anxiety

Joy estimated that approximately 80% of her students struggled with some form of anxiety (Joy's 1st Interview, 2020). She stated that some of her students experienced anxiety related to the content, technology, fractions, and general college readiness. Joy's own anxious experience provided her with the concept that when students struggle with anxiety the "content can become so nebulous so distorted" (Joy's 1st Interview, 2020).

Joy described students' perception as "it's almost like you're not able to even touch it, because that anxiety is like a block blocking it from you" (Joy's 1st Interview, 2020).

Additionally, she spoke of the loneliness that students experience when struggling with anxiety, you are on your own "lonely" (Joy's 1st Interview, 2020). Joy contrasts her students' experience with her own, "I had friends and all but Math was my world and it was a world I had control over and not saying I didn't need anybody else, but I was doing fine" (Joy's 1st Interview, 2020). She stated that those experiences informed her teaching strategies and practices. She knew that she did not want to be like the professor of her anxious experience. She recounted an experience wherein this professor would give back test grades in numeric order from highest to lowest.

Traditional vs. Non-traditional Teaching Styles (Teacher to Student), Manipulatives, Worksheets, Software, and Video - RQ3

At the time of the interview, Joy had taught both face-to-face and online. She considered herself to be a non-traditional teacher, she tries "different things in the class like the flipping thing" (Joy's 2nd Interview, 2020). She worked on removing the robotic nature of learning "taking notes and just regurgitating back, I want them to learn to think this way this quantitative reasoning class" (Joy's 2nd Interview, 2020). She stressed to her students that they are in the right class, as they will get a variety of topics (set theory, statistics) (Joy's 2nd Interview, 2020). Joy utilized worksheets, workbooks, computer programs, calculator tutorials, project videos (sponsored videos), and online software. She coupled content-related materials with learning strategies skills videos such as TedTalk (Joy's 2nd Interview, 2020).

Instructional Anxiety – RQ3

Joy stated that she had been in a class where a professor exhibited signs of anxiety while delivering instruction. She stated that during her bachelor's degree, she had a professor who never taught facing the class. Additionally, she stated that the professor hated to answer questions. She said that her professor had very good credentials, but he was not relatable or approachable at all. She thought that he could have been anxious as he was teaching freshmen students. She perceived that her professor preferred to teach graduate students, thus, teaching freshmen students was pushing him out of his comfort zone.

Joy's Advice to Colleagues Struggling with Instructional Anxiety

Joy stated that she would advise a colleague who struggles with instructional anxiety to seek out other professors, attend conferences, and engage in reading materials that enhance their instructional confidence. She stated that there are several books wherein professors provided some of their best practices for instruction. Additionally, Joy stated forming a support group wherein educators engage in book reading and discussions about the materials. She stated that there are many learning communities that an educator can engage in as a means of researching different topics such as classroom management. Joy was very confident that an educator could find resources to speak to whatever anxiety-related issues they may struggle with while teaching.

Observations – Mathematics Classroom Observation Protocol for Practices (MCOPP)

Below is Joy's MCOPP has a sixteen-item assessment for both class periods (See Table 4). Joy covered solving system equations for the 1st observation and set theory for the 2nd observation. Joy provided a review of a calculator tutorial. She provided students with an opportunity to have a Sunday study session, as they were slated to have a test the following week.

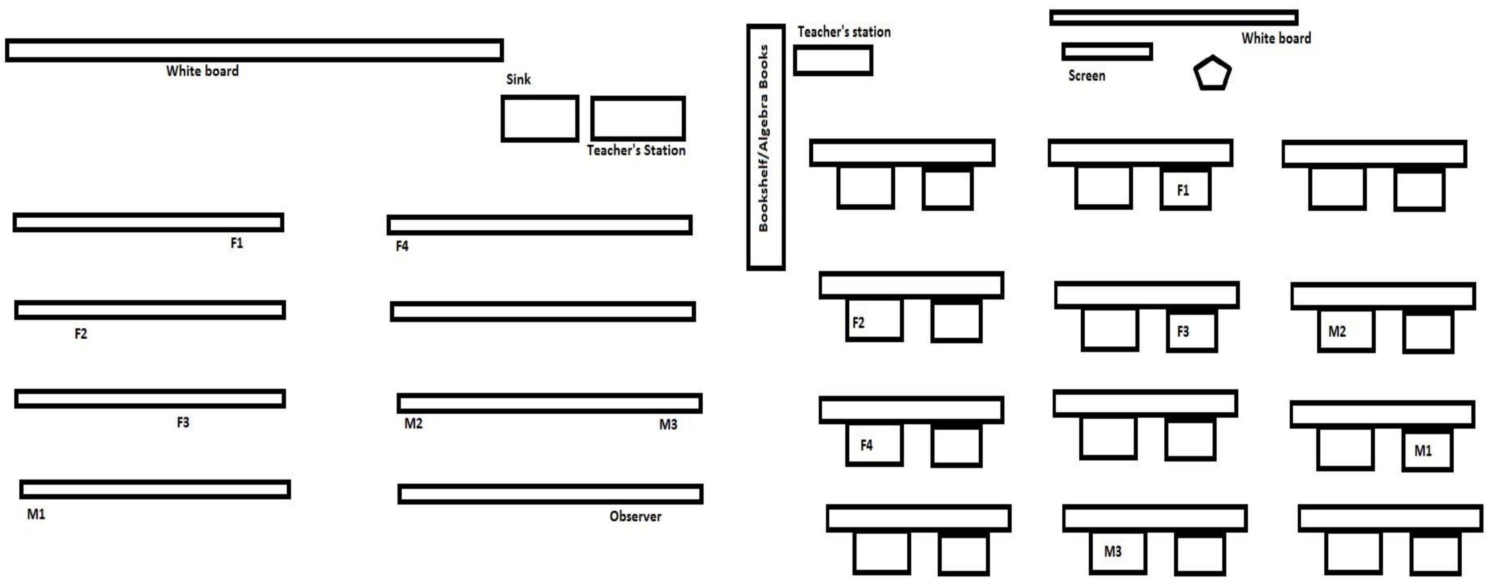


Figure 11Joy's Class layout for the 1st & 2nd Observations

Table 8: Joy's MCOPP (Gleason, Livers, & Zelkowski, 2017).

		1st Observation				2nd Observation			
Item #	Item	Student ID #	SE	TF	Problem or concept related to interaction	Student ID #	SE	TF	Problem or concept related to the interaction
1	Students Engaged in Exploration/investigation/problem solving		✓	✓			✓	✓	
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.		✓	✓			✓	✓	
3	Students were engaged in mathematical activities		✓	✓			✓	✓	
4	Students critically assessed mathematical strategies.		✓	✓			✓	✓	
5	Students preserved in problem solving	F2	✓	✓	Even though frustration		✓	✓	
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.		✓	✓			✓	✓	
7	The lesson promoted modeling with mathematics.		✓	✓	Regression		✓	✓	
8	The lesson provided opportunities to examine mathematical structure. (Symbolic notation, patterns, generalizations, conjectures, etc.).		✓	✓			✓	✓	
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.		✓	✓			✓	✓	
10	The lesson promoted precision of mathematical language.		✓	✓			✓	✓	
11	The teacher's talk encouraged student thinking.		✓	✓			✓	✓	
12	There were a high proportion of students talking related to mathematics.			✓		F1, F2, F3	✓	✓	
13	There was a climate of respect for what others had to say.		✓	✓	not as much process		✓	✓	
14	In general, the teacher provided wait time.		✓	✓		F1, F2, F3	✓	✓	
15	Students were involved in the communication of their ideas to others (peer to peer).	F1,F2 ,F3/M1-M2/F4	✓	✓	by was vocal		✓	✓	
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.		✓	✓			✓	✓	

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Joy's Observations Summary

Joy engaged in a number of the 16 items (throughout both observation periods). Both observation periods were guided by board work examples and reviews of the online homework. Joy tried to engage the students with the materials by asking about the next steps and processes when problem-solving. During her set theory, she asked students to critically think about the interconnection of variables. Joy's students were very quiet as they were really aware that they were being "observed." Thus, peer engagement was limited but students were engaged in the materials and responsive to their professor. Joy encourages students to attend a weekend test review, this is one of Joy's interventions for students who that maybe struggling with some level of anxiety. She also was intentional about breaking down complex practices or content such as set theory in a manner that made it accessible to the students.

Student engagement was high; however, it should be noted that the observer felt as if the students were experiencing some level of reactivity in the observer had an impact on the student's behavior (Maxwell, 2013, pp. 124-5). The observer or researcher felt that students were hyper-aware of the action of being observed. The observer sat in the very back for both observations and during the second observation arrived earlier than anyone the lessen some of the students' anxiety. The students were very responsive to Joy and engaged in the learning process. Prior to class starting students discussed nonacademic related issues. Once class started, they engaged in utilizing the new math terminology they were learning, especially during the set theory lecture. Students both demonstrated and checked their understanding of the new materials.

In the following Chapter 5, the researcher will utilize the interview and observation data to discover themes and patterns for which educators develop and implement their strategies and practices.

Chapter V

FINDINGS and DISCUSSION

The purpose of this study was to ascertain the career and life experiences of college remedial mathematics educators who teach students who struggle with moderate to high math anxiety. Additionally, the study was designed to examine the educators' strategies (instructional preparations based upon instructional beliefs, typically occurring outside of the classroom) and practices (educational practices are based upon an educator's instructional strategies, affecting instruction implementation within the classroom instructional environments). Chapter 1 contains an overview of math anxiety and its components (personality, intellectual, and environmental) as well as policies that underpinned developmental education (Uusimamki & Nason, 2004, p. 370). Chapter 2 contains a history of remediation and the theoretical framework of *The Instructional Triangle* and theories related to teachers' beliefs, instructional anxiety, self-efficacy, teaching-efficacy, math self-concept, and the interconnectedness of the relationships of *The Instructional Triangle* (Ball & Forzani, 2009). Chapter 3 contains the rationale for selecting a combination of qualitative design (grounded theory and case study) along with justifications for site and sample selection, data collection, and analysis (Yin, 2018). Chapter 4 contains participants' profiles of the career and life experiences, strategies, and practices utilized for remedial mathematics students struggling with moderate to high anxiety. Chapter 5 contains an analysis of the participants' career and life experiences, strategies, practices, and observational data in answering the following research questions.

Research Questions

1. What are the life and career experiences of educators who teach remedial? mathematics at identified post-secondary institutions in South Georgia?
2. What are the strategies used by these educators to mitigate math anxiety?
3. What are the practices used by these educators to mitigate math anxiety?

The researcher conducted two interviews and two observations (See Chapter 4 *Participants Profiles).* The researcher utilized MAX-QDA to code the interviews across the three research questions (VERBI Software, 2019). Coding for RQ1 included the career and life experiences, including but not limited to teachers as students (connection vs. disconnection), educational background, career paths, career detours, professional guidance, and professional development. Coding for RQ2 included educators' strategies, strategy acquisitions, educational philosophy, type of classes, lesson plan development, and changes in strategies for students struggling with anxiety. Coding for RQ3 included teaching styles, instructional tools, students' attributes, students' barriers, advice or advisement, interventions, instructional anxiety, educators' self-mitigation practices for instructional anxiety, methods of increasing connection (teacher, peers, content), percentage of students struggling with anxiety, type of students' anxiety, practices, and changes in practices for students struggling with anxiety.

Each participant's interviews were coded for the three research questions based on codes related to the topics mentioned above. Here's an overview of the total number of coded segments for each participant within MAX-QDA (VERBI Software, 2019):

Table 9:Participants' Documents and Coded Segments

Participants Document	Coded Segments
Brenda's Interviews	141
Harry's Interviews	138
Sarah's Interviews	126
LeAnn's Interviews	120
Penny's Interviews	140
Joy's Interviews	136
Total Number of Coded Segments	801

MAX-QDA afforded the researcher the ability to complete open (See Chapter 3 *Excel Coding*, axial (See Chapter 6), and selective coding (Below see *Table 2: Participants Connection and Disconnection Instructional Triangles – An Adaptation (The Instructional Triangle, Ball & Forzani, 2009, p.124; Instruction & Interactions, Cohen et al., 2003, p. 124;* VERBI Software, 2019*).* The researcher created 483 codes with three separations RQ1, RQ2, and RQ3. RQ1 concerning educators' life and career experiences had a total of 200 codes. The codes included educational background, career detours, connection as a student (teacher, peers, content), disconnection as a student (teacher, peers, content), faculty responses, self-mitigating techniques, career working environment, and career or professional guidance. RQ2 concerning educators' strategies had 64 codes; the codes included preparation of course design, origins of strategies, educational philosophy, course, course type, components of a good lesson plan, and strategies for students struggling with mathematics anxiety. RQ3 concerning educators' practices 218 codes is not surprising as this is the implementation of educators' experiences and strategies. The RQ3 codes included: instructional tools, class styles, descriptors of students or attributes, teaching style (traditional vs. nontraditional), student barriers, advice to students, interventions for students struggling with mathematics anxiety, changes in practices if students were struggling with math anxiety, instructional anxiety, self-mitigating techniques for instructional anxiety, practices for creating connections (teacher, peers, content), practices for addressing disconnections (teacher, peers, content), the discovery of anxiety, types of anxiety, percentage of anxiety, and origins of practices. The codes and segments of codes coincide with the Interview Questions (See Appendix B).

Career and Life Experience – RQ1

In examining the career and life experience, the researcher asked the participants several questions about their educational background and career path. All participants had a mathematics or mathematics education bachelor's degree except Brenda (Speech Pathology). Additionally, every participant has a master's degree except Harry. Joy is the only participant who had, at some point, pursued a doctoral degree; she completed all her coursework but failed to execute her dissertation. Joy stated that this is one of her regrets, as she was studying mathematics anxiety. Several participants alluded to detours on their journey to teach; Brenda stated that initially, she was pursuing Speech Pathology, and she had thoughts of pursuing nursing but decided that math gave her joy. Sarah and Joy are spouses of military husbands and, at some point, were deployed to other countries. Joy and Penny suspended teaching when they started their families for some time. LeAnn worked at a travel agency for more than sixteen years before returning to tutor and later teach math. Harry and LeAnn both gained experience while tutoring, Harry in the AVID program (supplemental program, See Chapter 3 – *Participant Profiles*).

Professional Guidance and Development

All participants are employed at higher education (Brenda, Sarah, and Harry – Community College, LeAnn – Regional Institute, and Penny and Joy- State Institution) (See Chapter 3, *Settings* for more descriptions). All met the participant criteria of being employed full-time or part-time at two-year or four-year institutions in South Georgia. Additionally, participants met the second criterion of teaching remedial, developmental or learning support mathematics. The last criterion was having a minimum of a bachelor's degree in mathematics or accrediting certification, such as a master's degree or higher in Education.

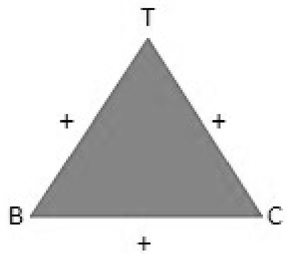
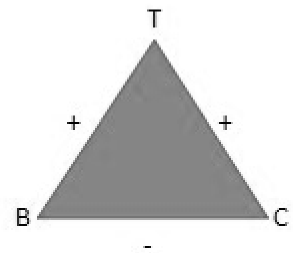
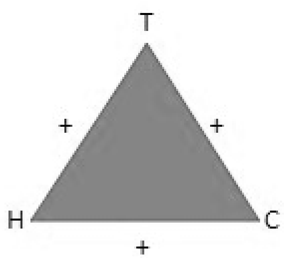
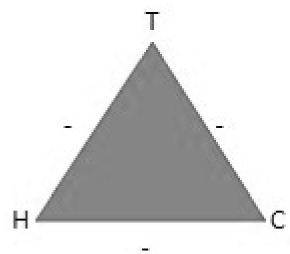
The researcher made inquiries concerning professional guidance and professional development that participants received at their institutions. Several participants stated that the lead Mathematics Coordinator or Learning Support Coordinator provided guidance and resources such as the syllabus, learning outcomes, and textbooks. Other participants discussed a type of mentorship. LeAnn stated that at least three other professors were assigned as her mentors, and she could go to either of them during or after her onboarding process. Mentorship and intentional training were discussed by Geist (2010) to lessen instructional anxiety. Most of the participants stated that they did experience some instructional anxiety when teaching new material for the first time. The participants informed the researcher of the methods they used to self-mitigate instructional anxiety (course prep, practice problems, PowerPoint presentations development, colleagues, conferences, books, and relaxation techniques). Except for

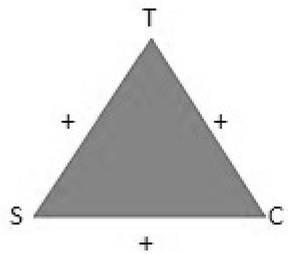
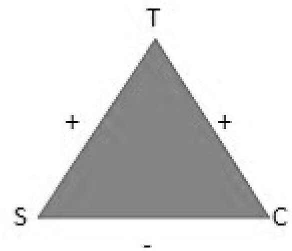
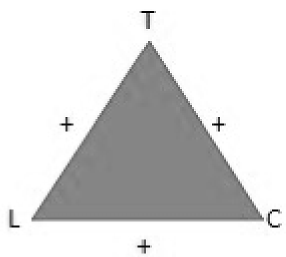
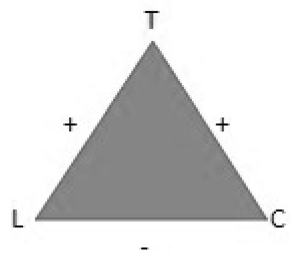
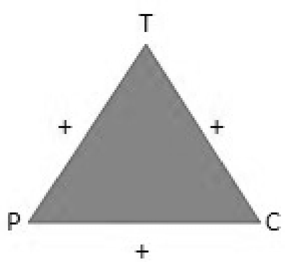
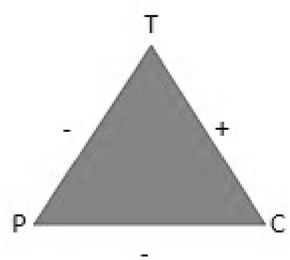
Harry, most of the participants utilized other professional development opportunities such as conferences, workshops, and campus readings to inform their strategies and practices. Harry primarily relied on the Learning Support Coordinator or his mother (Superintendent) to acquire professional guidance and development.

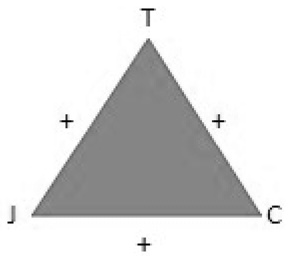
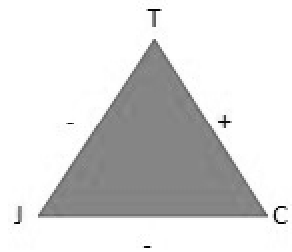
As training is important in lessening teachers' anxiety levels, training can also prepare teachers to lessen students' anxiety (Geist, 2010). The researcher asked the participants if they had been trained to assess students' mathematics anxiety and create interventions to address students' anxiety. McKibben (2017) admonished educators to be aware of anxiety symptoms but not diagnose students with anxiety (p. 4). All participants reported that they had not received any formal training on anxiety, nor had they been trained in creating interventions to help students self-mitigate anxiety. Each of the participants had been developing their interventions such as extended time on tests, testing in different environments, dropping lowest test or quiz grades, extensive practice test and practice test experiences, extensive feedback on practice problems, weekend study sessions, tutorials on technology and calculators, providing calculators during tests, one on one meetings/tutoring, and teaching students relaxation/destress (breathing) exercises.

To better understand how participants developed their strategies (instructional preparations that are based upon instructional beliefs, typically occurring outside of the classroom) and practices (based upon an educator's instructional strategies, which affects instruction implementation within the classroom or instructional environments), the researcher thought it pertinent to examine the participants' connection and disconnection experiences as a student (See Chapter 1 *Definition of Terms)*. The career and life experience also examined participants' influences when establishing a strong connection or disconnection with teachers, peers, and, most importantly, the content. The connections and disconnections will be examined through the theoretical framework of *The Instructional Triangle* (Ball & Forzani, 2009; Cohen et al., 2003). There are two consistent themes when examining the relationships of *The Instructional Triangle*, connection and disconnection. In Chapter 4, each participant examined their connection experience (to the teacher, peers, and or content), as well as their disconnection experience(s) (to the teacher, peers, and or content). A connection is defined as the depth of the relationships illustrated by *The Instructional Triangle* (teacher to content, teacher to student, student to teacher, student to student, and student to content) (Ball & Forzani, 2009; Cohen et al., 2003). Conversely, disconnection is the lack of depth in the relationships illustrated by *The Instructional Triangle* (Ball & Forzani, 2009; Cohen et al., 2003) (See Chapter 1 *Definition of Terms)*. The table below illustrates and contrasts both the participants' connection and disconnection experiences and possibly the impact of said experiences.

Table 10: Comparisons of Participants' Connection and Disconnection The Instructional Triangles - *(Ball & Forzani, 2009).*

<table>
<tr><th>Participant</th><th>Connection Instructional Triangle</th><th>Strongest Connection</th><th>Disconnection Instructional Triangle</th><th>Strong Disconnection</th><th>Perceptions of ability during and after course associated with the disconnection experience</th><th>Impact of Disconnection Experience on Teaching</th></tr>
<tr><td>Brenda</td><td>
</td><td>The strongest connection between the student and the content.</td><td>
</td><td>The strongest disconnection between the student and the content</td><td>During the course, Brenda felt as if everyone except her understood the content. She passed the course; during the interview, she stated that she could do geometry as an adult.</td><td>Brenda stated that the experience made her sympathetic to what her anxious students experience.</td></tr>
<tr><td>Harry</td><td>
</td><td>Strongest connections between the teacher (byproduct a stronger connection with the content connection to content) and the student and content.</td><td>
</td><td>The strongest disconnection between the teacher and content, the teacher and the student, and the student and the content</td><td>During the course, Harry thought the course experience was what he should expect as a college student. He later had his connection experience wherein he reconnected with the content and had a very impacted connection with a role model professor. Harry took this professor for several additional classes and chose math as a major due to his new relationship with the professor and the content. Harry stated that one of his outward signs of anxiety was that he cried during a test.</td><td>Harry stated that his experience informed him of "what not to do" as an educator.</td></tr>
</table>

Participant	Connection Instructional Triangle	Strongest Connection	Disconnection Instructional Triangle	Strong Disconnection	Perceptions of ability during and after course associated with the disconnection experience	Impact of Disconnection Experience on Teaching
Sarah		Strongest connections between the teacher and content, the teacher and the student, student and peers, and student and the content.		The strongest disconnection between the student and the content	During the course, Sarah's math self-concept was challenged in the course as she was so stressed that although she never contemplated suicide, she did not want to go on. Her professor was extremely helpful and made strong connections with her peers to overcome her challenges.	Sarah understands that “when students struggle, there is a reason for it.” Thus, she is not dismissive about the issue and seeks to helps students within her capacity.
LeAnn		Strongest connections between the teacher and the student and the student and the content.		The strongest disconnection between the student and the content	During the course, LeAnn had a really good report with the professor and her peers. However, the content was very difficult, and LeAnn and her peers worked hard to succeed in the course.	LeAnn is very student-centered in developing both her strategies and practices.
Penny		Strongest connections between the teacher and the content, teacher and the student, student and peers, student, and content.		Strongest disconnections between the teacher and the student (byproduct a disconnection between the student and the content)	During the course, Penny felt as if her professor was unapproachable, so she relied heavily on her peers to understand the material.	Penny “reaches out” and makes inquiries if she thinks that students are struggling in her class.

Participant	Connection Instructional Triangle	Strongest Connection	Disconnection Instructional Triangle	Strong Disconnection	Perceptions of ability during and after course associated with the disconnection experience	Impact of Disconnection Experience on Teaching
Joy		Strongest connections between the teacher and the student and the student and the content.		Strongest disconnections with the Teacher and the content	During the course, Joy felt as if the professor was making the classroom a hostile environment. Additionally, the professor also served as Joy's advisor. Joy was very anxious when going to his office. Joy wanted to change her major to Mathematics Education, and her advisor/professor counseled her against it. Thus, she later had to retake the class and get a new advisor.	Joy asserted that students were struggling with anxiety, which then makes the content "nebulous" and "distorted." Thus, she is conscious of the various types of anxiety students may struggle with and make interventions accordingly.

The Connection and Disconnection Triangles are An Adaptation of The Instructional Triangle (Ball & Forzani, 2009, p. 499).

Themes – RQ2 and RQ3

The Instructional Triangle is a depiction of the learning environment and the types of relationships within that environment (Ball & Forzani, 2009). The illustration is one in which all relationships can be examined individually or collectively. As a relationship can be developed (connections) or excluded (disconnections), within this study, the researcher examined the development of connection and how anxiety serves as a method of disconnection.

Connections

As *The Instructional Triangle* indicates, there are relationships between the teacher and the content, the teacher and the student, the student, peers, the student, and the content (Ball & Forzani, 2009; Cohen et al., 2003). A major theme is connection, which creates and or enhances the teacher and the content, the teacher and the student, the student and peers, and the student and the content relationships. To better understand this, we examine the teacher's student to content connection experience, as indicated by *Table 1: Their teachers enhanced comparison of the Connection and Disconnection Instructional Triangles (Ball & Forzani, 2009; Cohen et al., 2003) that all of the participants had a strong relationship with the content and all of their student to content relationship*s. Thus, they also have a very good teacher-to-student relationship, where the teachers indicated that they had a strong teacher to content relationship. Two participants, Sarah and Penny, indicated that their parents strongly influenced their connection to the content. The parental influence was stated to serve as an environmental element of mathematics anxiety; Sarah's and Penny's accounts indicate that parents can also help students connect with the content (Uusimamki & Nason, 2004, p. 370).

Additionally, peers serve as an environmental element of math anxiety; it should be noted that many of the participants had peer relationships that promoted a connection with the content

(Skoglund et al., 2018; Trujillo & Hadfield, 1999; UMKC, 2019). Brenda and Penny discussed how they worked independently with a small group of students and that they and their small cohort were more advanced than their counterparts. As a result, typically, they were encouraged by the teachers (in Brenda's case) or discouraged by their teachers (in Penny's case) to either keep advancing or keep pace with the rest of the class. As Harry struggled with social anxiety, he indicated that he did not necessarily seek other students' relationships. Joy indicated that she tended to avoid connections with other peers due to bad group work.

The participants indicated that they started to identify themselves as both math-oriented and achievers during their connection experiences. Most participants were encouraged to take advanced-level courses or even dual-enrolled in college courses (Penny). Thus, participants developed a strong math self-concept and efficacy (Bandalos et al., 1995). They each develop strong confidence in their ability until they experience a disconnection within a math course.

Disconnection

The disconnection experience for each participant was just as powerful and informative as their connection experiences. Thus, just as *The Instructional Triangle* is an indicator of the possible connection between the teacher to content, teacher to student, student to peers, and student to content relationships, it is also an indicator of the possible disconnections or disruptions of those relationships (Ball & Forzani, 2009; Cohen et al., 2003). All participants indicated that they had their disconnection experience much later in their student experience, as Jackson and Leffingwell (1999) indicated that most students develop or experience math anxiety during their formative years. Our participants had excelled during their formative periods. They did not experience their disconnection experience until they engaged in much more complex mathematic task such as Geometry (Brenda), Calculus I & II (Harry), Sarah (blended advance

Algebra course), LeAnn (Graduate work), Penny (Matrices-Linear Algebra), and Joy (College – Math Analysis). Thus, all participants were either in High, College, or Graduate School when they had their disconnection experience.

All the participants indicated that the content was rather difficult during this disconnection experience. Joy stated that it was "formidable," while LeAnn stated that the course was extremely difficult and that all the students were not faring well. Their perceptions of their ability changed; Brenda and Sarah thought everyone in the course except them understood the materials. Brenda was a high school student, and she indicated that she developed a very negative mindset during this time, a fatalist, as Brenda stated that it would not matter what she did. She "just wasn't going to get it." Additionally, Sarah stated that she was under such extreme pressure that she had never contemplated "suicide," but she just did not want to go on. Harry had been an achiever in his K-12 student experience; he felt that this course taught him "how college would be." He thought college would make him into a C student instead of the straight-A student he had been up until his disconnection experience.

Although the content was difficult, several participants (Harry, Penny, and Joy) indicated that the teacher served as the greatest disconnection within their experience. Harry stated that his professor seemed as if he did not enjoy teaching and made it difficult for students to ask him questions or for advice. Additionally, Penny stated that her professor was also very unapproachable. Joy indicated that her professor served as both her teacher and her advisor. She stated that he turned the classroom into a hostile environment. She described how he "sneered" at his students and passed back graded materials from highest to lowest grades (a clear indicator of who was doing well and not well in his class). Jackson and Leffingwell (1999) spoke of similar experiences wherein the teacher create an environment in which students develop a strong disconnection with the materials and exacerbates or increases students' anxiety (p. 583). Jackson and Leffingwell (1999) outlined several ways in which an educator can create a hostile environment, "derogatory comments," exhibiting "anger" at requests for help, and "pointing out" students' mistakes (p. 584). Jackson and Leffingwell (1999) defined educators who are perceived as unhelpful as "insensitive and uncaring" (1999, p. 584).

"Insensitive and uncaring" educators typically do not respond to students' requests for help, allow unacceptable behaviors between peers, ignore documented medical issues (allergies to chalk), and show "anger or disgust" at students' requests for help (Jackson & Leffingwell, 1999, p. 584). On some level, Penny and Joy experience some elements of a hostile environment. Jackson and Leffingwell (1999) outlined several educators' behaviors that negatively impact "students' attitudes and achievement" (1999, p., 584). As previously mentioned, educators who exhibit anger, as well as educators who set unrealistic expectations, educators who embarrass students in front of peer groups, educators who exhibit gender bias, as well as educators who have the perception of being insensitive or uncaring (Jackson & Leffingwell, 1999). The researcher's college disconnection experience was one in which the educator exhibited a gender and racial bias; additionally, the educator was insensitive and seemed to be intentional about undermining students' ability to successfully pass the course (See Chapter 1 *Purpose Statement)*.

In examining the type of anxiety, the participants' experience indicated that they either experienced general or test anxiety. As stated, earlier mathematics anxiety is generally discovered during the formative years. The participants had developed a strong math concept during those years, however, the disconnection was demonstrated by their anxiety episodically.

The following are ways that participants self-mitigated their anxiety:

Table 11:Participants' Self-Mitigation Techniques

Self-Mitigation Techniques	Number of Participants
Tutoring	3
Discussions with Faculty members	2

The participants stated that they self-mitigated anxiety by tutoring and discussing their issues with faculty members. Sarah stated that her professor was most willing to assist her and would spend time providing her with examples and additional resources. As previously stated, Harry, Penny, and Joy did not have very good faculty interactions, which made their disconnection to the content more pronounced. Brenda stated that she did not seek out faculty or peers as she felt very embarrassed during this time. LeAnn had a great peer group in that she worked with someone she had known for a while; this student was time and resource-intensive when helping LeAnn. Later, this student would recommend or refer LeAnn for the adjunct teaching position. Most participants who did not seek out faculty assistance were asked if they had a "do-over" would they now ask, and Brenda stated that she would seek assistance.

Impact on Teaching (Strategies & Practices) - RQ2, RQ3

Please see *Table 10: Comparison of Connection and Disconnection Instructional Triangles* below as information concerning the impact of the disconnection experience on educators' teaching strategies and beliefs (Ball & Forzani 2009, p. 499; Cohen et al., 2003, p. 124). Harry stated that his disconnection experience was an example of "what not to do." Additionally, other participants like Brenda and Joy develop sympathy and a more observant eye when working with students. Penny stated that it also made her more intentional about "reaching out" to students she thought were struggling in her course. Sarah was very similar to both Joy and Penny in that she was investigative concerning students' struggles. Lastly, LeAnn was mindful to be student-centered in developing and implementing her strategies and practices.

Strategies – RQ2

Participants were reminded of the definitions of strategies and practices and were asked what strategies they engaged in when assisting students in making a connection with (teacher, peer, and content):

Table 12: Participants' Self-Mitigation Techniques

Strategies	Number of Participants
Foresight about difficult materials	1
Scaffolding	1
Visual Learning	2
Clickers	1
Presentation of materials	1
PowerPoints	1
Textbook Reviews	2
Homework Development	2

The participants utilized several strategies when assisting students struggling with anxiety. LeAnn thought it pertinent to provide students with some foresight when encountering difficult materials. She encouraged her students by letting them know that they would work through the materials and that the subsequent materials would be easier. Scaffolding, much like foresight, was utilized by participants; some participants categorized this as a practice and not a strategy. Additionally, some participants utilized different technologies, such as preview materials or building on previous materials. Most of the participants alluded to the building block nature of mathematics and how missing components of the foundations would make it difficult for students to connect to the content. The importance of understanding learners' needs is associated when educators were intentional about visual learning elements of instruction. LeAnn was very conscious of visual learning about including technology in the lesson; she was the only participant to utilize clickers in her class. Presentation of materials, PowerPoints, textbook reviews, and homework development are all components of course preparation. Ironically, participants also utilized these techniques to self-mitigate instructional anxiety.

As strategies consist of developing and implementing lesson plans, participants were asked what the components of a good math lesson:

Table 13: Components of Good Lessons

Components	Number of Participants
Material Preview/Tell students what you are going to do	2
Different Techniques	1
Group work	1
Opportunity to see what students can do	1
Connection to previous materials	2
PowerPoints	1
Textbook Reviews	2
Homework Development	2
Curious and interest	1
Class participation	1
Example: Show the steps	5
Write everything down	2
Problems on the board	1
Problem on the board: Write the problem rewrite the problem and work on the same problem (stationary problem)	1

Participants components of a good lesson plan have some cross-over with strategies utilized for students struggling with anxiety, as a preview or showcasing materials was a consistent strategy and practice as it provides students with a demonstration of concepts. As noted above, five of the six participants thought a good lesson plan should include step-by-step problem-solving demonstrations. Sarah learned how educators wrote the problem down, then rewrote the problem down, and then began working on the second problem. She used this method as she did not want to rush her students in their problem-solving process. Several participants said they wrote everything down or gauged their students' understanding of previous knowledge and then provided them with practice problems.

Harry stated class participation was essential, and several other participants thought that group work was a necessary component of a good lesson plan. Other participants like Brenda saw the value of group work but did not intentionally structure this into the lesson. She felt that group work added pressure to students (thus causing them anxiety). Sarah was also aware of how group work may have impacted her students struggling with PSTD; thus, she provided an unstructured method of group work. Group work and board work for most participants went hand and hand; Sarah explained the organic nature with which her students "taught" one another on the board. She stated that sometimes this happened with no prompting from her, that students would just put problems on the board and help each other work them. Some participants thought that students being curious and interested in the work created opportunities to engage with the material intentionally. Participants discussed how and where they learned their strategies:

Table 14: Strategies Employed by Participants

Strategies	Number of Participants
Preparation	2
Practice	1
No preparation	1
Word Documents	1
Consistency and Time Management	1
Previous Experience	1
Conference	1
Detailed Explanation of homework, tests, and quizzes	1
Homework Development	2
Textbook Reviews	3
Notes	1
PowerPoint	2

Educational Philosophy – RQ2

Analysis Participants of Educational Philosophies

Educational philosophy comprises educators' beliefs that underpin instructional design and delivery (Geist, 2015). The researcher utilized the word cloud analysis system in analyzing the participants' educational philosophies. Atenstaedt (2017) stated that "a word cloud provided a visual representation of word frequency" (2017, p. 231). Thus, the larger the word is, the more frequently that word was generated in the data set (p. 231). The visual provides a quick summary of the most frequently discussed concepts; for instance, in the *Participants' Educational Philosophy Cloud* below, words such as students, can, know, learn, like, need, think, and teach are more prominent than other words.

Generally, across most of the participants, there was an understanding that it does not matter about students' baseline understanding. It is more so students' willingness to believe that they can engage with the material. Thus, students' math self-concept was very important in class; if students "thought" that they could do the math, it impacted their ability to actually "do math" (Bandalos et al., 1995, p. 612). Participants readily and willingly availed themselves and met students where they were in their educational journey. Yes, by providing instruction but beyond teaching to study skill development, referral for additional resources, an empathetic ear, and not punishing students for having a lazy disposition (or others' life situation, learning disabilities, or anxiety). The words "students, can, know, learn, like, need, think" indicate the participants' beliefs in students' ability to learn and successfully showcase their knowledge. For many students, their teachers' belief in their ability impacts students' mindsets about themselves (Sun, 2015). Much like Jackson and Leffingwell (1999) indicated, other researchers such as Muijs and Reynolds (2002) stated that teachers' beliefs and behaviors impact students' achievement.

Figure 12 Participants' Educational Philosophy Word Cloud

Practices – RQ3

Participants were asked what the go-to practices were when delivering instruction. Below are general practices that participants engaged in:

Table 15: Practices Employed by Participants

Practices	Number of Participants
Teaching students technology	1
Real-world interconnectedness of math	1
Practice Problems	2
Practice Tests	2
Homework	2
Pop quizzes	1
Checking for understanding	1
Board work	4
Group work	1

Four out of six participants engaged or employed board and group work during their in-class practices. Although only two out of six participants listed practice tests, practice problems, and homework, please note that participants employing the board and group work had prepared practice problems for students to complete. Penny was the only participant who stated that she utilized pop quizzes to check for understanding and preparation for upcoming tests. Brenda and Harry engaged in teaching their students the usage of technology or math usability in alignment with their students' chosen careers. Participants were informed of the three anxieties: (general, mathematics, and testing) and asked if they had to give a percentage of the number of students struggling with anxiety in their class; one participant taught at three different institutions and thus provided three different percentages:

Table 16: Participants' Perception of the Percentages of Students Struggling with Anxiety

Percentage	Participant
20%	Harry
30%m 30%, and 60%	LeAnn
50%	Brenda and Sarah
80%	Joy
100%	Penny

Harry stated that 20% of his students struggled with some type of anxiety. LeAnn worked at three different institutions: community college, technical college, and the regional institution. LeAnn stated that approximately 30% of students at the community college, 60% of students at the technical college, and 30% at the regional institution struggled with mathematics anxiety. Brenda and Sarah stated that 50% of their students struggled with anxiety. While Joy at 80% and Penny at 100% stated that students are struggling with anxiety. LeAnn made a similar statement during her interview; she stated that everyone will have to face an anxiety-inducing experience at some point and that her anxiety or disconnection experience helped her understand her students better. Joy addressed a different type of anxiety that was not in the researchers' categorical listing; she stated that students struggle with technological anxiety, as most institutions have had to convert to online or hybrid courses; this is an area for future study.

Additionally, participants were asked what type of anxiety they felt that their students struggled with: It should be noted that participants at the community college were well below (general, test, or mathematics) anxiety.

Table 17: Participants' Perception of the Types of Anxiety that Students Struggled with Anxiety Anxiety

Percentage	Participant
Anxiety (a combination of anxieties, no pinpointed anxiety)	1
Testing	3
General	2

Most of the participants stated their students informed them that they were struggling with test anxiety. Thus, many participants created practice tests on practice day, detailed explanations of each of the problems, or provided students with an alternative test time or site. Penny stated that students struggled with several anxieties and that those anxieties impacted how they made connections with the content. Lastly, two participants stated that students struggled with general mathematics anxiety; Ashcraft and Ridley (2005), Dew et al. (1983), and Hembree (1990) stated that out of the three (general, testing, and mathematics) anxiety that the specified mathematics anxiety is the most prevalent. As anxiousness is becoming commonplace in classrooms, workplaces, and homes, it will be important to help students and teachers develop self-mitigating techniques and interventions to address such an impact disconnection agent. Participants observed several outward indicators that students maybe be struggling with anxiety:

Table 18: Students Outward Signs of Anxiety or Distress

Behaviors	Number of participants who have Observed behavior
Doing nothing/Avoidance	1
Shaking	1
Twitching	1
Panic Attack	1
Crying	1
Test Scores	3
Tells Teacher	5

McKibben (2017) provided three categories for anxiety somatic complaints, distorted cognitions, and behavior (p. 4). A number of the outward signs of anxiety above are categorized as somatic (panic attack, shaking, and twitching). While doing nothing, crying, and telling the teacher are behavioral symptoms. Test scores served as a reflection and possibly confirmation for both teachers and students (several participants stated that students come to tell them that they are struggling with anxiety after the first test). Doing nothing/avoidance is a behavior response to anxiety. Participants like Brenda stated that she helps get students who are stuck or scared by asking them to start with what they know.

Participants were asked how they varied practices if they suspected that students were struggling with anxiety. Below are some practices that the participants engaged in when they suspected that students were struggling with anxiety:

Table 19: Practices that Participants Employed When Students Were Struggling with Anxiety

Practice	Number of participants who have Employ Practice
Test Prep	1
Saturday or Sunday Study Sessions	1
Teaching students technology	1
Group work	1
Group work: Collaborative Learning	1
Techniques	1
Averaging Test grades	1
Practice Tests	3
Stay within Students' comfort zone	1
Learn and teach to each student's ability	1
Practice Problems	3
Practice Problems: Ask students if they need help	2
Make sure that their answers are correct if they are called to work them on the board (to help them avoid embarrassment)	1
Refrain from: asking students to do group work	1
Refrain from: calling students to the board	1

In examining some of the practices (in-class activities) that the participants employed, it is interesting to note one of the practices includes refraining from certain activities. For instance, Sarah stated she refrained from calling students to the board and forcing students to work in groups. She stated this was a measure to counter anxiety in her classroom. Additionally, Sarah stated she would ensure that students' answers were correct before working on the board (to avoid embarrassment). Three of the six participants utilized practice tests as a practice to address students struggling with anxiety. McGuire and McGuire (2015) provided some tips on exam preparation and exam administration (p. 117). Some of the exam preparation included teaching students how to prepare for the test in that good study habits begin at the start of the course (p. 117).

Additionally, educators can provide students with a blueprint of what will be on the test; McGuire and McGuire (2015) advised students to practice teaching the materials to a "real or imaginary" audience (p. 117). The researcher believes that teaching allows students to take ownership of the materials in a way that other methods of studying cannot (memorization, rewriting notes, highlighting the book) (Brown et al., 2014). McGuire and McGuire (2015) and Brown et al. (2014) promote self-testing or quizzing as a method of high retrieval and retention of information. McGuire and McGuire (2015) advised students on exam day to: read carefully, write down needed formulas, budget time wisely, work from easiest to most difficult, remain hopeful that one can work through memory blocks, do deep breathing exercises, stay calm and confident throughout the test (pp. 117-8).

Learning and teaching to students preferred learning styles or modalities is very important (Visual, auditory, reading/writing, and kinesthetic). *Making it Stick, Small Teaching, and Teach Students How to Learn*, provided educators with good examples of how to address each of the modalities for visual learning (PowerPoint or presentations), auditory (should convey the educator's enthusiasm for the course and the students), reading and writing (note-taking, effective reading skills, flashcards), and kinesthetic (experimental work) (Brown et al., 2014; Lang, 2016; McGuire & McGuire, 2015). Thus, educators will have to employ methods that speak to their student populations; this may change from semester to semester. Additionally, participants were asked what types of interventions were created in addressing students' math anxiety:

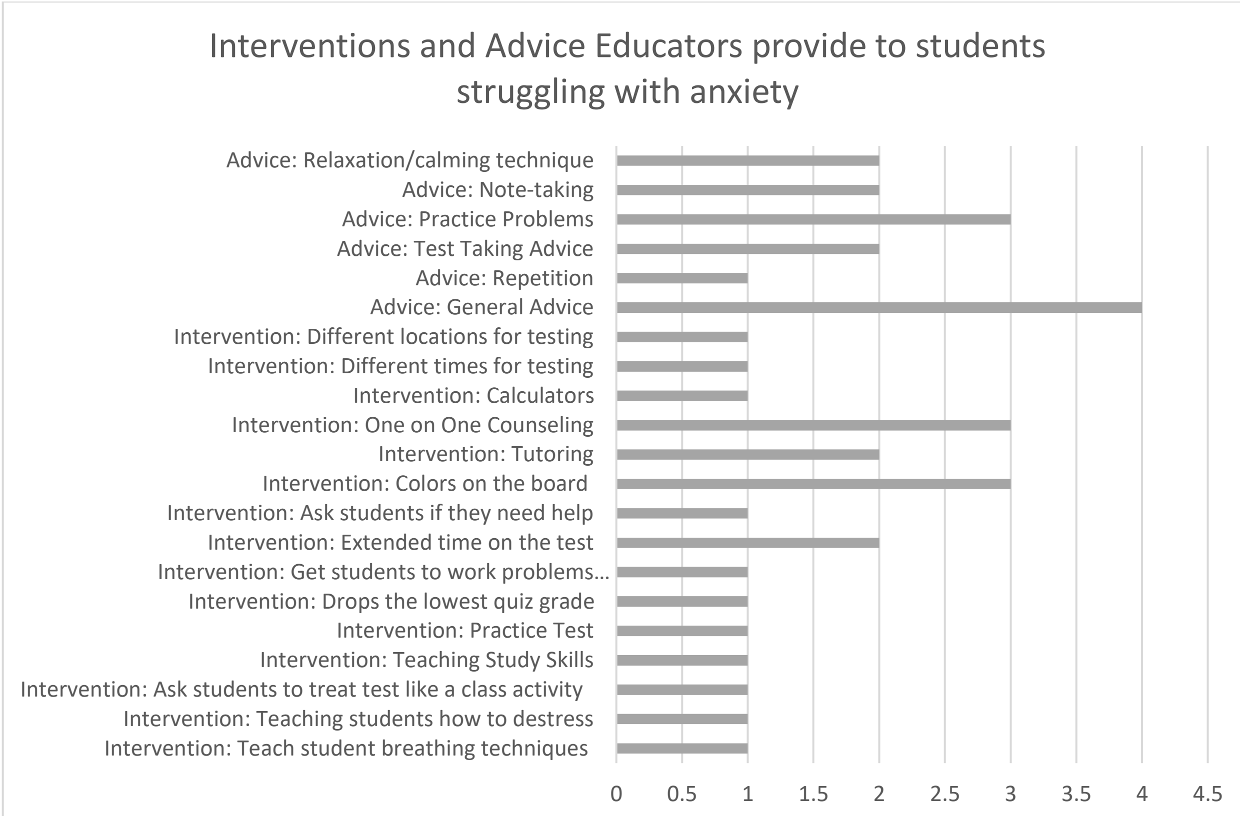


Figure 13 Interventions & Advice Employed by the Participants

Participants provided several interventions to address students' anxiety. A number of these interventions have been discussed in great detail in other finding sections; tutoring and repetition were highly selected interventions. Most of the participants offer some limited tutoring during office hours, while Harry served both as an instructor and a tutor (of most math subjects). Although most of the participants offered to tutor, LeAnn was the only participant who stated that students come to see her regularly. Other participants stated that although they offer their help consistently, students rarely utilize the opportunity. Participants were asked where they learned the practices that they employ:

Table 20: Where Educators' Learned Employed Practices

Practices	Number of participants who have learned practices
Educational Journal	2
Colleagues	2
Videos	3
Books	3
Conferences	2

As instructional anxiety can be observed during instruction or practices, participants were asked if they had ever experienced instructional anxiety and their self-mitigation method. All the participants indicated that they had struggled with instructional anxiety at some point in their careers. Additionally, some spoke of the general anxiousness of teaching new materials, which still occurs for many participants. Harry stated that he has, at some point, struggled with social anxiety; thus, his first time teaching was stressful for him. He stated that he was most concerned about the discipline aspect of "teaching" until he had been a tutor. As a tutor, the focus was on the material and was less teacher-centered or teacher-directed. The participants stated that these are some ways in which they self-mitigate instructional anxiety:

Table 21: Instructional Anxiety Self-Mitigating Tasks

Self-mitigating Task	Number of Participants that engage in these self-mitigating tasks
Relaxations	1
Worksheets	2
Book review	1
Write everything down	1
Practice problems	3
Lots of planning	1
Submitting discipline to someone else	1
PowerPoint Preparation	3
Talking to Colleagues	1
Course Prep	4

The participants engaged in several methods of self-mitigating anxiety. Four out of six stated that course preparation would review the content and gain confidence in their ability to both do and teach the materials. A component of course preparation is to practice problem review or development. Three out of six participants stated that they incorporate practice problems (as a means to alleviate instructional anxiety). Another course preparation method is the development of presentations and worksheets. Book reviews and speaking to colleagues were other methods by which the participant addressed instructional anxiety. LeAnn stated that she utilized some actual relaxation meditation, deep breathing, and physical exercise to alleviate her anxiety. Harry stated that turning the disciplinary matter over to someone else was a major relief as he struggled with being a disciplinarian because of his and possibly students' perception of his age. Participants were asked what advisement or resources they would provide their colleagues who may also experience some level of instructional anxiety.

Additional Tips to Self-Mitigate Instructional Anxiety

Finch (2020) stated that "Education Support" administered a survey in which 75% of teachers reported that they had exhibited anxiety or stress-related symptoms (Finch, 2020). Finch (2020) stated that "teaching" can serve as a trigger as teachers are dealing with burnout or long extended stressful times (Finch, 2020). In contrast, Eulberg (2017) stated that the five practices should include practicing mindfulness, seeking companionship and inspiration, caring for yourself, preparing and planning, and changing your mindset (2017). Eulberg (2017) statements concerning companionship and inspiration are very much like the participant's response of "discussion with faculty members" (Participants, 2019-2020). As mentioned in Chapter 2, teachers' mindsets and beliefs will help impact their and students' overall experience in the classroom (Sun, 2015).

Fink (2018) provided some additional self-mitigating techniques such as seeking mental-health help, exercising, investing in other sides of yourself, trying not to isolate yourself, establishing routines, and prioritizing mental health. As mental health is a pivotal component of anxiety, Fink's (2018) admonishment is timely and appropriate in helping professionals overlook this component of their health. Additionally, physical exercise underpins mental well-being and also can serve as a de-stressor. Educators becoming aware of their work environments' impact on their well-being (including but not limited to financial health) is a component of self-care as well (Fink, 2018).

Student Connections

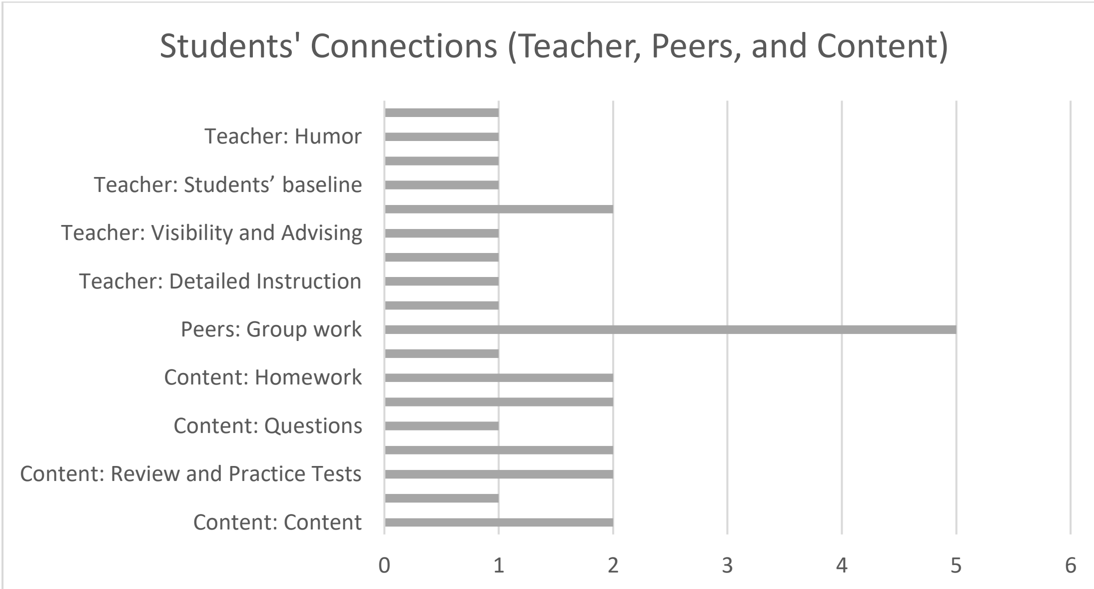


Figure 14 Students' Connection (Teacher, peers, content)

Participants stated that they engaged and employed several techniques to help students connect with them. Physically being present in some capacity was important to several participants; walking around, talking to students, visibility, using advice, and humor were teacher variables to student connection. Several participants stated that one on one attention and advisement was how they made the strongest connection with students. Ironically, Harry stated that he utilized humor to break the ice and connect with his students. Overwhelmingly, participants selected group work as a method by which they assisted students in making a connection with their peers. Participants employed several techniques by which to help students make connections with the content. Development of homework, practice tests, and questions serves as instruments for connecting the student and the content.

Students' Disconnection

Table 22:Students' Disconnection (Teacher, peers, content)

Students' Disconnections	Number of Participants who selected students' disconnection item
Content: Newness	1
Content: Fixed Mindset	1
Content: Lack of preparation	1
Content: Students' belief in their ability	1
Content: Phones	2
Content: Note-taking	1
Peers: Personality	1
Teacher: The teacher's young age	1
Teacher: Students aren't ready for my help	1

As participants observed different disconnection elements, there is a general spread across personality, mindsets, students' skills, introduction of content, educator's age, phones, students' perception of their ability and readiness to receive help. Several participants stated that college readiness is an element built into their remediation course; thus, they are intentional about teaching study skills and habits that address students' deficiencies. Students' mindsets and their perceptions of their ability for some of the participants changed throughout the course. Several participants told triumphs as students developed a strong math self-concept and saw themselves successfully engaging in mathematic tasks. Harry superficially stated that the phone was a disconnection within his classroom; however, Joy also mentioned that the phone had disrupted instruction delivery in her class.

Harry stated that is the area in which he placed the responsibility of the distraction on the student, and the student is responsible for obtaining any information missed during the distracting time frame. As Harry does not like the disciplinarian role, this type of students' ownness is the way to avoid conflict. Brenda stated that often, students might be struggling with the content; they could also have life/personal issues that have interrupted their academic focus. In the past, Brenda has offered unsolicited advice; she stated that sometimes the advice is received and implemented, but she also stated that sometimes the student might not be ready to receive help. She noted that students have had to repeat the course at times, and their maturity level and preparedness are better throughout their second attempt. Modes of Instruction & Instructional Tools

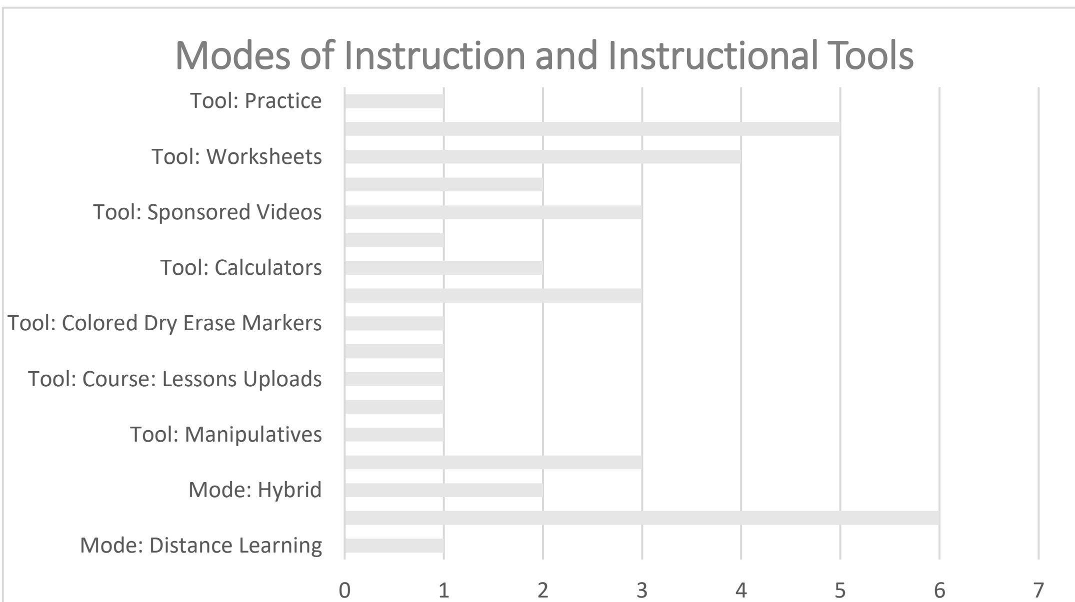


Figure 15 Mode of Instructions and Instructional Tools

LeAnn was the only participant who stated that she had conducted some classes within a distance learning environment. At the time of the interviews, every participant had been taught face to face. Additionally, Brenda and Sarah had taught hybrid formatted courses wherein 60% face to face and 40% self-internet-based learning. LeAnn, Brenda, Sarah, Joy, and Penny had taught online courses; however, face-to-face was the participants' preference. Five out of the six participants stated that they utilized the smartboard as an instructional tool. Based on the observations, all participants utilize the smartboard and other projection software to present their lessons or practice problems. Four out of the six participants utilized worksheets as an instructional tool; it should be noted that all of the participants provided their classes with a practice test and practice problems. Three out of six participants stated that they used sponsored videos, with Brenda being the only participant to make her demonstration videos. Other instructional tools are commonplace in math class; however, it should be noted that providing calculators and or teaching students how to use their calculators was listed as strategies that the participants used to lessen students' anxiety.

Observational Data

The researcher used the observation tool and protocol developed by Gleason et al. (2017). The observation protocol/tool allowed the researcher to gain "a holistic view of the classroom," focusing on the *Standards for Mathematical Practice* (Gleason et al., 2017, p. 123). Gleason et al. (2017) created the *Mathematic Classroom Observation Protocol for Practices (MCOPP)* with the following conceptual framework based upon the *Common Core State Standards in Mathematics*, *The MAA: CUPM Curriculum Guide, Crosswords documents* from the American Mathematical Association of Two-Year Colleges, and the *Process Standards* from the National Council of Teachers of Mathematics (AMATYC, 1995, 2006; NCTM, 2000; National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010).

Gleason et al. (2017) utilized the tenets of *The Instructional Triangle* or *Instruction as Interaction* framework to develop the MCOPP (Ball & Forzani, 2009; Cohen et al., 2003; Gleason et al., 2017, p. 113). Gleason et al. (2017) utilized *The*

Instructional Triangle or Instruction as Interaction to revise processes and examine "teaching mathematics for conceptual understanding through lenses examining teacher facilitation and student engagement" (Ball & Forzani, 2009; Cohen et al. 2003; Gleason et al., 2017, p. 113). The *MCOPP* has sixteen items that examine both "The facilitation" and "Student engagement" in which an observer can observe: tasks, interactions, student reasoning, teacher scaffolding, checks for understanding, thinking and communication, teacher-to-student interaction, student-to-student interactions, and student to content interactions (Gleason et al. l, 2017, p. 114). The researcher has developed the following tables, which examine the participants' "Teacher Facilitation" tasks as well as the "Student Engagement" tasks (Gleason et al., 2017, p. 114).

Table 23: Teacher Facilitation among Participants over the two observations
Mathematics Classroom Observation Protocol for Practices: MCOPP (Gleason, Livers, & Zelkowski, 2017).

		Brenda	Harry	Sarah	LeAnn	Penny	Joy
Item #	Item						
1	Students Engaged in Exploration/investigation/problem solving	✓	✓	✓	✓	✓	✓
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.	✓	✓	✓	✓	✓	✓
3	Students were engaged in mathematical activities	✓	✓	✓	✓	✓	✓
4	Students critically assessed mathematical strategies.	✓	✓	✓	✓	✓	✓
5	Students preserved in problem solving	✓	✓	✓	✓	✓	✓
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.	✓	✓	✓	✓	✓	✓
7	The lesson promoted modeling with mathematics.	✓	✓	✓	✓	✓	✓
8	The lesson provided opportunities to examine mathematical structure. (symbolic notation, patterns, generalizations, conjectures, etc.).	✓	✓	✓	✓	✓	✓
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.	✓	✓	✓	✓	✓	✓
10	The lesson promoted precision of mathematical language.	✓	✓	✓	✓	✓	✓
11	The teacher's talk encouraged student thinking.	✓	✓	✓	✓	✓	✓
12	There were a high proportion of students talking related to mathematics.	X	✓	✓	✓	X	✓
13	There was a climate of respect for what others had to say.	✓	✓	✓	✓	✓	✓
14	In general, the teacher provided wait time.	✓	✓	✓	✓	✓	✓
15	Students were involved in the communication of their ideas to others (peer to peer).	X	✓	✓	X	✓	✓
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.	✓	✓	✓	✓	✓	✓

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Teacher Facilitation Analysis (student to content)

The teacher facilitation task of engaging students also enabled students to connect with the content, and items 1-10 are related to this relationship of *The Instructional Triangle* (Ball & Forzani, 2017; Cohen et al., 2003; Gleason et al., 2017). All the participants intentionally engaged students in tasks that enabled them to connect with the content (Gleason et al., 2017). Items 1-5 are how the students engaged in the content as prescribed by the practices that the educator employed (Gleason et al., 2017). Items 6-10 indicate the educators' strategies and how they negotiated their goals with real-time instruction (Aguirre and Speer, 2000; Gleason et al., 2017).

Teacher Facilitation Analysis (teacher to student)

The teacher facilitation task of engaging students also enabled teachers to connect with the student; items 11,14, and 16 are related to this relationship of *The Instructional Triangle* (Ball & Forzani, 2017; Cohen et al., 2003; Gleason et al., 2017). All the participants intentionally engaged in tasks that enabled students to think critically about the content while also creating an environment in which they could establish a relationship with the educator. For the most part, most participants avoided some of the stressful, alienating behaviors as outlined by Jackson and Leffingwell (1999). Harry did exhibit some impatience and later clarified that this is one area of improvement. The other participants allowed for enough wait time as it is important to allow students to process the materials in their own way.

UMKC (2014) prescribed two wait times; one wait time is as a question is posed the second wait time is after a question is answered. The first wait time allows students to think, process, and organize information, while the second wait time allows students to reflect and confirm their thinking about their problem-solving methods. Educators can employ several techniques to ensure that they do not provide the answers during the first wait time. One such method is redirection; if the educator does not wait to answer the question directly, they could redirect the question to the students' peer group (UMKC, 2006). Additionally, educators can break the question down into basics, start with the students' baseline of understanding (just ask what the student does know about the question) (UMKC, 2006). Other institutions have expanded the ideas to include other techniques to employ during the first wait time as methods to both redirect and help the student engage in problem-solving (University of Wyoming (SI Program), 2015, p. 91):

- Repeat or rephrasing the question (p. 91).
- Prompting for an answer (p. 91).
- Giving a hint (p. 91).
- Asking a simpler question (p. 91).
- Modeling the reasoning involved in answering a similar question (p. 91).
- Inviting them to use support for a moment to help them answer (the researcher has advised students to use peers, their notes, their journals, their textbooks, their homework) (p. 91).
- Seeking a group response (polling students) (p. 91).

Wait time is an essential element of instruction design and delivery. Wait time is also a good time for educators to observe their class for connection and disconnection; as typically, disconnection shows up on students' bodies in ways that they may be conscious or unconscious of displaying.

Teacher Facilitation Analysis (student to student)

Pair or partnerships of complementary strengths can serve both students with a strong connection and those with a weak connection; students with a strong connection can reinforce what they know. Students with weak connections can speak to the holes in their understanding. Items 12, 13, and 15 are related to peer engagement; most of the participants except Brenda engaged in some form of peer-to-peer engagement even if it was limited, much like the LeAnn class. Providing students with an opportunity to demonstrate their knowledge in front of their peer groups can strengthen their math concepts and build their confidence in their presentation abilities.

Table 24: Student Engagement among Participants Class over the two observations
Mathematics Classroom Observation Protocol for Practices: MCOPP (Gleason, Livers, & Zelkowski, 2017).

		Brenda's Class	Harry's Class	Sarah's Class	LeAnn's Class	Penny's Class	Joy's Class
Item #	Item						
1	Students Engaged in Exploration/investigation/problem solving	✓	✓	✓	✓	✓	✓
2	Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.	✓	✓	✓	✓	✓	✓
3	Students were engaged in mathematical activities	✓	✓	✓	✓	✓	✓
4	Students critically assessed mathematical strategies.	✓	✓	✓	✓	✓	✓
5	Students preserved in problem solving	✓	✓	✓	✓	✓	✓
6	The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.	✓	✓	✓	✓	✓	✓
7	The lesson promoted modeling with mathematics.	✓	✓	✓	✓	✓	✓
8	The lesson provided opportunities to examine mathematical structure. (symbolic notation, patterns, generalizations, conjectures, etc.).	✓	✓	✓	✓	✓	✓
9	The lesson included tasks that have multiple paths to a solution or multiple solutions.	✓	✓	✓	✓	✓	✓
10	The lesson promoted precision of mathematical language.	✓	✓	✓		✓	✓
11	The teacher's talk encouraged student thinking.	✓	✓	✓	✓	✓	✓
12	There were a high proportion of students talking related to mathematics.	X	X	✓	X	X	✓
13	There was a climate of respect for what others had to say.	✓	✓	✓	✓	✓	✓
14	In general, the teacher provided wait time.	✓	✓	✓	X	X	✓
15	Students were involved in the communication of their ideas to others (peer to peer).	X	✓	✓	✓	X	✓
16	The teacher uses student questions/comments to enhance conceptual mathematical understanding.	✓	✓	✓	✓	✓	✓

Student Descriptor (*F-Female, *M-Male); Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)

Student Engagement Analysis (student to content)

Every participant's class engaged in all of the first ten items is a direct demonstration of students connecting to the content. During Brenda's lesson graphing, she provided several practice problems. Students learned different types of mathematic terminology (slope, the axis of symmetry, minimum, maximum, parabola vs. linear, and vertex). Much like Brenda, when Harry covered his test review, he reviewed an in-depth understanding of the rules of exponents and covered the types of operations that should occur when you multiply exponents with the same base (add), divide exponents with the same base (subtract), raise an exponent to another power (multiply), reposition negative exponents, evaluate separately when there are different bases, different exponents (when adding or subtracting). For both Brenda and Harry, their students demonstrated their understanding; Harry had students work in groups and then present their work on the board.

During her lesson, Sarah covered terminology related to logs, and her students worked on practice problems and demonstrated some of the board. LeAnn had the largest class attendance across the participant group; thus, LeAnn was intentional in connecting the in-class materials to both the students' homework and practice tests. Unlike Sarah, students were not asked to put problems on the board; LeAnn did walk around while students work some practice problems. Penny and Joy both taught lessons on set theory in which they demonstrated such terms as a union, intersection, Venn diagram, and set. Student participants were engaged and asked clarifying questions as they completed their practice problems.

Student Engagement Analysis (teacher to student)

There are three items related to the teacher-to-student relationship 11, 14, and 16 (Gleason et al., 2017). For item 11, every participant helped students think critically about the materials; several participants (Sarah, Penny, and Joy) related the materials to real-life everyday knowledge or activities. For item 14, every participant provided some wait time for students to ask or answer questions, although LeAnn and Brenda's wait time was in smaller increments than the other participants (Gleason et al., 2017). Typically, with their wait time, they employed one of the techniques outlined by The University of Wyoming (SI Program), redirection, engaging the peer group, or analyzing the students' baseline understanding of the material (The University of Wyoming, 2015). For the last item related to the teacher-to-student relationship, item 16, every participant welcomed and encouraged questions throughout their instructions as a method of checking for students' understanding.

Student Engagement Analysis (student to student)

Items 12, 13, and 15 are related to peer-to-peer engagement. It should be noted that several participants lessen the inclusion of "forced" group work as they are very conscious that this may also cause anxiety (Brenda, Sarah). Sarah does employ a more organic group work selection process; wherein, students can opt to work by themselves. LeAnn's class was large; there was "limited" partner work as group work and get loud and distracting. Penny's class setup may have hindered peer-to-peer engagement as students were seated behind computer monitors. Thus, only students seated beside one another engaged in any discussions; there were a total of 3 different groups in the class (Group 1 – 3 females, Group 2 – 2 males, Group 3- 1 female). Thus, the breakdown is indicative of the type of peer-to-peer engagement that can occur or lack of peer engagement with a single student. Group work or peer engagement can be an element to relieve or increase anxiety; educators can create a safe environment where mistakes are encouraged to demonstrate a growth mindset (Boaler, 2016; Moser et al., 2011).

Chapter VI

IMPLICATIONS AND RECOMMENDATIONS

The problem is that approximately 80% of community college students and 25% of four-year students taking mathematics courses in post-secondary institutions struggle with moderate to high math anxiety; and 67% of two-year and 44% of fouryear students are remedial noncompleters “no degree and not enrolled” (Chen, 2016, p. 35). (Beilock & Willingham, 2014, p. 2; Chen, 2016, p. 32). The purpose of this qualitative study is to determine the strategies and practices used by educators who teach remedial mathematics courses at identified postsecondary institutions in South Georgia to identified students with moderate to high math anxiety who are unlikely to graduate.

Research Questions

Through interviews and observations, this study sought to answer the following research questions:

1. What are the life and career experiences of educators who teach remedial?
2. mathematics at identified post-secondary institutions in South Georgia?
3. What are the strategies used by these educators to mitigate math anxiety?
4. What are the practices used by these educators to mitigate math anxiety?

Mathematics anxiety has relational components, such as parents, peers, and teachers; for this study's scope, we examined educators' influence (Uusimaki & Nason, 2004). Educators bring themselves to teaching; they bring their fears, goals, beliefs, education, and training (Aguirre & Speer, 2000; Geist, 2010; Jackson & Leffingwell, 1999; Polly et al., 2013). As educators are environmental factors of mathematics anxiety, a closer examination of the teachers' influence and potential impact on students' anxiety is warranted (Uusimaki & Nason, 2004). As previously stated, mathematics anxiety has relational components; thus, The *Instructional Triangle* is a framework in which to examine the relationships between (teacher and content, teacher and student, student and student, student and teacher, and student and content) (Ball & Forzani, 2009; Cohen et al., 2003). It is very important to note that every student will have their triangle (connection or disconnection) with teacher, peer, and content. A good example of this would be the educators' triangle when making strong connections or experiencing strong disconnections with their teacher, peers, or content (see Chapter 5).

Strategies

Strategies are instructional preparations that are based upon instructional beliefs, typically occurring outside of the classroom. The educators' belief concerning their teaching efficacy was challenged greater during moments of instructional anxiety. The educators' beliefs concerning their math self-concept or self-efficacy were challenged during moments of disconnection or math, general, or test anxiety (Bandura, 1986). All of the participants stated that they had not been trained in administering mathematics anxiety assessments. Additionally, none of the participants stated that they had received training on developing interventions for their students.

Practices

Educational practices are based upon an educator's instructional strategies, affecting instruction implementation within the classroom or instructional environments. The participants stated that they learned their practices via other colleagues, mentors, professional conferences, books, learning communities, and videos. Participants are cognizant of students who struggle with anxiety and change their strategies and practices to address anxiety through their self-design interventions. The participants had a self-awareness level to identify when they have struggled with math, test, social, or instructional anxiety. Each participant created measures to self-mitigate anxiety; those experiences allow for more informed, empathic instructional design and implementation.

Transformational Teaching

Connecting beliefs and practices

Slavich and Zimbardo (2012) examined a set of different strategies and techniques within instruction identified to serve as the foundation for "transformational teaching" (p. 569). Researchers examined the relationship between teachers, students, and knowledge content, much like this study's design. As a transformational educator, teachers become facilitators much as prescribed by John Dewey (1938), where educators create an exchange environment (Dewey, 1938). Within transformational learning environments, students are empowered to take ownership of their learning experience. Thus, students have to measure introspection in which they are examining their attitudes about themselves and the content. Teachers and students accomplish desired learning outcomes by having a shared vision that includes mastery of context, "personalized attention and feedback," connective lessons that apply beyond the classroom, and embedding time for reflection (Slavich & Zimbardo, 2012, p. 569). A shared vision creates a synergistic environment where students can develop a depth of connection (teacher, peers, and content).

Researchers Slavich and Zimbardo (2012) examined skills, values, and attitudes that superseded content or teacher-focused learning outcomes. In establishing such an environment, educators allow for collaborative and experimental learning, which as Boaler (2016) and Moser et al. (2011), allows students to learn through mistakes (Moser et al., 2011; p. 1487). Student's ability to learn through mistakes allows students to develop a growth mindset further. Teachers will have to model a growth mindset by addressing perfectionism and being the sole content curator within the learning environment. The collaborative nature of learning will allow both teacher and students to explore the content and learn from each other. Dewey's (1938) insisted that students come with their knowledge; thus, making the class more collaborative will allow students to demonstrate what they know. A collaborative learning environment will also help create an environment in which students can connect (UMKC, 2006).

The teacher-content-centered has more of a one-directional exchange; this does not mean that teacher or content-centered classes do not engage in any peer interactions (typically, it is prescribed by the teacher or student organically interact). Note that the collaborative environment encourages connections beyond the prescribed interactions. It is multiple directional exchanges wherein the teacher is also learning from the student. Students are also learning from one another (Dewey, 1938). Student-centered learning is categorized by instructors assigning tasks based upon "students' needs, abilities, interests, and learning styles by making them active learners and giving them autonomy and control over subject matter choices (Slavich & Zimbardo, 2012, p. 572). Additionally, a student-centered environment incorporates learning methods, and pace of study, which in turn increases students' responsibility for learning and helps them develop skills to actively choose and manage their educational goals" (Slavich & Zimbardo, 2012, p. 572). Collaborative-learning is categorized by students working with peers on problem-based tasks to develop problem-solving skills (Slavich & Zimbardo, 2012, p. 572).

A collaborative learning environment lends itself well to experimental learning in which students base their knowledge and personal experiences (Slavich & Zimbardo, 2012, p. 573). These three stages of experimental learning are "concrete experience, reflection, abstract conceptualization, and active experimentation" (Slavich & Zimbardo, 2012, p. 573). Participants demonstrated through their lesson plans and delivery that they allow students to move through their concrete understanding of math concepts' most abstract conceptualization. Additionally, wait time allows students to reflect some educators even engage in experimental learning as they connect the content to real-life tasks. Lastly, problem-solving learning is categorized as problem-based tasks, in which students try to resolve complex problems (Slavich & Zimbardo, 2012, p. 573). Problem-solving learning is said to increase "self-efficacy, problem-solving skills, collaboration skills, and self-directed learning skills" (Slavich & Zimbardo, 2012, p. 573).

Slavich and Zimbardo (2012) stated that transformational teaching and learning occurs when there is a dynamic relationship between the teacher, student, and knowledge content (Slavich & Zimbardo, 2012, p. 576). Although teachers facilitate mastery of subject matter, the courses are neither teacher nor content-centered. The transformation occurs when the teacher imparts information and changes and influences a student's attitude towards learning (Slavich & Zimbardo, 2012, p. 576). Transformative teachers compel students to see the big picture beyond the classroom into education's relevance to students' everyday lives and future. Students are transformed on several different levels and or components of their personhood and can experience personal growth (Slavich & Zimbardo, 2012, p. 577).

Researchers Slavich and Zimbardo (2012) broke down the development of transformational teaching into six methods (Slavich & Zimbardo, 2012, p. 585):

1. establishing a shared vision for a course
2. providing modeling and mastery experiences
3. intellectually challenging and encouraging students
4. personalizing attention and feedback
5. creating experimental lessons that transcend the boundaries of the classroom
6. prompting ample opportunities for pre-flection and reflection

Teachers and students can create a shared vision by establishing shared ideas, statements, and or expectations. It is important to establish the shared vision earlier on within the course as it sets the tone for goal setting and attitudes and behaviors. Providing modeling and mastery of experiences enables teachers to influence attitudes and values. Providing modeling and mastery may also increase peer teaching and learning, peer reliance, and peer accountability (Slavich & Zimbardo, 2012, p. 587). An important practice for the participants was step by step demonstration of problem-solving methods.

Intellectually challenging and encouraging students, aids teachers transform "students' attitudes, values, and beliefs" (Slavich & Zimbardo, 2012, p. 589-590). Personalizing attention and feedback showcase a type of intentionality that helps teachers and students assess both the strengths and weaknesses to devise a plan to maximize the students' potential. Creating experiential lessons creates a connection with classroom activities with real-life responsibilities and tasks. Promoting preflection and reflection are “critical for translating educational activities and exercises into a meaningful, sustainable change in students’ lives” (Slavich & Zimbardo, 2012, p. 594). Preflection thinking allows students to think about problem solving methods before engaging, much like the two wait times discussed in Chapter 5.

It is essential to understand the effects of teachers’ beliefs and their influences and instructional practices and student outcomes. As previous research has shown, there is a significant relationship between teachers’ beliefs and instructional practices. Teachers who employ more student-center instructional techniques are more likely to increase student achievement and possibly even personal and intellectual growth. Thus, teachers’ beliefs and or instructional practices should be examined to discover further the relationship and or level of impact on anxiety and self-efficacy. Additionally, professional development should be examined to train teachers of student-centered instruction, which can aid in both discovery/connectionist orientation and transformational teaching (Geist, 2015; Polly et al., 2013; Slavich & Zimbardo, 2012).

Educators were once students; thus, if they had a negative experience within the mathematics classroom environment, research indicates that the experience could impact their self-efficacy, teaching efficacy, instructional design and implementation, and relationships with their students. Thus, becomes a cylindrical process in which their students could have a similar experience with their self-efficacy development and increase anxiety. As mathematics anxiety has a relational component, it will be important to examine the teacher's relationships to content (strategies) and teachers' relationship with students (practices). Likewise, practices also should be tailored to the mode of instruction.

Implications & Recommendations

The researcher recommends that educators be trained to assess their classes for opportunities for connection and areas where students have disconnections. Additionally, as McKibben (2017) stated, educators should be trained in learning the flags of anxiety to help students become more aware of how they feel. Assisting students in gaining self-awareness will allow educators to provide the students with some self-mitigating techniques. As the participants indicated, they are devising interventions for their students. The researcher proposed that mathematic education-related organizations provide a free depository; wherein educators can become a part of communities and share successful interventions.

It is difficult for new educators to know which educational organizations offer such training; thus, the researcher thinks that the depository should be a free resource like Wikipedia (Wikipedia, 2020). Experts are expected to vet information for quality assurance (Wikipedia, 2020). As Penny suggested, educators should consider the benefits of accountability groups, and learning communities as an aid in which they have opportunities for mentorship relationships. Some social media apps or platforms, such as Facebook's group settings, allow new interested individuals to solicit mentorship (Facebook, 2020). Mentorships is a self-selecting option wherein group administrators can identify that they are available to mentor and provide what areas of advisement they are willing to offer (Facebook, 2020).

Additionally, the mentorship initially lasts up to 10 weeks and can be extended by choosing both the mentor and the mentee (Facebook, 2020). As groups offer virtual meeting rooms, the mentor and mentee can meet and goals set via Facebook or any other virtual platform (Facebook, 2020). As indicated by the participants, mentorships and colleague advisement was essential to them learning their instructional strategies and practices.

Relational Solutions to Anxiety

As outlined in the study, there are relational components of anxiety; then there must also be solutions rooted in relationships. *The Instructional Triangle* provided a framework in which educators can be cognizant of how anxiety impacts the relationship between the teacher and the content (math anxiety) and the teacher and the student (instructional anxiety). Additionally, other relationships can be impacted as well, peer to peer (general and math anxiety), student to teacher (general and math anxiety), and student to content (general, test, and math anxiety) (Ball & Forzani, 2009; Cohen et al., 2003). As educators, peers, and parents can serve as environmental elements of anxiety, educators, peers, and parents help students self-mitigate the impact of mathematics anxiety (Uusamkia & Nason, 2009). Educators can help students develop self-awareness and use a calming and relaxing technique to lessen moment anxiety. Additionally, educators can structure instruction in such a manner as they reduce stress and anxiety within the classroom.

Teaching Fearlessness (Interventions)

Educators can create a culture by which they "teach fearlessness" in the classroom. The following are some of the techniques that educators can employ: setting expectations, creating a safe environment, assessing and addressing disconnections, creating intentional opportunities for connection with (teacher, peers, and content), restructure the course grading as to reduce test anxiety, holistically addressing the whole student.

Creating a Safe Environment and Holistic Invitation

Educators may consider having students develop some academic, personal, and professional goals. Starting the course with goal setting, set the rest of the semester's intention as do expectations. Additionally, it allows students to learn the educators' intent of holistically addressing them throughout the course. Brock and Hundley (2016) stated that the classroom and the learning environment's culture could significantly impact students' goal orientation (p. 140). Brock and Hundley (2016) provided examples by which educators can help students work through their educational or learning goals (pp. 142-4).

Class Partnership or Accountability Partner

Class partnerships offer students an opportunity in which to teach each other before teaching the class. McGuire and McGuire (2015) that teaching allows students to assess their understanding as teaching a class partner will illuminate the gaps in their understanding (p. 55). Often, the class partner can speak to the gap or correct deficient thinking when problem-solving. Teaching is also a demonstration of students' mastery of the content and builds their confidence (students know more than what they think they do).

Class Expectations and Class Goals

The start of the course affords educators with the ability to establish expectations. Brock and Hundley (2016) advised educators to set high expectations, not unrealistic expectations; for instance, educators should not think that every student will connect to them, the content, or the peers in the same manner. As a remedial mathematics educator, this is especially true. The researcher understands that setting expectations allows the students to know that the label "remedial" does not categorize their performance and achievement for the course. Brock and Hundley (2016) examined teachers' expectations and the impact of beliefs, which leads to students experiencing self-fulfilling prophecies that mirror their educators' expectations (p. 112). McGuire and McGuire (2015) advised educators to set expectations and enlighten students on the standard of success.

Educational Philosophy, FISH

Educators can create safe spaces by informing the class of their educational philosophies. As demonstrated in Chapter 5, the participants believed that their students could think and learn. Thus, when their beliefs drive educators' strategies and practices, it provides opportunities to create connections while also assessing and addressing disconnections. Additionally, educators' development of a growth mindset can be demonstrated in practices within the course. Educators can create environments where learning can occur while students embrace the growth mindset through "learning through mistakes" (Boaler, 2016).

Moser et al. (2011) demonstrated that even when a student is making a mistake in the process of doing problems but has a growth mindset that his or her brain is more activated than an individual with a fixed mindset (Moser et al., 2011, p. 1487; Subramony et al., 2014). Thus, engaging students in a safe environment, where experimental learning and mistakes are encouraged while enhancing students' ability to develop a strong math self-concept and address anxiety with non-avoidant methods. Brock and Hundley (2016) provided educators with three ways in which to empower students to learn through mistakes: "normalize mistakes," "value mistakes as learning opportunities," and "coach students through setback" (pp. 147-150)

Educators may utilize the FISH principles with the class (Choose Your Attitude, Be Present, Make Someone's Day, Have Fun) as aids in developing a mathematical mindset (Lundin et al., 2000; Boaler, 2016). Educators can utilize the FISH principles to create expectations and practices, such as: "Make Someone's Day" (the intentionality needed and cost analysis of making someone's day (may cost nothing or could cost something: money, time, resources) (Lundin et al., 2000). The "Be present" principle may allow educators to create practices about mindfulness, as some participants indicated that disconnection occurs when students are distracted or using their phone (educators can make cell phone usage expectations) (Lundin et al., 2000). Choose Your Attitude goes along with the cultivation of a growth mindset (Dweck, 2006; Lundin et al., 2000). If a student start showcases somewhat disruptive behaviors, educators can both remind and demonstrate a positive attitude (Lundin et al., 2000).

Class Structure and Fear Reducing Test Design and Techniques

The course's start is when educators can utilize their class's grading structure to aid in lessening anxiety. Iossi (2007) and other researchers stated that testing or retesting is a practice or strategy for addressing math anxiety, specifically test anxiety. Educators should consider doing the homework grading category the higher point value for the course. It provides students with a level of control (work ethic more than the ability to test becomes the motivating value). It should be noted that this suggestion will not work for every educator as they may have a different motivating value, much like Harry, who stated that students should pass his class even if they are lazy. The first day of class is when the researcher informs her class the highest point value item in the course is homework.

Boaler (2016) also advised educators to allow students to resubmit their work for the highest grade (p.167). Boaler (2016) stated that this sends a key message of growth mindset to students, which communicates those educators "care about learning, not just performance" (p. 167). Thus, as educators, value decisions will have to be made on the side of the growth mindset/transformational or on the side of performance evaluation. Educators' choice is not a binary decision. An educator can still assess students' knowledge and performance while also promoting a growth mindset. Brock and Hundley (2016) stated that the performance-based educator typically ranks students by intelligence and achievement and focuses primarily on those students that are deemed "smart" (p. 140).

Thus, the performance model is the antithesis of growth as it is promoting perfectionism more than the power of learning through mistakes. Students who may be struggling with anxiety may not fare well in performance-based courses as they will not receive differentiated learning that accommodates their learning styles (Brock and Hundley, 2006, p. 140). McGuire and McGuire (2015) provided educators who are teaching underprepared students some tips: set high expectations and showcase the standard for success, asses while teaching, meet students where they are, provide students with critical thinking tips, clearly communicate students' responsibility, stay connected, and have faith "this stuff works" (pp. 158-9). The tips allow educators to understand the need for differentiated learning and the importance of setting high but realistic expectations for students individually and corporately.

Assessing for Connection and Disconnection

Educators can assess or observe students for disconnection with the content; educators can ensure that they sense a high level of patience and care. One method is to ensure that students do not feel rushed when asked questions or repeat demonstrations. Educators' responses will set the tone for how students' peers' respond and perceptions of students' ability (Jackson & Leffingwell, 1999). Thus, removing the anxiety related to peer's judgment or the need for students to have a fully developed knowledge of the content. Educators should avoid some of the behaviors outlined by Jackson and Leffingwell (1999), such as creates a hostile environment (ignoring students' questions, demonstrating impatience, angry behaviors, and an insensitive or uncaring demeanor) (Jackson & Leffingwell, 1999, p.584).

Building Students' Math Self-concept: Filling the Holes in Students' Understanding

Several of the educators create GAP lessons in which to assess and equip their students with the fundamentals. During the fundamental week or GAP lesson, educators can assess for holes in students' understanding and address those holes (also to build students' math self-concept and give them tools that they will utilize with more complex concepts). Several participants stated that practice during the fundamental week or GAP lesson addresses anxiety-causing topics such as fractions (adding, subtracting, multiplying, dividing, graphing, simplifying, converting to decimal, and vice versa). During the fundamental week or GAP lesson, educators can help students discover or strengthen their math self-concept by developing new skills and knowledge that they did not obtain in high school.

Students can consistently build on their first week's success; most are amazed at their new connection with the content, teacher, and peers. Overall, educators can create class experiences wherein students know that they are more important than content coverage and schedules. Educators should be accessible to students and seek opportunities to re-engage them when disconnected and encourage them when connected. The participants provide several opportunities to showcase their accessibility, such as office hours, one-on-one tutoring, in-class responses to questions, and request more demonstrations.

Grounded Theory

As grounded theory and the case study design was employed for this study. The design warrants open, axial, and selective coding. An example of opening coding was provided in *Chapter* 3 (*Excel Coding) Axial Coding, Chapter 5(MAX-QDA tables),* an example of selective coding was provided in *Chapter 5(Comparison of Participant's Disconnection and Connection Instructional Triangles),* and below is an example of an axial coding for the study's data set (Ball & Forzani, 2009, p. 499; Cohen et al., 2003, p. 124; VERBI Software, 2019).

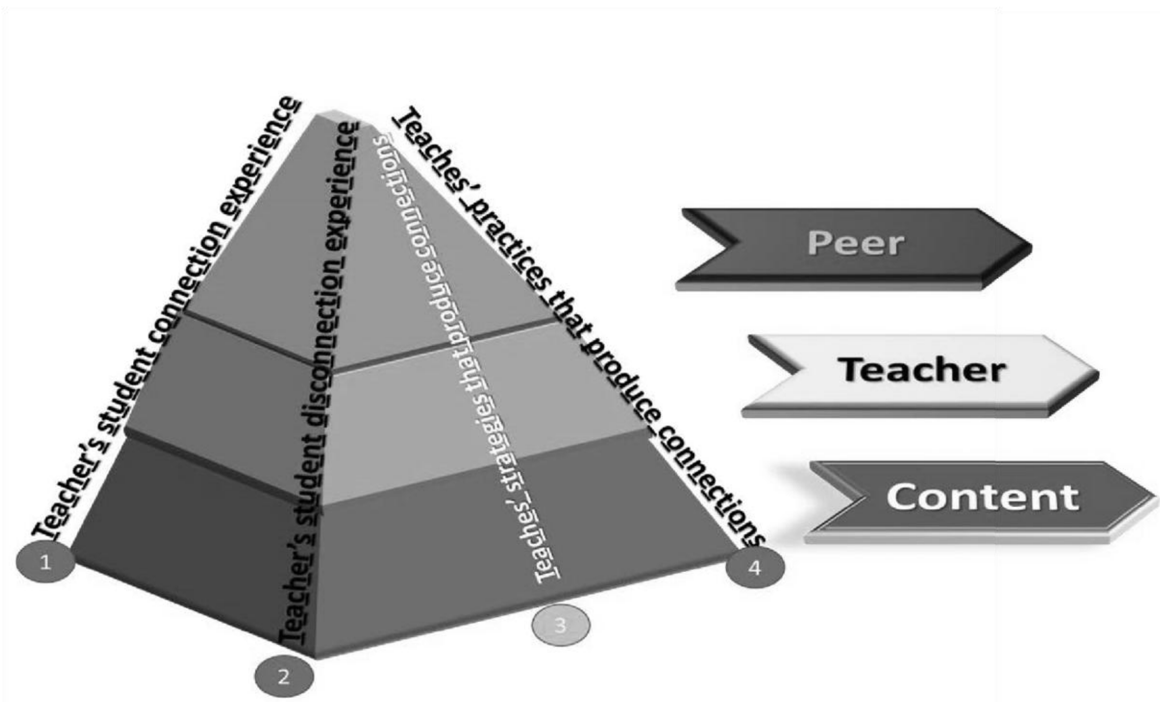


Figure 16 The Educator's Perceptive Taking Instructional Pyramid

The pyramid relationship is ideal based on the most consistent or stable elements of the instructional. The content is the most stable element within any *Instructional Triangle,* as it is the most consistent. For example, the baseline elements or learning outcomes for each subject, for example, College Algebra, have an agreed-upon curriculum. The teacher or educator element of the pyramid has the most influence on shaping both the content and students' possible connection to the content's disconnection. Educators need to have the connection experience first in their formative learning. As the strong connection will help create a strong math self-concept before having a disconnection experience that can induce anxiety (Bandalos et al., 1995, p.612).

Perspective 1: Educators' Student Connection Experience

The pyramid allows educators to take a different perspective to develop and employ different strategies and practices. The teacher can take the students' perspective who had a connection experience and recall their connection teacher (instructional practices that helped them connect with the teacher, peers, and the content). Those connection experiences can be informative as teachers develop strategies and practices to help their students make connections. The educator's student connection experience is one in which the educator develops a strong math self-concept and methods by which to make a connection with the content (and sometimes their teachers and peers) as indicated by the participants (See *Chapter 5 Comparison of Connection and Disconnection Instructional Triangles*) (Bandalos et al.,1995).

Perspective 2: Educators' Student Disconnection Experience

Chapters 4 and 5 have indicated, the teachers' disconnection experience can be just as impactful as their connection experiences. As the participants indicated, their disconnection experiences have informed or shaped their strategies and practices. Thus, participants have developed beliefs about how intentional they are with creating practices to help students connect with (teacher, peers, and content). Additionally, as Brenda stated, she develops a sympathy filter when dealing with students struggling with anxiety. As sympathy is a close concept to empathy, Brené Brown (2013) stated that “empathy fuels connection” while “sympathy drives disconnection” (Brown, 2013). Brown (2013) stated that individuals who want to serve others in empathic ways must “feel” with the individual. Thus, an educator's ability to develop empathetic responses will serve them while addressing disconnection in their classrooms. Additionally, researcher Sorakin-Balli et al. (2020) examined the connection between educators’ empathic tendencies and classroom management styles.

Sorakin-Balli et al. (2020) stated that empathy provides the foundation for establishing interpersonal communications between teachers, students, and peers (p. 147). Empathy serves as a conduit in which a respectful and safe environment is created, thus reducing anxiety within the learning environment Sorakin-Balli, 2020, p. 147). Empathic responses may provide educators an avenue for which to holistically understand their students, as students are maybe more willing to share as they feel “being understood,” which makes them relax (Sorakin-Balli, 2020, p. 147). Harvard Graduate School of Education (2020) developed the *Making Caring Common Project*. They provided the benefits of an empathic learning environment and ways in which educators can build empathy and address barriers for empathy development (Harvard Graduate School of Education, 2020).

Some of the listed benefits include “more classroom engagement, higher academic achievement, better communication skills, lower likelihood of bullying, less aggressive behaviors and emotion disorders, more positive relationships (Harvard Graduate School of Education, 2020, p.1). Educators can build empathic learning environments by modeling empathy, showing empathy is important, practicing perspective-taking, setting clear expectations, and analyzing the impact of empathy in a scientific manner (Harvard Graduate School of Education, 2020). Educators will have to be aware of the barriers to building empathy such as “feeling different” or “distant from another person,” simply put when students feel “othered” this will serve as a barrier to building an empathic environment (Harvard Graduate School of Education, 2020, p. 3).

Thus, educators will have to empower students to reject stereotypes, value differences, expand their “circle of concern,” learn to listen, manage or self-regulate emotions, and be solution-oriented in challenging social situations (Harvard Graduate School of Education, 2020). Ultimately, empathy serves as a vehicle for which educators can “connect” and “feel” with a student experiencing disconnection. The ability to take the perspective of students struggling with anxiety is enhanced by educators' ability to connect to their anxiety (disconnection) experience.

Perspective 3: Educators’ Internal/Intrinsic Values that Inform Strategy Development

The third perspective may be the most impactful, as this perspective is an inner dialogue within the educator. As previously stated, and as illustrated by the pyramid, this is the one relationship that cannot be seen visibly by the image (intra-teacher’s relationship). Aguirre and Speer (2000) indicated that this internal dialogue consists of establishing goals and negotiating said goals when carrying out class practices. Aguirre and Speer (2000) also alluded to a possible disconnect between the goals and the in the moment implementation of an instructional design. Thus, elements of this perspective include the teachers’ connection to the content (knowledge base), math self-concept, “pedagogical knowledge and beliefs” (Aguirre & Speer, 2000, p. 331).

As the inner dialogue is an indication that educators need to have a level of self-awareness, the researcher recommends that educators engage in a type of 360 assessments much like those offered in Peter Northouse's (2010) *Leadership*: *Theory and Practice.* Several of the assessments require participants to solicit feedback from people in leadership and those they possibly lead. As educators, a participant would be able to do a self-assessment and have their supervisors, peers, and students conduct the same assessments to see any incongruencies. Northouse (2010) has a *Multifactor Leadership Questionnaire (MLQ)* in which the items allow participants to evaluate their leadership styles as one of the three (transformational, transactional, passive/avoidant) (p. 199).

As transformational leadership can be paired with transformational teaching and learning; transactional leadership can be paired with performance-based teaching wherein there is a more managerial (micro) style in which a goal and tasks are completed to achieve the goal. Transformational teaching and learning allow for a more holistic (macro) development of the goals to align with the development and growth of the stakeholders or participants (teachers and students). A future study could examine the *Educators' Perspective Taking Pyramid* of educators who identify as transformational, transactional, or passive/avoidant to ascertain the impact on students' *Instructional Triangles* (connections or disconnections to the teacher, peers, or content) (Ball and Forzani, 2009).

Perspective 4: Educators' In-class Practices (Implementation of Instructional Design)

As educators encounter "goal shifts," they have to prioritize their "belief bundles" (Aguirre & Speer, 2000, pp., 332-335). As Aguirre and Speer (2000) recommended, the in-class practice provides an opportunity for observation in which an observer can examine strong manifestations of teachers' standard beliefs (Aguirre & Speer, 2000, p., 335). Additionally, observations allow observers to view educators' triggers for goal and action shifts and influence new collaborative goals to enact standard goals (p., 335). Teachers' adjustment to engage in their new goals (p. 335).

The practice of perspective-taking within the moment instruction allows the educator to connect to the connection and disconnection experiences to enhance connection and assess disconnection. The adjustment of both strategies and practices are necessary when students are struggling with anxiety. The participants demonstrated their strategies and practice adjustment through their design of interventions. The following are some of the participants' interventions (different color makers, practice test, different test times and locations, extended test time, test corrections, weekend study sessions, and detailed explanations for tests, quizzes, and homework) (See Chapter 5).

In conducting practices, educators will also have to be very conscious of the true implications of the "intra" dialogue on practices. Thus, assessing for congruencies is very important as it aids in the consistency of messaging from the educator to the students. Although Sorakin-Balli et al.'s (2020) study did not yield significant findings or correlations between empathetic practices and classroom management, the study does recommend that this is an area where more studies are warranted. The researcher recommends that as educators are being assessed for empathic practices, a comparison of those practices will be examined to ascertain the impact on students' *The Instructional Triangle* (connection or disconnection to teacher, peers, or content) (Ball & Forzani, 2009).

The four perspectives allow educators to be intentional about the development of the teacher-to-student relationship. Brock and Hundley (2016) advised educators to develop a growth-oriented relationship with students (p.76). Some benefits of educators developing a growth-oriented relationship include: students' perspective of teachers' belief in their ability, the likeability of educator, students accept feedback, learning is more important than performance (grades), and students feel safe with the educator (Brock & Hundley, 2016, p. 76).

Limitations and Recommendations for Future Study

As stated in the limitations section of Chapter 1, a major limitation was the exclusion of students' participants. Students are the direct and indirect recipients of educators' instructional design and implementation. As noted by Jackson and Leffingwell (1999), students become barometers of the educational climate created by educators; thus, educators have the power to create safe environments where students can fully engage in developing relationships with (teacher, peers, and content). Additionally, within a conducive learning environment, one can discover or gain depth in one of the two relationships that cannot be depicted by *The Instructional Triangle (*the intra teacher and students' relationships) (Ball & Forzani, 2009; Cohen et al., 2003). This study provided a context for exploring the intra educators' relationships with (teacher, peers, and content). As educators revisited the experiences of connection and disconnection, it provided educators an opportunity to gain a perspective of what issues may arise for students in terms of their instar student experience.

The study showcases the need to explore students' connection and disconnection experience in which there may also be a way in which the theory of *The*

Student's Perspective Taking Pyramid can be further explored and developed. The theory proposes that students also will be able to connect to their connection and disconnection (anxiety) experiences to create both strategies (thinking, math self-concept, organization) and practices (hands-on practices both in class and other places in which they are problem-solving).

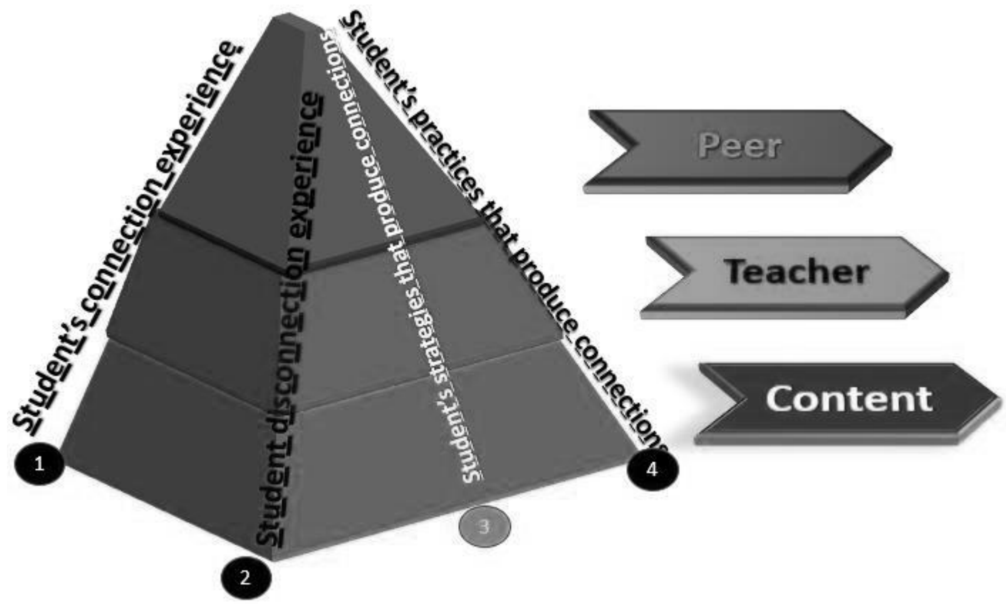


Figure 17 The Student's Perspective Taking Pyramid

Future studies can provide content for each of the tenets or perspectives that a student can engage while self-mitigating anxiety and making stronger connections with (teacher, peers, and content). Thus, future studies offer a resolution to the limitation of ways in which students are self-mitigating anxiety. Additionally, with *The Student's Perspective Taking Pyramid*, researchers may discover students' role in creating connections or disconnections. Thus, an exploration of how educators may utilize students' intra understanding to speak to those mechanisms of the connection while also partnering with students to address the disconnection mechanism. Education is a partnership with a commitment of sorts to exchange, develop, improve upon, or address deficiencies in understanding.

A longitudinal study proposal in which remedial mathematics students are followed throughout their academic career to ascertain what aspect of *Cognitive Consistency or Balance Theory* serves as a predictor of the types of connection or disconnection (Heider, 1958; Schunk, 2016, p. 344). *The Instructional Triangles* students experience up until they graduate or quit (that respective higher learning institution) (Heider, 1958; Schunk, 2016, p. 344). A longitudinal study could explore students' self-perception (intra) self-experience when having a connection experience and students' self-perception (intra) when having a disconnection experience. During the study, students experiencing a disconnection (anxiety) related experience could serve as a control group for experiments in which interventions are designed to help address anxiety and disconnection. The study should include the impact of the mode of instruction on educators and students' *Instructional Triangles* (Ball & Forzani, 2009). As there is a need for more research on mode of instructions' impact on instructional or student's anxiety.

Additionally, as the study structure did not include K-12 educators, there is an avenue to discover how K-12 deal with their "own" anxiety while discovering their students' anxiety (Geist, 2015, Jackson & Leffingwell, 1999). As Geist (2015) suggested, intentionality towards training may immensely help K-12 educators address math and instructional anxiety. K-12 educators seem to have an advantage of sorts related to instructional design and delivery, as there is immense training on how to help students develop a connection with the content. There is a strong accountability level, as K-12 educators must receive certification and continuous training in their specified content area. The accountability found in K-12 systems is a stark contrast to higher education educators.

Some educators are content experts but may lack pedagogical knowledge to help students connect with the content. Additionally, K-12 educators are constantly assessing students' connection with the content, be it state or local system assessments. Unlike in Higher education, professors are not demoted or promoted based upon their pass or fail rate. The success and requirements of tenure are not structured based on students' documented connection to the content. Tenure requirements may ask professors to deepen their knowledge of the content and make discoveries (this could be in pedagogy design but could be in experimental exploration of the content). There is a disconnect; there is a disconnect between the systems of learning, and those systems lead to the need for remediation for college students who are not prepared for the rigors of "content experts" who may or may not be "student-centered." The system of K-12 is very student-centered, while the college/higher education environment is very content-centered.

Lieberman (2005) stated that often professors have deep knowledge of their discipline but lack "the appropriate pedagogical theory and practice" (Lieberman, 2005, p. 87). Thus, higher education institutions are working to address the issue by creating centers for teaching and learning. Educators can gain skills and knowledge that will propel connection and speak to disconnection in their classrooms. Centers are evolving from the original goals of student-centered approaches to instructional delivery and assisting professors in serving as facilitators in assisting students in mastering the content (Liberman, 2005, p. 88). Higher education institutions are expanding the goals to included topics of retention and also becoming experimental “laboratories for learning” (Liberman, 2005, p. 88).) The difficulty arises when there is no shared value of the need to pursue additional training and knowledge. How do you tell an expert that there is more to learn? How does an expert discover or have the introspection of connection and disconnection serve as beckons of the possibilities of the magic that can happen both inside themselves and their students? Learning should be likened to magic as it forever changes the collective; the collective is never the same after engaging in a connection that furthers connections. The magic is in the ability to change perspective, at one time being disconnected and isolated, now to move into a place of connection and beyond to serve as a connection agent.

Conclusions

Anxiety has served as an agent of disconnection in learning environments. Anxiety has impacted educators’ connection to the content and students and students’ connection to teachers, peers, and content. Educators utilize their methods to assess and address anxiety. There is a need for more advanced training for educators to assess and address anxiety more effectively. Educators’ interventions and students’ self-mitigating techniques can serve as ways to change the paradigms of education; education can become connection-driven instead of (teacher, peers, and content) driven. Both educators and students can learn how perspective-taking can allow them to speak to their anxiety and maintain connection within the learning environment.

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APPENDIX A:

- IRB: Protocol Exemption Approval (older version will update)
- The CITI Program: Human Research IRB Basic Course Certificate
- The CITI Program: Completion Report_Course Work Requirements
- Transcriptionist's The CITI Program – Completion Report

Institutional Review Boad (IRB)
For the Protection of Human Research Participants

PROTOCOL EXEMPTION REPORT

Protocol Number:	03967-2019	**Responsible Researcher:** Njeri Pringle
Supervising Faculty:	Dr. Meagan Arrastia-Chisholm ***(effective 05.27.2020)***	**Co-Investigator(s):** n/a
Project Title:	*Mathematics Anxiety and the Instructional Triangle: A Case Study of Remedial College Instructors.* ***(revised 05.27.2020)***	

INSTITUTIONAL REVIEW BOARD DETERMINATION:

This research protocol is **Exempt** from Institutional Review Board (IRB) oversight under Exemption **Category 2**. Your research study may begin immediately. If the nature of the research project changes such that exemption criteria may no longer apply, please consult with the IRB Administrator (irb@valdosta.edu) before continuing your research.

ADDITIONAL COMMENTS:

- *Exempt research guidelines prohibit the collection and/or sharing of recorded interviews and/or focus group sessions. The recordings must be deleted immediately upon creating the transcript.*
- *In order to maintain participant anonymity, please advise Focus Group participants not identify themselves or others.*
- *The Research Statement (interviews & focus group sessions) must be read aloud to participants at the start of each session. The researcher's reading of the statement and confirmation of participant understanding must be part of the final transcript.*
- *Upon completion of this research study all data (emails, survey data, participant lists, etc.) must be securely maintained (locked file cabinet, password protected computer, etc.) and accessible only by the researcher for a minimum of 3 years.*

☒ If this box is checked, please submit any documents you revise to the IRB Administrator at irb@valdosta.edu to ensure an updated record of your exemption.

Completion Date 17-Jun-2019
Expiration Date 16-Jun-2022
Record ID 6297033

This is to certify that:

Njeri Pringle

Has completed the following CITI Program course:

Human Research (Curriculum Group)
IRB Basic (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Valdosta State University

Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wb28ededf-60f2-4b04-b35a-37ce2cf5a7a9-6297033

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Njeri Pringle (ID: 383707)
- **Institution Affiliation:** Valdosta State University (ID: 475)
- **Institution Email:** npringle@valdosta.edu
- **Institution Unit:** Student Success Center
- **Phone:** 6024001703

- **Curriculum Group:** Human Research
- **Course Learner Group:** IRB Basic
- **Stage:** Stage 1 - Basic Course
- **Description:** This course is suitable for Investigators and staff conducting SOCIAL / HUMANISTIC / BEHAVIORAL RESEARCH with human subjects. The VA module must be completed if you plan to work with subjects at a VA facillity.

- **Record ID:** 6297033
- **Completion Date:** 17-Jun-2019
- **Expiration Date:** 16-Jun-2022
- **Minimum Passing:** 80
- **Reported Score*:** 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
History and Ethical Principles - SBE (ID: 490)	17-Jun-2019	5/5 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	17-Jun-2019	5/5 (100%)
The Federal Regulations - SBE (ID: 502)	17-Jun-2019	5/5 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	17-Jun-2019	5/5 (100%)
Assessing Risk - SBE (ID: 503)	17-Jun-2019	5/5 (100%)
Informed Consent - SBE (ID: 504)	17-Jun-2019	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	17-Jun-2019	5/5 (100%)
Valdosta State University (ID: 746)	17-Jun-2019	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k655bbcf0-f61c-4dac-acd8-0adbf78d0f85-6297033

Collaborative Institutional Training Initiative (CITI Program)
Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

Transcriptionist

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

Transcriptionist

- **Name:** [redacted]
- **Institution Affiliation:** Valdosta State University (ID: 475)
- **Institution Email:** [redacted]u
- **Institution Unit:** Academic Support Center
- **Phone:** 4702619014

- **Curriculum Group:** Human Research
- **Course Learner Group:** Students in Research
- **Stage:** Stage 1 - Basic Course

- **Record ID:** 36695979
- **Completion Date:** 22-May-2020
- **Expiration Date:** 22-May-2023
- **Minimum Passing:** 80
- **Reported Score*:** 80

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Students in Research (ID: 1321)	22-May-2020	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k78be6131-6bb5-4a8c-938b-0bf6997cd417-36695979

Collaborative Institutional Training Initiative (CITI Program)
Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 2 OF 2
COURSEWORK TRANSCRIPT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** [redacted]
- **Institution Affiliation:** Valdosta State University (ID: 475)
- **Institution Email:** [redacted]
- **Institution Unit:** Academic Support Center
- **Phone:** 4702619014

- **Curriculum Group:** Human Research
- **Course Learner Group:** Students in Research
- **Stage:** Stage 1 - Basic Course

- **Record ID:** 36695979
- **Report Date:** 22-May-2020
- **Current Score**:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Students in Research (ID: 1321)	22-May-2020	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k78be6131-6bb5-4a8c-938b-0bf6997cd417-36695979

Collaborative Institutional Training Initiative (CITI Program)
Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

APPENDIX B:

- Administrative Invitation
- Participation Invitation,
- Instructor’s Survey, Interview Guide, Observation Permission Email, and Protocol

Instructor's Survey

Q1 You are being asked to participate in a survey research project entitled "A Qualitative Study of Teachers and Mathematics Anxiety with Student," which is being conducted by Njeri Pringle, a Dr. Meagan Arrastia-Chisholm at Valdosta State University. The purpose of the study is to determine the strategies and practices used by educators who teach remedial mathematics courses at selected post-secondary institutions in South Georgia to students with moderate to high math anxiety and the students are unlikely to graduate. You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about strategies and practices used by educators when teaching remedial students with moderate to high mathematics anxiety. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life. Participation should take approximately 5 minutes to complete. This survey is confidential. No one, including the researcher will be able to associate your responses with your identity. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. Participants must be at least 18 years of age to participate in this study. Your completion of the survey serves as your voluntary agreement to participate in this research project and your certification that you are 18 or older. You may print a copy of this statement for your records.

Questions regarding the purpose or procedures of the research should be directed to Njeri Pringle at npringle@valdosta.edu . This study has been exempted from Institutional Review Board (IRB) review in accordance with Federal regulations. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at 229-253-2947 or irb@valdosta.edu.

Q2: Please enter the survey code provided. By entering this code, you are providing your consent to participant in the research study as explained in your email. You may exit this survey at anytime and withdraw your participation from the research study without consequence.

Q3: Did/will you teach a singular remedial or concurrent/concourse mathematics course during the 2019-2020 school year? Yes or No

Q4: Part: Demographics: What is your gender? Female or Male

Q5: What type of remedial course did you teach in 2019? (singular course offering, concurrent/concourse – core, concurrent/concourse – remedial, singular/concourse)

Q6: What type of remedial course will you teach in 2020? (singular course offering, concurrent/concourse – core, concurrent/concourse – remedial, singular/concourse)

Q7: How many years have you taught remedial mathematics?

Q8: Have you taught mathematics in other educational environments (K-12, only online, etc.)?

Q9: What is the highest degree that you have earned? (Associate's Degree, Bachelor's Degree (B.A., B.S., etc.), Master's Degree (M.A., M.B.A., M.Ed., M.S., etc.), Education specialist or professional diploma (Ed.S.), Doctorate or first professional degree (Ph.D., Ed.D., etc.), Postdoctoral

Q10: Any additional certification or professional development that informs your educational strategies and practices?

Q11: What is your ethnicity? (White, Black or African-American, American Indian or Alaska Native, Asian, Native Hawaiian or Pacific Islander, Other)

Administrative Invitation

Date
(Institution's Name) and oversight:

Thank you for taking the time to explore the components of this study and for considering participation by your school. This study will assist in examining the relationships between instructional strategies and practices in environments where a percent of the remedial students are struggling with moderate to high mathematics anxiety.

Instructors will be asked to complete a survey instrument that includes a teaching mathematics anxiety and efficacy, mathematics teaching efficacy beliefs scale, and teachers' survey. The survey instrument will be administered electronically. Each participant will be given a code as to ensure the confidentiality of both the institution and the study participant.

I will need permission is needed for access to your instructors during November of 2019 or prior to April 30, 2020(If the institutional approval is delayed). I would like to conduct a (60 minute) focus group, one (60) minutes interview, and two course session observations. The instructor(s)/educator(s) will have the opportunity to select the dates and times that would work best for him or her.

The published research will not contain any instructor nor institution names, other than to note that all participating post-secondary institutions are located in South Georgia. Please send me an email indicating whether or not you are willing to grant permission for your instructors to participate by completion of the survey, interview, and observation should they choose.

Upon completion of this study, you will have the opportunity to receive a copy of the published results, as well as a copy of the results of the data collected for the county. Questions about this study can be directed to myself by email at npringle@valdosta.edu My faculty advisor, Dr. Meagan Chisholm, may be contacted at (229) 249-2777 or by email at mcarrastia@valdosta.edu.Your time and effort in helping me gather information is greatly appreciated and will ultimately assist educational professionals to improve student achievement in the area of mathematics.

Sincerely,
Njeri Pringle Doctoral Candidate, Valdosta State University
Adjunct Instructor, Georgia Military College
Graduate Assistant in the Academic Support Center, Valdosta State University

Participant Invitation

Dear Remedial Mathematics Instructor:

You are being asked to participate in a survey research project entitled "A Qualitative Study of Teachers and Mathematics Anxiety with Student," which is being conducted by Njeri Pringle, a Dr. William Truby at Valdosta State University. The purpose of the study is to determine the strategies and practices used by educators who teach remedial mathematics courses at selected post-secondary institutions in South Georgia to students with moderate to high math anxiety and the students are unlikely to graduate. The following research questions will guide this study. You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about strategies and practices used by educators when teaching remedial students with moderate to high mathematics anxiety. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

Participation should take approximately 5 minutes to complete. This survey is confidential/anonymous. No one, including the researcher, will be able to associate your responses with your identity. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. Participants must be at least 18 years of age to participate in this study. Your completion of the survey serves as your voluntary agreement to participate in this research project and your certification that you are 18 or older. You may print a copy of this statement for your records.

Your completion of the survey is voluntary. You can decline to participate in this survey without repercussions. There are no anticipated professional or financial risks. To help ensure the confidentiality of your identity, you will be assigned a numeric code ISC:00(date 11/12/19)SC/RI/LA. The instructor's survey code, as well as all the information gathered through the use of the survey instrument, will be held confidential and discarded upon completion of the research. If you choose you will be asked to participate in a (60) minute focus group, a (60) minute individual interview, and two-course session observations.

The instructor's survey code will be used for tracking purposes only in order to match the institutions with the collected focus group, interview, and observation data for analysis purposes through the completed survey. Your privacy and research records will be kept confidential to the extent of the law.

The results of this study may be published. The published results will not include your name or any other information that would personally identify you or your school in any way.

If you have any questions about this survey or would like additional information about this study, please contact me at npringle@valdosta.edu My faculty advisor, Dr. Meagan Chisholm, may be contacted at (229) 249-2777 or by email at mcarrastia@valdosta.edu. This study has been exempted from the Institutional Review Board (IRB) review in accordance with Federal regulations. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at 229-253-2947 or irb@valdosta.edu.
The submission of the online survey will indicate your consent to volunteer to participate in this study. Thank you in advance for your assistance with this research.

Sincerely,

Njeri Pringle Doctoral Candidate, Valdosta State University
Adjunct Instructor, Georgia Military College
Graduate Assistant in the Academic Support Center, Valdosta State University

Interview Protocol

Research Questions

1. What are the life and career experiences of educators who teach remedial?

   mathematics at identified post-secondary institutions in South Georgia?

2. What are the strategies used by these educators to mitigate math anxiety?

3. What are the practices used by these educators to mitigate math anxiety?

Interview Questions

Category	Questions	Serve as data for which Research Questions
Career & Experience Focus Group	1. Tell me about yourself?	RQ(s) 1
	2. What is your career or educational background?	RQ(s) 1
	3. What are some things that your academic background did not prepare you for in teaching math?	RQ(s)1,2,3
	4. What guidance are instructors given for math? (lead instructor, administration, etc.) Describe it to me.	RQ(s)1,2,3
	5. When was the first time that you made a strong connection with either your teacher, other students, or the content in a class? Please describe.	RQ(s) 1
	6. Have you ever experienced anxiety in a course as a student? Can you tell me about the experience?	RQ(s) 1

	7. When was the first time you had a strong disconnection with either your teacher, other students, or the content in a class? Please describe.	RQ(s) 1
	8. Do you think that you had outward indicators of your anxiety (such a stressed facial expression, excessive pen, finger, leg tapping, prelonged distracted appearance, etc.)? a. Did your instructor/professor recognized it as anxiety? b. If so, what was their response? c. If not, what would have been a favorable response?	RQ(s) 1
	9. Did you explicitly tell your professor if you were struggling with some level of fear/anxiety/or challenge, if so, what was there response? a. If not, what was the reasons from not sharing your struggle with your instructor/professor? b. If you could have a "do over" would you respond in the same way?	RQ(s) 1
	10. What about the course design, content, course material delivery, instructor/professor relationship attribute to your stress/anxiety/fear in the course?	RQ(s) 1,2,3
	11. What ways did you self-mitigate your stress/anxiety/fear?	RQ(s)1
	12. How did anxiety/stress/fear have an impact on your connection to the content? a. What was the overall outcome of the course/grade wise?	RQ(s)1
	13. How did anxiety/stress/fear have an impact on your connection with your educator/professor?	RQ(s)1
	14. How did anxiety/stress/fear have an impact on your connection with other student?	RQ(s)1

	15. Overall, what did you learn from the stressful/anxiety related experience about yourself, about education, about the content, etc.? a. Did this experience in any way inform how your teach?	RQ(s)1,2,3
	16. What are the connection between your weaknesses/strengths as a student and things you struggle/successful with as an adult?	RQ(s)1,2
	17. When did you know that you could be a good math teacher?	RQ(s) 1, 2
Strategies & Practices	18. Would you describe yourself as a traditional/non-traditional teacher?	RQ(s)1,2
	19. What is your philosophy of education? Do you share this with students?	RQ(s) 2,3
	20. What learning environments have you taught in? a. Face to face b. Online c. Hybrid d. Synchronous e. Distance learning What is your preference?	RQ(s)2,3
	21. In your opinion, what are the components of a good math lesson? a. How many days a week do you teach math? b. How much time do you have to teach math? c. How often do you meet with students about their individual math concerns?	RQ(s)2,3
	22. What is different now from when you first taught the course?	RQ(s)2,3
	23. What would your classroom look like if each student were interacting with math the same way you are?	RQ(s)2,3

	24. What are some supplemental tools that you use to implement your lessons? a. Manipulatives b. Worksheets/Journals, etc. c. Smartboard d. Videos i. Other sponsored ii. Self-made videos 25. Online software/websites	RQ(s)2,3
	26. If you had to give a percentage, how many students do you think struggle with anxiety?	RQ(s)2
	27. What are some indicators that a student may be struggling with anxiety? a. What are your go to responses? If any?	RQ(s)2
	28. How often do students often tell you that they are struggling with anxiety? a. What is your response/advice to them? b. In turn, what are the students response to your advice/response? c. Have you seen students that have taken your advice? i. If so, what are some of the outcomes?	RQ(s)2,3
	29. If not, what are some of the outcomes?	
	30. Were you trained on how to assessment your students for mathematics anxiety and create interventions?	RQ(s)1,2,3

So, in the design of this study; strategies are your preparatory actions for instructions (educational background, professional development/continuous training/continuing education) while practices(are these that you do inside of the classroom (facilitation, lesson implementation, assessing, etc.). Please provide your understanding of strategies and practices?	RQ(s)2,3
31. What are your go to strategies? i. If you sense that a student has moderate or high anxiety do those strategies change?	RQ(s) 2
32. How did you locate or learn these strategies?	RQ(s) 2
33. What are your go to practices?	RQ(s) 3
34. Where and how did you locate or learn these practices?	RQ(s) 3
a. If you sense that a student has moderate or high anxiety do those practices change?	RQ(s) 3
35. What words or descriptors would you use for your students?	RQ(s) 2, 3
36. What serves as barriers or gets in the way of you making connections with students?	RQ(s) 2, 3
37. What serves as barriers or gets in the way of your students making connections with other students?	RQ(s) 2, 3
38. What serves as barriers or gets in the way of your students making connections with the content?	RQ(s) 2, 3
39. Do barriers impact your students in the same way (remembering the descriptors or categories mentioned earlier)? If not how do you address them differently?	RQ(s) 2, 3
40. What increases your connection with students?	RQ(s) 2, 3

	41. What increases student's connection with other students? 42. Is there group work in the class? If so, what is it, if not what are thoughts about peer interactions?	RQ(s) 2, 3
	43. What increases student's connection with the content?	RQ(s) 2, 3
	44. Do the strategies and practices that increase connection vary among your students group(remember the descriptors or categories mentioned earlier)?	RQ(s) 2, 3
	45. Have you ever struggle with teaching or instructional anxiety?	
	a. Typically, when or with what subject has this happen?	
	46. How do you typically remedy that feeling of stress/fear while you are teaching?	
	47. Do you think that your students have been impacted by any stress and or anxiety you have felt while teaching?	
	48. What are some resources you would suggest to another educator that may be struggling with instructional anxiety?	
	49. Have you struggled with instructional anxiety? How did you mitigate it?	
	50. Have you ever been in a class with a professor that struggle with instructional anxiety, how were you impacted?	

Mathematics Classroom Observation Protocol Request & Permission

Njeri Monik Pringle
Mon 10/28/2019 5:32 PM

- jgleason@ua.edu

Good evening Dr. Gleason,

My name is Njeri Pringle and I am a doctoral student at Valdosta State University. I am currently working on the proposal for my dissertation regarding mathematics anxiety as a barrier to remedial students at post-secondary institutions. I am writing to request permission to be able to use, the Mathematics Classroom Observation Protocol for Practices (2) as a part of my observation guidelines. I would greatly appreciate your support.

Please feel free to contact me should you have any questions or concerns.

Thanks in advance for your consideration and support.

Sincerely,

Neri Pringle, M.Ed
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Gleason, Jim <jgleason@ua.edu>
Mon 10/28/2019 5:38 PM

- Njeri Monik Pringle

Delivered From External Sender

It is open source and you are more than welcome to use it. We do ask that you reference the primary related research article with your publications. (https://www.tandfonline.com/doi/abs/10.1080/19477503.2017.1308697?tokenDomain=eprints&tokenAccess=Z3ymSHM4uDpwgvBTId9D&forwardService=showFullText&doi=10.1080%2F19477503.2017.1308697&doi=10.1080%2F19477503.2017.1308697&journalCode=uiml20)

Mathematics Classroom Observations Protocol (2) - MCOP2

You are being asked to participate in a survey research project entitled “A Qualitative Study of Teachers and Mathematics Anxiety with Student,”

Updated 01.21.2019

which is being conducted by Njeri Pringle, a Dr. Meagan Chisholm at Valdosta State University. The purpose of the study is to determine the strategies and practices used by educators who teach remedial mathematics courses at selected post-secondary institutions in South Georgia to students with moderate to high math anxiety and the students are unlikely to graduate. The following research questions will guide this study. You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about strategies and practices used by educators when teaching remedial students with moderate to high mathematics anxiety. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

Theoretical structure of the MCOP^2 based on initial expert survey.

Item
Students explored prior to formal presentation.
Students engaged in flexible alternative modes of investigation/problem solving.
Students used a variety of means (models, drawings, graphs, concrete materials, manipulatives, etc.) to represent concepts.
Students were engaged in mathematical activities.
Students critically assessed mathematical strategies.
Students persevered in problem solving.
The lesson involved fundamental concepts of the subject to promote relational/conceptual understanding.
The lesson promoted connections across the discipline of mathematics.
The lesson promoted modeling with mathematics.
The lesson provided opportunities to examine elements of abstraction. (symbolic notation, patterns, generalizations, conjectures, etc.)
The lesson included tasks that have multiple paths to a solution or multiple solutions.
The lesson promoted precision of mathematical language.
The teacher's talk encouraged student thinking.
There was a high proportion of students talking related to mathematics.
There was a climate of respect for what others had to say.
In general, the teacher provided wait time.
Students were involved in the communication of their ideas to others. (peer to peer)
The teacher uses student questions/comments to enhance mathematical understanding.

Observation Protocol

Description of Study

You are being asked to participate in a survey research project entitled “Mathematics Anxiety and the Instructional Triangle: A Case Study of Remedial College Instructors,” which is being conducted by Njeri Pringle, a Dr. Meagan Chisholm at Valdosta State University. The purpose of the study is to determine the strategies and practices used by educators who teach remedial mathematics courses at selected post-secondary institutions in South Georgia to students with moderate to high math anxiety and the students are unlikely to graduate. You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about strategies and practices used by educators when teaching remedial students with moderate to high mathematics anxiety. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life. Participation should take approximately 5 minutes to complete. This survey is confidential. No one, including the researcher will be able to associate your responses with your identity. Your participation is voluntary. You may choose not to take the survey, to stop responding at any time, or to skip any questions that you do not want to answer. Participants must be at least 18 years of age to participate in this study. Your completion of the survey serves as your voluntary agreement to participate in this research project and your certification that you are 18 or older. You may print a copy of this statement for your records.

Questions regarding the purpose or procedures of the research should be directed to Njeri Pringle at npringle@valdosta.edu or npringle@valdosta.edu my faculty advisor, Dr. Meagan Chisholm, may be contacted at (229) 249-2777 or by email at mcarrastia@valdosta.edu. . This study has been exempted from Institutional Review Board (IRB) review in accordance with Federal regulations. The IRB, a university committee established by Federal law, is responsible for protecting the rights and welfare of research participants. If you have concerns or questions about your rights as a research participant, you may contact the IRB Administrator at 229-253-2947 or irb@valdosta.edu.

Date/Time: ______________________________1st/2nd observation: _________________________

Course:_____________________________
Instructor's Code: ________________________Survey completed/consent:___________________

Role of observer:____

Length of observation:____
Topic/content covered in class session:____
Observation Checklist (Creswell & Gutterman, Observational checklist, Figure 7.5, p. 217).

Checkbox	Item	Checkbox	Item
	Did you gain permission to study the site?		Will you develop rapport with individuals at
	Do you know your role as an observer?		Will you observations change from broad to
	Do you have means for recording fieldnote observational protocol?		Will you take limited notes at first?
	Do you know what you will observer first?		Wil you take both descriptive as well as refle
	Will you enter and leave the site slowly, so the setting?		Will you describe in complete sentences so th detailed fieldnotes?
	Will you make multiple observations over		Did you thank your participants at the site?

Description Notes (Creswell & Gutterman, p.216).

Time	Description of classroom	Reflective Notes: (Insights, hunches, themes)

Problems demonstrated in class:

Item #	Item	Student ID	SE	TF	Problem or concept related to interactio
1	Students Engaged in Exploration/investigation/probl				
2	Students used a variety of means (models, drawings, materials, manipulatives, etc.) to represent concepts.				
3	udents were engaged in mathematical activities				
4	Students critically assessed mathematical strategies.				
5	Students preserved in problem solving				
6	The lesson involved fundamental concepts of the sub relational/conceptual understanding.				
7	The lesson promoted modeling with mathematics.				
8	The lesson provided opportunities to examine mathem structure. (symbolic notation, patterns, generalizatio etc.).				
9	The lesson included tasks that have multiple paths to multiple solutions.				
10	The lesson promoted precision of mathematical langu				

11	The teacher’s talk encouraged student thinking.				
12	There were a high proportion of students talking rela mathematics.				
13	There was a climate of respect for what others had to				
14	In general, the teacher provided wait time.				
15	Students were involved in the communication of thei (peer to peer).				
16	The teacher uses student questions/comments to enha mathematical understanding.				

Diagram of the classroom layout:

Mathematics Classroom Observation Protocol for Practices: MCOPP (Gleason et al., 2017).

Facilitation Actions (*SE – Student Engagement, *TF- Teacher Facilitation)