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Analyzing the Effects of Mathematical Mindsets and Self-regulation of Middle School Students to Overcome the Challenges of Math Anxiety

Bardhyl Gjoka

ANALYZING THE EFFECTS OF MATHEMATICAL MINDSETS AND SELF-REGULATION OF MIDDLE SCHOOL STUDENTS TO OVERCOME THE CHALLENGES OF MATH ANXIETY

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ABSTRACT

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Bardhyl Gjoka

Dr. Suzanne Marmo, Ph.D., Dissertation Chair

In the rapidly changing world, schools must prepare students for jobs and careers that may not exist today. Mathematics is one of the core subject areas that help students prepare to meet the demands of the 21st-century. When students are proficient in mathematics, they have the opportunity to build problem-solving skills. Learning mathematics helps students find solutions to a problem logically and develop analytical thinking skills. However, many students struggle with mathematical content and concepts during math lessons and learning activities. Teachers need to create practical age-appropriate lessons focusing on problem-solving skills to help students who fear math and experience math anxiety. Skilled teachers make a difference, especially when working with students who have different learning styles and abilities. Engaging students in meaningful math learning activities in the early years of schooling is necessary because it helps them create a solid foundation for future success in mathematics and life. This Improvement Science Dissertation in Practice study aimed to analyze the effects of self-regulation and mathematical mindsets development of middle school students to reduce feelings of fear and anxiety when learning mathematics.

Keywords: learning mathematics, math anxiety, middle school, self-regulation, mathematical mindsets, problem-solving skills

DEDICATION

I dedicate my dissertation work to my family, especially my mother and father, who went to the Lord before completing my doctorate program. Both of them encouraged, supported, and

always believed in me. Their unconditional love has always energized and strengthened me, regardless of the challenges that I have experienced in life.

I am grateful to my wife, Vjollca, who has supported me throughout the doctoral program, and I want to give special thanks to my two sons, Emanuel and Andrew. I am most proud of the three of you. I also dedicate this work to my brother, sisters, nephews, and nieces.

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Mathematical proficiency, knowledge, and skills are essential not only for Science, Technology, Engineering, Arts, and Mathematics (STEAM) related fields but also for everyday life to perform tasks in 21st-century high technology workplace (Namkung et al., 2019). Students acquire most of their math knowledge and develop their problem-solving skills when interacting with their teachers in the classroom (Ramirez et al., 2018). Students must have the best possible chance for success in mathematics regardless of gender, race, and socioeconomic status (Kim et al., 2017). However, many students struggle with mathematical content and concepts as they move from elementary to middle and high school (Hann, 2020). Many students who struggle with math have deep fears about this subject and experience math anxiety (Ramirez et al., 2018). Math Anxiety (MA) occurs when students experience discomfort while performing mathematical tasks.

When students learn math and build their knowledge and skills to solve multi-step problems, they are expected to struggle. Research indicates that the process of struggling is "at the heart of learning mathematics, solving problems through combining many areas of cognitive functioning with trial and error" (Kooken et al., 2016, p. 218). Although learning outcomes depend on students' input and performance, their interests, knowledge, and skills develop over time when engaged in meaningful math lessons and activities. When students are more engaged and enthusiastic about the possibility of finding a solution to a problem, they focus on learning and have a desire to complete their assignments (Hyson, 2008). Another benefit of engaging students with practical math learning activities is that it allows them to develop analytical thinking skills through hands-on problem-solving.

Background of the Problem

Students who naturally like mathematics and are motivated to engage in mathematical tasks, even when struggling with finding solutions, do not experience the same level of discomfort that students who fear math experience (Linder et al., 2015). Research conducted by Hann (2020) found that "mathematics anxiety and mathematics self-concept contribute significantly towards explaining variation in mathematics achievement after accounting for gender, race, socioeconomic status, truancy, and school-level poverty" (p. 22). It has been suggested that schools need to focus more on helping students who fear math and experience math anxiety (Hatcher, 2018). Teachers should develop practical math lessons and employ effective teaching methods to engage students in meaningful lessons and learning activities.

When middle school students complete challenging mathematical learning tasks, they may at times encounter difficulties and even experience failure. Under these circumstances, students will use varying coping strategies. Some students will use adaptive techniques and keep trying, however, others may use self-protecting strategies and avoid exposure by not completing their math assignments. Research indicates that "the choice of coping strategies is therefore critical for the students learning and progress in school" (Skaalvik, 2018, p. 710). Furthermore, Raccanello et al. (2019) argued that when students use self-protecting and performance-avoidance strategies when dealing with mathematical tasks, it is a predictor that these students experience higher levels of math anxiety. Student performance data in mathematics assessments and school climate data at The Guardian Angels Catholic Academy indicate that 14% of middle school students struggle in mathematics and express discomfort during math classes. However, this group of students does not report any concerning issues during English Language Arts and other non-math-related subject areas.

Statement and Definition of the Problem

The problem of practice addressed in this study was to explore effective methods for improving the academic experiences of middle school students who struggle with math, have deep fears about this subject, and experience math anxiety. Previous research supports the idea that self-efficacy and resilience can help students overcome fear and math anxiety (Linder et al., 2015). Therefore, teaching middle school students coping strategies to manage their math anxiety and assist with development of necessary Social and Emotional Learning (SEL) skills, requires intentional integration of SEL into daily teaching practice. Brackett (2019) suggested that schools should incorporate social and emotional learning skills into the subjects already being taught daily in the classroom. Teaching the necessary social and emotional skills early on in school helps students with self-reflection, self-efficacy, focus, and future success in school and the workplace (Brackett, 2019).

To define the problem of practice in education, the improvement science framework requires the input of teachers and other educational professionals involved in that educational setting (Hinnant-Crawford, 2020). As a result, the researcher conducted an anonymous online empathy interview survey to collect qualitative data from teachers at the school where the study took place (Appendix A). The participants in the anonymous electronic survey included four middle school teachers, the school counselor, and the dean of student life. The average educational experience consisted of nine years, where the most extended experience was twenty-two years, and the shortest was three years. When analyzing participants' responses, several themes emerged as shown on Table 1A, and the researcher grouped the responses according to the following themes. Table 1A shows the seven themes that emerged from participants' reflections.

Table 1

Empathy Interview Data Collection Themes and Supporting Evidence

Theme #1 Some Students Struggle to Stay on Task, Attention Waning	"Students' attention and focus appear to be waning because they are easily distracted, and it is difficult to keep them on task." "Their attention span and focus are changing as students want things instantaneously and do not want to wait for anything they want or need. I have also observed that if things do not interest them, they tend to dawdle with an assignment."
Theme #2 Increased Use of Technology Interferes with Learning	"Increased use of technology both in the home and the school has been a large contributor. Students seem to be more focused on the electronic games they play and other online distractions than on education." "The constant exposure to screen time has created difficulties in focus and motivation."
Theme #3 Students Experience Greater Fear of Math, When Struggling With New Concepts	"Students who do not understand the content and lessons taught seem visibly upset and demonstrate greater fear of math; cannot open their minds to learning the new concept." "Some students will come up with the general phrase of "I don't get it," but when asked where it is exactly they are having an issue, they are unable to answer the question."

Theme #4 Some Elementary Teachers Unable To Teach Math Effectively	"Many elementary teachers are reluctant to teach math because they themselves have never achieved mastery. This is the reason why some Early Elementary teachers choose those grade levels because of their perceived inability to teach math and be comfortable with the subject area."
Theme #5 Limited Parental Support to Help Students With Math	"The parents are either unable to help their child with the math because they are not proficient in the area or learned a different way to solve the problem when they in school." "Many parents email to express frustration over the method of completing the math homework."
Theme #6 Understanding Math Is Key To Continued Learning	"I have found that when the students understand the materials they are learning and have the confidence to complete the work, they love math and want to continue learning. I have many who repeatedly tell me math is their favorite subject area." "Getting the problems correct and understanding what they are doing are the greatest motivators in math, as is having the confidence to complete their work."
Theme #7	"Children need to know that failure is okay because the way they get better and more comfortable with math is through practice. They

Positive Classroom Experiences Improve Learning In Math	need constant reassurance that their effort is appreciated and noticed. Math fear and anxiety will not disappear from students' perceptions. Still, it can be lessened by forming relationships between teachers and students that promote recognition for effort and progress in any form." "I have found that many behaviors and learning struggles are alleviated through solid relationships in the classroom. The child's negative self-talk is replaced by positive messages when their teacher believes in them and speaks positively about their abilities."

As the qualitative data shows in Table 1A, the experiences of educators at the private school where the study took place were similar to Hatcher's (2018) findings on the topic of students' math fear and anxiety. The observations and reflections of participants helped the researcher to better understand how students responded to math tasks at this school. The main goal of this project was to explore ways to help teachers, students, parents, and researchers understand the impact of age-appropriate math assignments on student engagement. Furthermore, another goal of this study was to identify the experiences of middle school students when they are motivated and provided with adequate supports to be able to complete age-appropriate math assignments and develop critical thinking and problem-solving skills. The positive outcomes of this research project could aid the researcher to replicate and propose using the lessons learned in other middle schools.

Emotional well-being plays a vital role as students learn mathematical content. Learning challenges occur when students' emotional processing system may not be able to be ready to

learn. Increasing problems of focus, inattention and coping were identified in the root cause analysis of this study as well as being supported by previous research. Recognition of the effectiveness of social-emotional learning (SEL) techniques to improve barriers to learning, has increased attention to the need for improved SEL curricula school-wide (Boaler, 2016). However, while explicit instruction is necessary to establish foundational SEL skills, new learning has already started to show a more significant impact on both a student's well-being and academic growth when the same techniques are intentionally embedded directly into the academic curriculum (Daunic et al., 2013; Jones, Aber, & Brown, 2011; Van de Sande, Segers, & Verhoeven, 2018). This improvement science project aimed to add to this growing body of knowledge seeking out the most impactful instructional practices for balancing social-emotional and academic learning for all.

The Setting and the System

This mixed methods case study research project aimed to identify how to best help middle school students at The Guardian Angels Catholic Academy who struggle with math, have deep fears about this subject, and experience math anxiety. This study took place at The Guardian Angels Catholic Academy, in New England, and is a private school with students in grades preschool through grade eight. The researcher disclosed all the necessary information to the participants and took all the steps to protect their privacy. Participants were asked to sign an agreement to participate in the study voluntarily. In addition, the IRB at Sacred Heart University reviewed all the documentation before conducting the research and granted permission for the study. The data for root cause analysis phase of this mixed methods case study research was collected by using interviews and questionnaires. Additional information was gathered from the performance data of students. The participants in this study were 31 sixth grade students and two

teachers who taught at The Guardian Angels Catholic Academy when the study took place during the school year 2021-2022.

The private school where the study took place accepts students from any background with the mutual understanding between parents and school that the shared goal is a success for each child. The school's mission is to establish a clear and direct conversation with parents to ensure the placement always keeps the student's best interest in mind. In 2009, this school received the Blue-Ribbon Award from the U.S. Department of Education. The Blue-Ribbon Award program honors schools whose students achieve in the top 10 percent of the nation on nationally normed tests. The majority of students come from families within a higher socioeconomic income bracket, and the annual tuition at the time of the study was $10,000 a year per student. Tuition assistance is available to students and families who qualify for financial aid. The process to apply for financial aid involves fully registered students, and parents are aware of that step in the process.

At the beginning of each school year, the faculty and staff at The Guardian Angels Catholic Academy are required to attend professional development where they learn about new trauma-informed classroom approaches to be implemented at the school. New teachers also learn about students who have individualized educational plans (IEP) and need specific social and emotional support to learn. Massachusetts Advocates for Children (2005) explained that trauma-sensitive schools create a foundation for all children and allow them "to achieve at their highest levels despite whatever traumatic circumstances they may have endured" (p.12). Returning teachers learn about changes in the student population for each grade and are assigned as mentors to the new teachers.

Research shows that trauma can undermine children's ability to learn, form relationships, and function appropriately in the classroom. Frieze (2015) explained that children who are exposed to a traumatic event "struggle with motivation, concentration, focus, and personal connections" (p.29). According to Massachusetts Advocates for Children (2005), building trauma-sensitive school environments benefit all children "those whose trauma history is known, those whose trauma will never be clearly identified, and those who may be impacted by their traumatized Classmates" (p. 12). The first step in creating trauma-sensitive schools is to help educators become aware of trauma symptoms.

Participating students in this study did not require any special services accept four students who received accommodations of preferred seating and extended time when taking tests. The school employs Edmentum assessments to assist teachers in assessment and development of lesson planning based on students' performance. Edmentum is an online platform designed to empower educators and create a learning environment around the needs of each learner to make personalized learning an achievable reality in every classroom (Edmentum.com, 2022). Edmentum is an online platform utilized by 40 states and more than 8,000 school districts around the country. Founded in 1960 at the University of Illinois, Edmentum was designed to assist students and teachers to provide assessment data to inform strategies to better access high-quality education. At the time when the study took place, it was the third consecutive year that this school used Edmentum, and students and teachers had optimal experience and knowledge about this assessment platform.

Table 1.1

The Guardian Angels Catholic Academy Total Enrollment for 2021-2022 School Year

Grade	Returning Students n	New Students n	Percent Increase %	Total Enrollment n
PreK	12	14	54	26
K	6	14	70	20
1	18	4	18	22
2	11	1	8	12
3	18	3	14	21
4	27	3	10	30
5	24	5	17	29
6	19	12	39	31
7	17	6	26	23
8	19	5	20	24
Total	171	67	28	238

The Guardian Angels Catholic Academy has seventeen full-time faculty, five part-time, one school counselor, and two administrators. The first-grade and fourth-grade teachers were new to the school the 2021-2022 school year. All other faculty and staff members have been with The Guardian Angels Catholic Academy for two or more years. The student-teacher ratio is 12:1, and this school year, all grades have one class/section each except sixth grade, which has two sections. Minoritized enrollment is 12 % of the student body and includes African American,

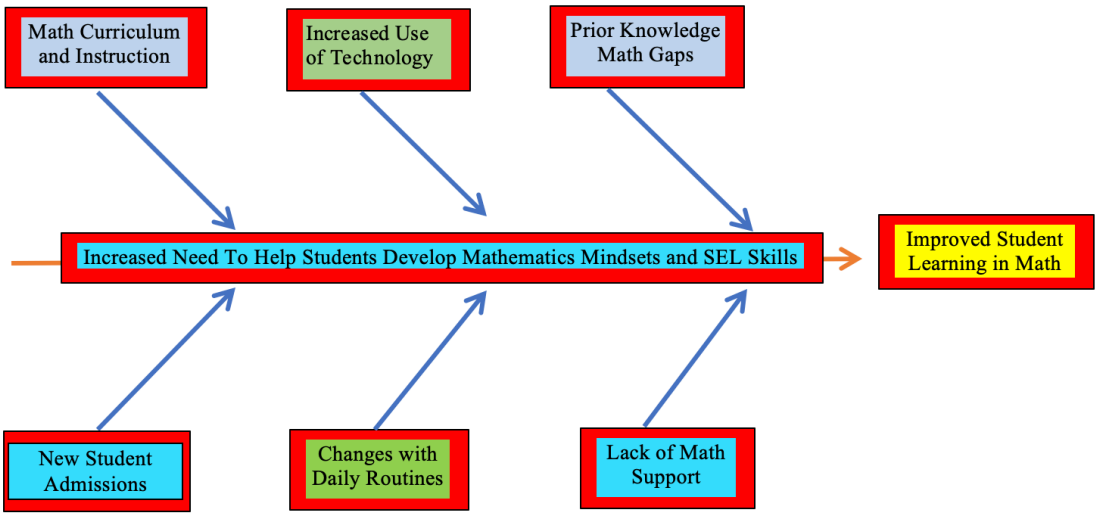
Hispanic, and Asian students. Although the school had an increase in enrollment during the 2022-2022 school year, the demographics are similar to prior years.

Root Cause Analyses

Hinnant-Crawford (2020) explained that understanding the root cause of the problem is necessary to help practitioners identify what lies beneath the surface of the problem that could potentially lead towards an intervention to address the issues. The researcher used a fishbone diagram to represent the root causes of middle school students' math fear, discomfort, and anxiety.

Figure 1A

Fishbone Diagram to Represent Root Causes of Students' Math Fear and Anxiety



Math Curriculum and Instruction: Math teachers need the necessary training to implement a math curriculum using interactive, relevant, and engaging instruction. Students often describe how math topics are not always exciting and related to everyday life situations

(Boaler, 2016; Brackett, 2019). In their climate and culture survey responses (Appendix K), students reported that they could not understand examples that teachers used to illustrate specific learning objectives, making the lesson more complicated and harder for students who struggle with math. Lack of excitement to connect numbers and formulas learned in the classroom with students' personal experiences, and interests adds another component that makes math irrelevant for students who are not motivated to learn this subject. When students develop negative perceptions about math content and see math as abstract and not relevant to their daily lives, they do not understand the value of working hard and learning math as expected.

Increased Use of Technology: Students used more technology in the classroom to complete assignments, which added to their anxiety and fatigue. This issue was present more with students who opted for distance learning. These students logged in to join their class remotely and spent most of their day navigating lessons on their laptops. Furthermore, students who attended classes in person experienced an increase in technology use during the day. Teachers utilized google classroom for lessons and assignments. Students did not work in pairs and small groups as much as they did in prior years. As a result, the students had minimal interactions with their peers and used more technology to complete their assignments.

Figure 1B shows students responses indicating that social media significantly impacted their feelings and interfered with their academic time outside school (Appendix K). Middle school students reported an increase in their time on social media. Some of the students created group chats and spent a significant amount of time online while at home. These chats that took place outside the school impacted students socially and emotionally at home and school. Also,

the influx of new students to the school made it hard for students to form meaningful relationships with peers.

Prior Knowledge Math Gaps: When students change schools, they need to adjust to the new learning environments and teachers' teaching methods. Nearly half of the new students who registered at The Guardian Angels Catholic Academy indicated that this was their second or third school. The parents of the new students reported to the school that one of the main reasons they changed schools was a lack of strong academics, especially in mathematics programs. Some of the reasons for inconsistent math instructions included teacher turnover and lack of support for students who struggled in core subject areas.

New Student Admissions: The Guardian Angels Catholic Academy enrolled 67 new students where 23 of the new students were in middle school for grades 6-8. COVID-19 pandemic negatively impacted teaching a learning and it was the main challenge to the admissions process and prevented the school from providing an opportunity for the new students to visit and tour the school in person. As a result, newly registered students did not follow all the required admissions process steps because the school could not allow visitors due to safety restrictions during the pandemic. Virtual tours replaced in-person interactions, and teachers could not observe the prospective students interact with their peers.

Some of the admissions steps that new students missed included academic screening, shadow dates, new family orientations, and new students' and parents' orientations. The school relied on the report cards sent from their previous schools and other assessments that new students completed from their homes. When the new academic year started in the fall, math

teachers reported that some of the new students needed support because they lacked the necessary skills required to enter middle school.

Changes With Daily Routines: During the academic year 2021-2022, students did not have the same scheduled activities as they did in prior years because student activities were reduced or canceled due to the pandemic. In previous years, students in grades four through eight changed classes. During the 2021-2022 school year, the students stayed in their homerooms, and teachers went to their classrooms. Students reported their disappointment and frustration with the lack of movement to the school counselor, dean of student life, and homeroom teachers. The students found it challenging to spend the entire day in one classroom, even with frequent mask breaks throughout the day. Students reported feeling socially isolated because they did not interact with peers outside of their classroom in the same manner as in prior years.

Lack of Math Support: The school did not provide the support that new students needed to help close their prior mathematics knowledge gaps. The administration and teachers met with the parents of students who struggled earlier in the school year and requested that parents seek help for their children outside the school. Students who received tutoring outside the school shared with their teachers that they spent four to six hours a week practicing math problems that they learned in elementary grades. The tutoring hours were determined to be less effective in helping students with the content and math concepts they learned in class. Instead, it was reported that students experienced a decrease in confidence by working on basic math skills and drills below what they perceived to be their current grade level. As a result, these students reported added confusion and frustration with their math assignments.

According to the tuition management system data that the school uses to collect tuition, approximately 8 % of middle school students at The Guardian Angels Catholic Academy are from low-income families. Furthermore, when looking deeper at the data generated from the tuition management system, half of the middle school students from these families reported struggling with math. These students demonstrated the greatest need for help with their math skills. However, their families could not hire private tutors outside the school to provide the service that their children need with math. Likewise, the school lacked resources to provide teacher training and support to help this group of students. Additionally, teachers indicated in their interviews that they need training and support to help students who demonstrated emotional struggles in math and often ask to leave the classroom to visit the school counselor or the school nurse. When students left the classroom during math instructions, they missed out on learning topics and practicing new math skills. As the learning progressed and became more complex, these students fell further behind in math.

To effectively help students who struggle in math, schools should develop and implement a curriculum that includes units and lessons designed based on a spiral approach (Wiggins & McTighe, 2005). As described in their book *Understanding by Design*, Wiggins & McTighe (2005) explained that "a spiral approach develops curriculum around recurring, ever-deepening inquiries into big ideas and important tasks, helping students come to understand in a way that is both effective and developmentally wise" (p. 297). The spiral approach is advantageous in helping students gain a deeper understanding of math skills learned earlier in their education, where prior knowledge serves as the foundation for developing new knowledge.

The quality of teaching and methods that teachers use in their classrooms directly impacts student achievement, and this has been suggested to be even more important in applied subjects that are reliant on cumulative knowledge instruction to succeed, such as mathematics (Jacobs, 2010). Competent and well-trained teachers can be better prepared to deliver essential information to students in a way that the students can understand. To prepare students with the necessary skills to meet the demands of the 21st century, teachers themselves need to learn 21st-century teaching methods. Jacobs (2010) said that "As educators, our challenge is to match the needs of our learners to a world that is changing with great rapidity" (p. 7). Jacobs (2010) suggested that teachers should become strategic learners and commit to becoming comfortable with at least one new tool per semester per year to meet this challenge. He further recommends that professional development can provide an efficient way for teachers to update their skills and effectively implement the curriculum.

In addition to improving concrete pedagogical teaching skills, teachers should also have the necessary training and knowledge on social and emotional learning strategies to develop lessons and utilize different methods for effective student engagement. Aidman & Price (2018) indicated that "faculty support is necessary for any change effort to be successful" (p. 30). Furthermore, school culture, climate, and overall environment are equally important to the curriculum. According to the National School Climate Center (NSCC) schools should help teachers create a warm and welcoming environment to foster classroom learning that can have the most effective lasting impact (Schoolclimate.org, 2020). Positive change happens when schools develop plans for a continued improvement of education programs that enable students to learn and grow socially, emotionally, and academically. Education programs' success requires

that faculty and staff assume their professional responsibilities to help students reach their highest potential.

Purpose and Significance of the Study

The purpose of this study was to improve the learning experiences of middle school students who struggle with mathematical content and concepts and reduce math fear and anxiety. Using a mixed-methods case study research design, the researcher sought to determine the effects of guided instructions combined with SEL interventions to help middle school students who struggle with math and have deep fears about this subject overcome challenges of math anxiety. The study included sampling of two middle school classrooms (n = 31), grade sixth, as well as the use of the two teachers and their classrooms at The Guardian Angels Catholic Academy in New England, United States.

Students succeed in mathematics when they view this subject as practical, worthwhile and enjoy the challenges while learning new skills and concepts (Ramirez et al., 2018). However, many students struggle to learn math, have deep fears about this subject, and experience discomfort when learning new math topics and applications (Kim et al., 2017). When presented with new math concepts that require solving multi-step problems, fear and discomfort interfere with the ability to complete a given task. Students experience difficulties with math at various levels, but researchers believe that students start to develop math anxiety around sixth grade (Ramirez et al., 2018).

This dissertation in practice aimed to improve the learning experiences of middle school students who struggle with math and increase their academic performance at The Guardian

Angels Catholic Academy. When the new school year started, the main focus was to make learning individualized and meet the educational needs of all students. When students who struggle receive the help they need, all students benefit because the teacher will be able to teach math at a higher level and help students build their critical thinking and problem-solving skills. Additionally, the teacher spends less time with classroom management and more time assisting students to reach their full potential. Furthermore, if students and parents learn that The Guardian Angels Catholic Academy challenges and supports all middle students to the best of their ability, the enrollment may remain stable. The success of this dissertation project could lead to improving the learning experiences of students who struggle with math and develop math anxiety.

Research Design

This Improvement Science Dissertation in Practice (ISDiP) study used a mixed-methods case study research design. This study was conducted with the cooperation of the Diocese of Bridgeport Catholic Schools and The Guardian Angels Catholic Academy in New England, United States, where the primary researcher was employed as an elementary school principal at the time when the study took place. The purpose of this ISDiP study was to improve educational practice employable by the researcher in his current role. In the first phase of this study, the researcher utilized both qualitative and quantitative methods to explore how math fear and anxiety impacted student performance at The Guardian Angels Catholic Academy. Qualitative data was gathered from anonymous online empathy interview surveys, in-person interviews, and classroom observations. The purpose of this data collection was to gather information regarding how to best help middle school students who struggle with math, have deep fears about this subject, and experience math anxiety. The voluntary survey was sent to middle school teachers,

the dean of student life, and the school counselor at The Guardian Angels Catholic Academy. The outcome of this data collection served to defend part of the problem of practice for the more extensive study. Student performance data, interviews, and observations helped guide the research and identify a specific intervention for implementation.

In the second phase of the study, quantitative data were collected through pre and post math assessments, as well as using existing student performance data and new data collection on Edmentum tests. During this phase of the study, the researcher conducted a form of action research that aimed to determine the effects of guided instructions combined with SEL interventions to help middle school overcome challenges of math anxiety. The study included the sampling of two middle school classrooms as well as the use of the two teachers and their classrooms. The researcher conducted all interventions to increase treatment fidelity. Participation in the study by students and staff was completely voluntary, and informed consent, including the use of de-identified information of the participants, ensured that participant rights and privacy were accounted for. Both the root cause analysis (IRB#210726C) and the second phase of the ISDiP study (IRB#211110A) were approved by the Sacred Heart University Institutional Review Board.

Research Questions

The researcher aimed to answer the following research questions in this mixed-methods case study research design:

- **Quantitative Research Question**:

  What is the effectiveness of a mathematical mindset intervention for improving mathematics achievement?

- **Qualitative Research Question**:

What are the perceptions of math mindset guided instructions, combined with SEL interventions aimed at improving students' and teachers' experiences with math to reduce mathematics anxiety?

Limitations of the Study

This ISDiP study aimed to analyze the effects of mathematical mindsets and self-regulation of middle school students to overcome the challenges of math anxiety. However, there were some limitations to consider. The main limitation of the study was small sampling size. The sample population included only one grade level with thirty-one students and two teachers. Furthermore, the study took place in one school with limited diversity related to race and ethnicity and socioeconomic status. However, the purpose of improvement science is to engage in change ideas in the context of the educational setting that the primary researcher is located in and is not meant to generate generalizable knowledge. Instead, change ideas are tested in rapid cycles, resulting in efficient and useful feedback within a community of practice to inform system improvements, as the improvements are being implemented (Perry, Zambo, & Crow (2020).

The intervention took place during the course of four weeks. Therefore, short-term limitations that could have impacted findings included variable maturation of skills and behaviors were minimized. Self-regulation and other social and emotional skills may take longer for students to develop and implement on a regular basis, so integration of skills may not have been able to be adequately measured. An additional limitation to consider included potential researcher and educator bias due to previous collaborations with students and fellow colleagues.

To minimize this bias, student evaluation of math proficiency outcomes was conducted by using standardized testing by an outside educational testing service.

Positionality – The Researcher and The Problem

As the researcher of this ISDiP study, I have been in education for 24 years, nearly half of this time as a classroom teacher and the other half as a school administrator. At the time of this study, I completed my fourth year as principal of the school where the study took place. Prior to becoming principal, additional positions included assistant principal, STEM program director, mathematics, physics, and engineering high school teacher.

When I think about my elementary school years, I believe that I was meant to become a math teacher. I remember helping my friends with homework assignments and in small group activities. After completing middle school, I attended a high school boarding school. I participated in different clubs and sports and maintained good grades in all subject areas throughout all four years. I went to college to become a math teacher and graduated with a double major with a degree in mathematics and physics. I started teaching math in high school in my hometown in Albania, and within a few years, I became assistant principal and then principal.

In June 2000, my wife and I moved to the United States. While adjusting to the new life in America, I worked in non-teaching jobs for nearly five years. In 2005 my wife and I became US citizens, and I started teaching mathematics in high school in Bridgeport, United States. While I taught in high school, I attended graduate school for my Master of Arts degree, completed the 092 Certification program for school administrators, and Sixth Year degree. At the same time, I attended summer programs at the University of New Haven to teach engineering to

high school students. In 2008, I was one of the three teachers in the Diocese of Bridgeport who were fully trained to teach Pre-Engineering courses. As teachers, we were involved with learning the same materials that students would learn over the course of the year, but in a shorter period of time at the University of New Haven during the summer.

One of my most remarkable learning experiences was meeting with the astronaut Michael J. Massimino, Ph. D. Dr. Massimino met with a group of high school students enrolled in the High School Engineering Academy (HSEA) at the Discovery Museum in Bridgeport in May of 2009. He shared his experience on the servicing mission of the Hubble Space Telescope (HST) in March 2002. Dr. Massimino was very influential in his presentation and made everyone feel like we were on a trip with him. Dr. Massimino spoke with a sense of pride when he shared a picture of the Galileo telescope replica he received from Italy and used it on the space station. Furthermore, he shared specific trip details and presented pictures of the universe captured by the Hubbell Telescope. The magnificent images of the universe created an emotional reaction that I had never experienced before. The distances, the sizes, the brightness, and the colors of the galaxies were beyond comprehension. Additionally, Dr. Massimino played a video of one of his spacewalks. The footage taken from the space station created a sense of the infinite powers of the universe.

While attending the doctoral program at Sacred Heart University, I expanded my knowledge about Social and Emotional Learning (SEL) and brain development and function. During this program, my level of knowledge and understanding of the complexity of the brain, the effect of emotions, and self-reflection on my emotions has significantly increased. I have learned to be a better listener, not jump to conclusions, provide a quick answer, or find a solution. Mindfulness, breathing techniques, and meditation are just a few things that I have

started to integrate into my teaching practice. As a result, I feel that I have been more in control of my stress compared to the prior years. Self-care is necessary for everyone, especially educators, and I have started to help my teachers develop a self-care plan. Jennings et al. (2017) explained that "Cultivating Awareness and Resilience in Education (CARE for Teachers) is a mindfulness-based professional development program designed to promote teachers' social and emotional competence and improve the quality of classroom interactions" (p. 1010). I am committed to exploring programs to help my teachers overcome school-related stress and create a social and emotional supporting system at school.

Both my learning and experiences in education helped with my ISDiP study. As a classroom teacher, I always encouraged my students for feedback. I created surveys that I used at the beginning and the end of each semester. I used this feedback to reflect on my instruction methods and developed and implemented meaningful strategies to help my students learn. Getting to know my students and learning about their interests and their math skills and knowledge early in the semester served as a guide for my lesson plans.

As a school administrator, I have often witnessed teachers spend time arguing with students why they did not know something or why they came unprepared to class. When arguing with a student, educators may not realize how much they damage the relationships with the students and unintentionally create a classroom environment that is not conducive to learning. I always asked teachers to assess students' math knowledge and skills, develop an action plan to teach students based on their level, and help them grow to learn and love math. I believe that students learn best when schools and teachers create a balanced learning environment where the social and emotional needs of the students are addressed to enable students to thrive in their academics. This belief is the central focus of my IDSiP study.

Summary

This Improvement Science Dissertation in Practice study aimed to analyze the effects of self-regulation and mathematical mindsets development of middle school students to reduce feelings of fear and anxiety when learning mathematics. Root-cause analysis conducted by this researcher revealed that math fear and anxiety are among the leading root causes for hindering student learning in this subject. While previous research studies have shown that instructional interventions in mathematics are effective in helping some students improve learning outcomes, most of these interventions require extensive training for teachers. They may not be helpful to all students or address needs for self-regulation and development of mathematical mindsets skills to overcome the challenges of math fear and anxiety. Therefore, this study focused on identifying the most effective way to integrate self-regulation techniques into mathematics lesson planning, to help students access their best learning experiences.

Definitions of Key Terms

SEL: *Social-emotional learning (SEL) is the process of developing the self-awareness, self-control, and interpersonal skills that are vital for school, work, and life success* (CASEL, 2020).

STEM: *an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise* (NCTM, 2022; NSTA, 2022).

Math Anxiety: *a negative emotional response when faced with mathematical situations. Math anxiety can impact anyone regardless of gender and can begin at a very early age (Hartwright et al., 2017)*.

Mathematics Mindset: *A mathematical mindset reflects an active approach to mathematics knowledge, in which students see their role as understanding and sense-making. Number sense reflects a deep understanding of mathematics, but it comes about through a mathematical mindset focused on making sense of numbers and quantities* (Boaler, 2016).

Self-Regulation: *The ability to successfully regulate one's emotions, thoughts, and behaviors in different situations; effectively managing stress, controlling impulses, and motivating oneself* (CASEL, 2020).

Chapter Two: Review of Scholarly and Professional Knowledge

The research literature on the effects of mathematics mindsets and self-regulation of middle school students, along with analyses of educational practices of other schools like The Guardian Angels Catholic Academy, supports the need to address the problem of students' fear, discomfort, and anxiety when learning math. The researcher used an Environmental Informant Consultation Protocol to interview educators from three pre-k through grade 8 private schools in New England to improve understanding of how this educational problem impacts students in similar settings to the setting of this study (Appendix B). The primary purpose of these interviews was to understand current educational practices to address middle school students' fear, discomfort, and anxiety when learning math. Analysis of data collected from three environmental informant interviews, along with thorough literature review of previous research related to mathematics mindsets, self-regulation, math fear, and anxiety, revealed four distinct themes to guide inquiry into this problem of practice:

- Understanding the impact of math fear and anxiety has evolved, yet math anxiety remains a challenge for many students and teachers.
- Negative experiences with mathematics in early elementary instruction are potentially detrimental to student's likelihood of success.
- Math anxiety can have a lasting negative impact on students' math abilities and can affect their self-confidence and professional outcomes.
- Research suggests creating mathematics mindsets along with self-regulation, and self-management as a possible solution.

After further analyses and review of the previous research, the researcher used the four categories as the bases for a working theory of improvement: When students utilize mathematics mindsets, self-regulation, and self-management techniques during a mathematics lesson, they can develop the necessary skills to learn and retain mathematics concepts.

Category #1: Understanding the impact of math fear and anxiety has evolved, yet math anxiety remains a challenge for many students and teachers.

Literature Review of Category #1: The research focused on students' emotional reactions in mathematics has shown evolution in our understanding since the early 1950s. The focus of research has been to explore the impact of math anxiety on students' performance. Gough (1954) is the first researcher to introduce the term as a pathology, which she referred to as "mathemaphobia" to describe students' feelings in mathematics while attempting to identify the root causes of the problem (p. 290). Dreger and Aiken (1957) further explored the concept of math anxiety and explained it as a negative emotion of students in reaction to the topic of mathematics. In the 1970s, math anxiety continued to get more attention in research literature. Richardson and Suinn (1972) defined math anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems" (p. 551). They developed a method of measurement, which is the first math anxiety measurement scale called the Mathematics Anxiety Rating Scale (MARS). Recent research builds on the Richardson and Suinn (1972) math anxiety definition and argues that students experience this type of anxiety when involved with specific math tasks and assignments (Ramirez et al., 2018).

According to Cunningham and Sood (2018), working memory enable students to use their cognitive ability to utilize reasoning and problem-solving skills when processing information. Research shows that math anxiety affects working memory and diminishes the

proper development of the ability to perform and process mathematical content (Jones et al., 2020; Melby-Lervag and Hulme, 2013). Furthermore, Ashcraft and Krause (2007) argued that math anxiety can also impede cognitive math processing ability with feeling of discomfort, fear, and anxiety before and during mathematics learning tasks. As a result, students who experience high levels of math anxiety tend to have lower scores and achievement measures in mathematics compared to students who do not experience or who have very low levels of math anxiety (Kim et al., 2016; Hembree, 1990). Students who experience high levels of math anxiety tend to develop a negative perception of mathematics as a subject and tend to avoid mathematical tasks and what they perceive to be challenge math course content in high school and college (Goetz et al., 2013).

Professional knowledge review of category #1: The Environmental consultation and interviews revealed that students who struggle with math experience fear and discomfort when learning math. A new challenge that has emerged with changes in technology, is noted to be students' waning attention, most notably in the past three years. Participants in consultation interviews discussed how focus tends to be short-lived, and efforts are described as sub-par, with limited engagement and struggles in recognizing the value of learning mathematics or motivation to perform at their top level. Consultants reported that there may be many contributing factors to this problem causes, but few can be quantified. The isolation caused by the Covid-19 virus has created anxiety and uncertainty among school-aged children. Learning was compromised even when they participated online during the quarantine. Furthermore, quarantine allowed bad habits to develop, such as guessing, weak comprehension, inability to recall math facts, and challenges in application of math concepts to word problems. Additionally, not having teachers available for

extra help and the classroom environment created learning gaps that students could not identify until returning to in-person school.

Standardized test results demonstrate an apparent lack of mastery across subject areas and grade levels. Another cause of poor student engagement and performance was described by informants as social media, video games, and cell phones. Because of the isolation of Covid-19, students depended on their phones for communication and socialization more intensely than in prior years. The constant exposure to screen time has created difficulties in focus and motivation, and social media platforms interfere with school, grades, and academic success.

Category #2: Negative experiences with mathematics in early elementary instruction are potentially detrimental to student's likelihood of success.

Literature Review of Category #2: Research suggests that math anxiety has a negative impact on student learning. Kim et al. (2016) argued that math anxiety develops out of various extrinsic influences and intrinsic factors, and it is detrimental to mathematics learning. Additionally, the research identifies two typical components of mathematical anxiety: emotional and cognitive, which trigger this type of anxiety (Herges et al., 2017; Kim et al., 2016; Hembree, 1990). The emotional component is the leading cause of math anxiety that makes individual students experience stress, nervousness, fear, and discomfort (Devine et al., 2012; Reyes et al., 2012). Negative emotional experiences in the early years of school have been identified as the leading reoccurring cause of math anxiety (Andrews and Brown, 2015; Bekdemir, 2010). The cognitive component directly impacts students' performance, self-confidence, creates doubts about math learning ability, and lowers perceptions of their math skills (Kim et al., 2016; Goetz et al., 2013).

Another area of focus among researchers who studied math anxiety is elementary school teachers' performance and effectiveness in the classroom. When planning and implementing math lessons and learning activities, elementary teachers who have high levels of math anxiety spend less time teaching mathematics and more time for non-mathematics-related learning lessons and activities (Beilock et al., 2010; Swetman et al. 1993). Additionally, Geist (2010) indicated that more than one-third of elementary teachers stated that math was their least-liked subject to learn in school. As a result, elementary teachers who found math difficult as students or experienced math anxiety themselves felt uncomfortable teaching math because they did not like math as a subject (Geist, 2010). Beilock et al. (2010) stated that anxious elementary math teachers did not have the confidence to teach math. Consequently, Beilock et al. (2010) indicated that student learning was negatively impacted and led to lower mathematics achievement.

Professional knowledge review of category #2: The Environmental Consultation interviews also described the influence of early negative experiences with math at school on later performance and interest in learning mathematics. Many primary grade teachers are reluctant to teach math for the allocated weekly time because some of them may have struggled with math themselves and never achieved mastery. This is one possible reason why early elementary teachers choose those grade levels because of their perceived inability to teach math and be comfortable with this subject area. Suggestions for primary education included number sense, patterns, and number lines, so students know that numbers exist on the other side of zero at an early age.

Category #3: Math anxiety can have a lasting negative impact on students' math ability and affect self-confidence and professional outcomes.

Literature Review of Category #3: Beilock and Willingham (2014) indicated that math anxiety among students of all ages presents a serious challenge to academic achievement and professional carrier choices. In their study, Beilock and Willingham (2014) found that nearly half of elementary school students in the United States experience math anxiety. They stated that "because math anxiety is widespread and tied to poor math skills, we must understand what we can do to alleviate it" (Beilock and Willingham, 2014, p. 29). Additionally, researchers argue that math anxiety has a lasting negative impact on students' math ability and affects their self-confidence and professional outcomes (Goetz et al., 2013; Ashcraft & Krause, 2007; Hembree, 1990).

Researchers believe that teachers who experience mathematics anxiety are not only influenced by it but unintentionally pass it on to their students (Beilock et al., 2010). In their study, Johnson and vanderSandt (2011) investigated mathematics anxiety amongst education majors enrolled as pre-service teachers in special education, deaf and hard of hearing, early childhood, and elementary education. They found that the current teacher preparation system does not provide adequate training to teach mathematics and reduce math anxiety among pre-service teachers. According to Johnson and vanderSandt (2011), the current education system "fails to prepare prospective teachers" to effectively teach mathematics and mitigate math anxiety in the classroom, especially during the early years of children's education (p. 7).

Professional knowledge review of category #3: The Environmental Consultation and interviews revealed that students who struggle with math or have negative experiences with this subject seem to have lower self-confidence and tend to find excuses to avoid learning math. When students change schools, they need more time to adjust to the new learning environments and teachers' teaching methods. The interviews described how students who join private schools

for their middle school year, may have switched schools two or more times, hoping to find a better fit for their learning styles. Instead of changing schools to help their children learn, it may be more effective to focus on the root cause of the problem, addressing issues early on, instead of seeking out a new school. Additionally, it was reported that parents themselves in the other three private schools described one of the main reasons for seeking a change in schools for their children was a lack of solid academics, especially in mathematics programs. Some of the reasons for inconsistent math instructions included teacher turnover and lack of support for students who struggled in core subject areas. As the students who struggle with math grow older and move on to high school, they may lose interest in learning math, which affects their professional career choices and future.

Category #4 Research supports increased math mindsets and self-regulation SEL support as possible solutions.

Literature review of category #4: A possible solution to address the mathematics achievement problem and reduce the level of math anxiety is to provide social and emotional support focusing on student motivation to learn mathematics. Herges et al. (2017) suggested that many studies indicate a positive correlation between student motivation and academic achievement, including mathematics. However, Herges et al. (2017) stated that there is a gap in the research about the motivation of middle school students.

Schools should create a positive learning environment to prepare students with the knowledge and skills to meet the demands of the 21-century. Aidman and Price (2018) found that standards-based teaching and high-stakes testing of academic subjects have created learning environments that mainly focus on meeting performance targets and improving test scores. They believe that schools must improve students' learning experiences to provide a well-rounded

education and prepare students with strong social and emotional skills to succeed in higher education and the 21-st century work environment (Aidman and Price, 2018). When schools create a nurturing school environment and culture to support all learners, students develop a sense of belonging and are motivated to learn, including the most challenging subject areas (Raccanello et al., 2019; Aidman and Price, 2018; Linder et al., 2015).

Researchers have identified student motivation as an essential element for students to succeed in mathematical tasks beginning with early years of schooling (Skaalvik, 2018; Linder et al., 2015). When students have a positive perception about their ability to solve mathematical tasks and see the value of these tasks, they are motivated to learn mathematical concepts (Raccanello et al., 2019; Linder et al., 2015). Furthermore, teachers' instructional practices to facilitate learning and motivate students significantly impact student learning (Federici and Skaalvik, 2013). Similarly, to help students with their mathematics performance and achievement, the National Council of Teachers of Mathematics (NCTM, 2014) recognized that teachers must include motivational strategies in their instructional practices.

Professional Knowledge Review of Category #4: Environmental consultation and interviews described how students' motivation increases when schools create a welcoming learning environment for all learners. In other words, students will be motivated to learn and to achieve if they feel supported, safe, and cared for at school. Consultants described how positive social and emotional environment can be a determining factor to create a better school culture and climate for both students and teachers. School administrators need to constantly take the pulse of their staff to monitor their emotional health. Teachers who may not feel supported and safe, can impact students’ learning experiences in their classrooms. Children need to learn how making mistakes is part of learning process and provided with motivation to improve and get better and

more comfortable practicing math. Consultants described how students benefit from constant reassurance that their effort is appreciated and noticed. Math anxiety will not disappear from students' perceptions, but it can be lessened by forming relationships between teachers and students that promote recognition for effort and progress in any form. Students' motivation increased if they see a purpose to their learning. Math is a subject that can be applied to everyday living, and the reason for learning higher-level math includes STEM activities and real-world problem-solving.

Working Theory of Improvement

A working theory of improvement uses educators' input, students' learning experiences, and previous research to address critical issues that need attention. Based on the analyses of current professional knowledge and review of the previous research, the working theory of improvement for this study identified that when students utilize mathematics mindsets, self-regulation, and self-management techniques during a mathematics lesson, they can develop the necessary skills to learn and retain mathematics concepts. Additionally, this working theory of improvement aimed to address some of the identified root causes of the problem of practice on the negative impact that math fear and anxiety have on students' achievement.

Strategies to Mitigate the Problem of Practice

To mitigate math fear and anxiety, schools and educators need to use various strategies and utilize engaging high-quality curricula and instruction to meet the needs of diverse learners. A high-quality curriculum helps students expand their knowledge and deepen their understanding when introduced to new concepts and ideas. For example, in mathematics and the sciences, students can have an authentic experience learning something new if they collect data,

look for patterns, create hypotheses, and come up with their conclusions (Boaler, 2016). When middle school students are involved in the classroom through hands-on learning, they are better prepared to use their knowledge during the high school years and beyond. Guiding students through the process of collecting and analyzing data and drawing their own conclusions can be an excellent experience for them (Boaler, 2016). It makes them feel like they are the first to discover new concepts and relationships.

Students who have an interest in the sciences and technology have more significant potential to advance their education through Science, Technology, Engineering, and Mathematics (STEM) project-based learning. Schools should introduce students to STEM project-based learning in the early years to create an active learning environment. Husin et al. (2016) indicates that "The implementation of project-oriented and group activities can help nurture positive attitudes and interpersonal skills, such as teamwork, diligence, perseverance, and creative thinking as well as presentation skill" (p. 16). The students who naturally like math and sciences will make connections among concepts they learn in different subjects. This type of learning environment allows students to build a strong foundation with knowledge and develop problem-solving skills early on in school.

To prepare students with a strong foundation in education and be able to meet the demands of the 21st century, a school should develop and implement a curriculum with a central focus to meet the needs of diverse learners. A new trend that has gained momentum is adding arts to the traditional mathematics and STEM curriculum by expanding students' learning experiences. According to Wajngurt & Sloan (2019), "STEAM (STEM + the Arts) is an educational approach to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student inquiry, dialogue, and critical thinking" (p. 13).

Although learning outcomes depend on students" input and performance, the students do not need to know all of the content areas to start a STEAM project. Students can get excited about the possibility of finding a solution to a problem, prior to starting the project. This process allows them to work in teams, develop communication skills, and study different content areas through hands-on projects.

The quality of teaching and methods that teachers use in their classrooms directly impacts student achievement, especially in mathematics. Competent and well-trained teachers can deliver essential information to students so that the students can understand. To prepare students with the necessary skills to meet the demands of the 21st century, teachers themselves need to learn 21st-century teaching methods. Jacobs (2010) said that "As educators, our challenge is to match the needs of our learners to a world that is changing with great rapidity" (p. 7). Jacobs (2010) suggested that teachers become strategic learners and commit to becoming comfortable with at least one new tool per semester per year to meet this challenge. He further recommends that professional development is the best way for teachers to update their skills and effectively implement the curriculum.

Intervention Selection

After analyzing different approaches for intervention, the researcher identified that helping students create mathematics mindsets and practice self-regulation would be best to help students with their learning in math. When selecting the intervention approach, the researcher adopted Boaler’s (2016) mathematical mindsets and classroom norms to encourage students to learn math.

The central components of mathematical mindsets include:

- **Everyone can learn math to the highest level**: encourage all students to believe in themselves because everyone can reach the highest levels they want to, with hard work.
- **Mistakes are valuable**: when we struggle and make mistakes, our brains grow.
- **Questions are really important**: encourage students to always ask questions and answer questions.
- **Depth is much more important than speed**: inform students that top mathematicians think slowly and deeply
- **Math is about learning, not performing**: math is a growth subject; it takes time to learn, and it is all about the effort.

(Boaler, 2016)

The researcher explained to the students and discussed in greater detail with them the benefits of self-regulation, self-management, and strategies to develop mathematical mindsets. Furthermore, the researcher practiced self-regulation and breathing techniques with students before conducting math lessons. Students reported feeling comfortable utilizing the new skills throughout the day, during mathematics class, and other subjects. During the intervention phase, the researcher conducted all lessons/interventions and both strands of data, along with the aid of the teacher participants in the qualitative strand. The researcher conducted a post-test again, approximately three weeks after intervention application, to assess the skill retention of students. This measure helped assess the dependent variable (the pre/post-test) and the independent variables (self-regulation and mathematical mindsets intervention).

Summary

Research literature along with educational practices revealed that mathematics mindsets, self-regulation, and breathing techniques help students to overcome challenges of math fear and anxiety. Learning mathematics and sciences is necessary in today's highly technological workplace. To help students who struggle with math and have deep fears, experience discomfort, and at times have anxiety, teachers should embed self-regulation during math classes. Additionally, students benefit when they develop mathematics mindsets and understand that making mistakes is part of the learning process.

Chapter Three: Methodology and Research Design

Study Aims

To analyze the effects of mathematical mindsets and self-regulation of middle school students for an Improvement Science Dissertation in Practice (ISDiP), the researcher engaged in conducting a self-regulation and mathematic mindsets intervention through a series of math lessons. Improvement science is a systematic approach to solving a problem of practice in an educational setting. Problems are validated, drivers are identified, and change ideas are implemented in a continuous cycle of improvement and adjustment (Perry, Zambo, & Crow, 2020). Improvement science allows educational organizations to understand on a deeper level how their systems work and what positively or negatively affects their improvement reforms (Perry, Zambo, & Crow, 2020). This study aims to evaluate the effectiveness of an intervention to determine the best instructional practices.

The specific aims of this study were to:

1. Analyze the effects of mathematical mindsets and self-regulation of middle school students to develop the necessary skills to reduce their anxiety and fear when learning mathematics and identify the most effective way to conduct self-regulation techniques to help students access their learning best.
2. Compare mathematical scores pre to post-test and retention post-test.
3. Explore what focus/inattention behaviors were noticed during and after lesson implementation.

Theory of Improvement

This Improvement Science Dissertation aimed to identify the most effective way to integrate self-regulation techniques into mathematics lesson planning, to help students access their best learning experiences. Bryk et al., 2017 suggested that "Improvement science is a methodology that disciplines inquiries to improve practice" (p. 10). After determining the theory of improvement, the researcher designed an intervention to implement and assess the degree of practicality and success in the classroom. To determine the effectiveness of the intervention in mitigating the problem of practice the researcher used pre and post-test academic data and educator interviews.

In the first phase, the researcher used the standardized midyear assessment from Envision Mathematics (Savvas Learning Company – Prentice Hall® Publications, Copyright 2021): (Appendix G) as a pre and post-test to determine the quantitative data set. During the intervention phase, the researcher conducted all lessons/interventions and collected both strands of data, along with the aid of the teacher participants (Appendix I). The researcher conducted post-tests, approximately three weeks after intervention application, to assess the skill retention of students. This measure helped assess the dependent variable (the pre/post-test math assessment scores) and the independent variables (self-regulation and mathematical mindsets intervention).

The following questions guided this research:

1. **Quantitative Research Question:**

   What is the effectiveness of a mathematical mindset intervention for improving mathematics achievement?

2. **Qualitative Research Question:**

   What are the perceptions of math mindset guided instructions, combined with SEL interventions aimed at improving students' and teachers' experiences with math to reduce mathematics anxiety?

Setting

This mixed-methods case study research identified how to best help middle school students at The Guardian Angels Catholic Academy who struggle with math, have deep fears about this subject, and experience math anxiety. This study took place at The Guardian Angels Catholic Academy, in New England, United States. The researcher disclosed all the necessary information to the participants and took all the steps to protect their privacy. Participants' parents were sent a letter and asked to sign an agreement to participate in the study voluntarily. In addition, the IRB at Sacred Heart University reviewed all the documentation before conducting the research and granted permission for the study. The data for this qualitative action research was collected by using interviews and questionnaires. Additional information was gathered from the performance data of students. The participants in this study were teachers who taught at The Guardian Angels Catholic Academy during the school year 2021-2022.

This Improvement Science Dissertation in Practice (ISDiP) study used a mixed-methods case study research design in order to achieve an in-depth analysis of the implementation of the math mindsets intervention. Case Study research is "a design inquiry found in many fields, especially evaluation, in which the researchers develops in-depth analysis of the case...and researchers collect detailed information using a variety of data collection procedures over a sustained period of time"(Creswell, 2014, p.14). This study was conducted with the cooperation of the Diocese of Bridgeport Catholic Schools (Appendix D) and The Guardian Angels Catholic

Academy in New England, United States, where the primary researcher was employed as an elementary school principal. The outcome of this ISDiP study may aid in the improvement of educational practices employable by the researcher in his current role. The researcher selected this design to allow the utilization of both qualitative and quantitative data to describe how math fear and anxiety impacts student performance at The Guardian Angels Catholic Academy. In the first phase of the study, qualitative data were gathered from anonymous online empathy interview surveys, in-person interviews, and classroom observations. This data collection aimed to gather information regarding how to help middle school students who struggle with math, have deep fears about this subject, and experience math anxiety. The voluntary survey was sent to middle school teachers, the dean of student life, and the school counselor at The Guardian Angels Catholic Academy. The outcome of this data collection served to defend part of the problem of practice for the more extensive ISDiP study. Student performance data, interviews, and observations helped guide the research and identify a specific implementation intervention.

Sampling Plan

The sampling for this study consisted of middle school-aged students. The sample population consisted of two sixth-grade middle school classes from a suburban private school (The Guardian Angels Catholic Academy, New England, United States). Approximately 15-16 students were part of each class, with ages ranging between eleven and thirteen and mixed genders and mixed academic and behavioral levels. Although a maximum of approximately 31 student-participants were invited to participate, the researcher utilized an “opt-out” letter to parents (Appendix E) for parent consent. The lessons were an intervention that is traditional educational practice and has been approved by the Diocese as curriculum, and the lessons were given to all students. The students’ parents had the option of opting out of the evaluation of this

lesson, which involved simply not reviewing that child's assignments and tests in the assessment evaluation (which was the research study content). Since classroom educational intervention and assessment is considered a low-risk activity, the American Educational Research Association Code of Ethics, conditions for consent of classroom assessment can be obtained with the inclusion of this statement, which appears in the Opt-Out letter: "Even if your child does not participate in study, he or she will receive the required instruction and be expected to complete the required assignments and tests" (Appendix E).

For the qualitative sample, the sampling population consisted of no students and included two middle school teachers at the same school site (noted above). The two teachers had mixed ages, mixed experience levels, and were both females. The maximum number of teachers invited to participate was two and the researcher utilized an informed consent form for these adult participants (Appendix F). Sampling procedures and protocols in both strands consisted of obtaining IRB permission, considering ethical concerns, and transparently disseminating all research components and findings. In both sampling plans, the source of the participant recruitment consisted of two similar classrooms within the school and the district that the researcher worked. The study included all invited participants with no exclusions.

Intervention

Before the intervention, the students learned to solve linear equations. This unit had seven lessons, and the math lesson taught during the intervention did not change. The researcher used the same lessons planned at the beginning of the year and recorded on the pacing guides, scope, and sequence of the units for grade 6 math. The researcher conducted all lessons/interventions, along with the aid of the teacher participants. In the first phase, the study

used the standardized midyear assessment from Envision Mathematics (Savvas Learning Company – Prentice Hall Publications, Copyright 2021): (Appendix G) as a pre and post-test to determine the quantitative data set. This measure assessed the dependent variable (the pre/post-test) and the independent variables (self-regulation and mathematical mindsets intervention). The post-test was conducted again, approximately three weeks after intervention application, to assess skill retention as well. The researcher used bivariate quantitative data analysis, using statistical analysis software, to perform a t-test to determine the statistical significance of pre to post-test growth within groups and across groups as well as a correlational test to determine if other factors such as gender, age, and prior year attendance had any relationship to the assessment scores.

Qualitatively, in the second phase, while the researcher conducted the academic lessons/interventions, the teacher participants took anecdotal focus/inattention notes of the student participants using an adaptation of the academic engagement – nonengagement portion of the Pearson Behavioral Observation of Students in Schools (BOSS) observation checklist (Appendix H) regarding on-task behaviors as well as participated in debriefing interviews (Appendix J) conducted by the researcher after each session and again after the follow-up assessment. The researcher manually recorded, transcribed, coded, and drew conclusions about emerging themes with this data set.

Qualitative Methods

All middle school participants engaged in self-reflections in the classroom prior to the math lesson and independently when completing their homework, mathematical lessons as well as a pre and post academic skill assessment with a follow-up skill retention assessment,

approximately three weeks later. Both middle school classrooms were engaged in self-regulation and breathing techniques prior to the math lesson. This was part of lesson plan approved by Diocese. Please see detailed study protocol for further information related to methods.

While the lessons were conducted by the researcher, both middle school teachers conducted inattention observations on students' academic engagement using an inattention checklist (Appendix H). In addition, these educators were asked to participate in follow-up debriefing interviews (Appendix J) at the end of each lesson as well as a final interview after the retention assessment, approximately three weeks later.

Research Design

This ISDiP study was a mixed-methods case study research project within the framework of Improvement Science. This project benefited from a mixed-methods format because the "primary experimental design needs to be expanded or enhanced…" (Creswell & Plano Clark, 2018, p.8). More specifically, the project employed the use of a mixed-methods design which aims to "bring together the results of the quantitative and qualitative data… with the intent of obtaining a more complete understanding of the problem" (Creswell & Plano Clark, 2018, p.65). Additionally, the study aimed to apply an intervention and evaluate pre and post test to determine the extent of the intervention effects with the goal of exploring and answering the research questions (Creswell & Plano Clark, 2018).

This ISDiP study design used several steps. First, the study conducted both the quantitative and qualitative strands within approximately the same time frame. Next, the integration of the data commenced allowing for the qualitative data to add more information to the depth of the quantitative data findings. Last, based on the data analysis outcomes, the

researcher drew conclusions, answered the research questions, and provided suggestions for improving the problem of practice. The researcher conducted the study within a single school district, in a single state, across two comparable classrooms. To allow for the reduction of the confounded variable of maturation and allow the students enough time to learn foundational grade six mathematical skills (September to December), the study took place in the month of January 2022. The study continued approximately three weeks after in February 2022 to allow for a follow-up retention of skills assessment. Finally, the study used several steps to collect and analyze the data.

Quantitative Data Collection

The purpose of this data collection was to analyze pre and post math assessments, as well as using previous student performance data and new data collection on standardized Iowa tests. The study used the standardized midyear assessment (Appendix G) as a pre and post-test to determine the quantitative data set. This measure assessed the dependent variable (the pre/post-test) and the independent variables (self-regulation and mathematical mindsets intervention). The post-test was conducted again, approximately three weeks after intervention application, to assess skill retention. The researcher used bivariate quantitative data analysis, using statistical analysis software, to perform a t-test to determine the statistical significance of pre to post-test growth within groups and across groups, as well as a correlational test to determine if other factors such as gender, age, and prior year attendance had any relationship to the assessment scores.

Qualitative Data Collection

The purpose of this data collection will be to gather information regarding how to help best middle school students who struggle with math, have deep fears about the subject of math, and experience math anxiety. To gather qualitative data, the researcher conducted debriefing educator interviews after each lesson implementation followed by a final educator interview to reflect on the overall classroom experiences and findings.

Debriefing questions after each lesson:

1. How engaged/focused do you think students were in the lesson today?
2. What factors do you think affected student engagement/focus and/or learning access in the lesson today?
3. What else did you notice regarding the student's engagement, presentation of the lesson, and/or students' acquisition of the skill being taught?

After follow-up extended post-test skill retention assessment:

1. To what extent has the intervention carried over beyond the lesson implementation?
2. How did the outcomes relate to your observations during lesson implementation?
3. What limitations and/or additional support do you need to use these outcomes to improve your students' self-regulation and overall learning access?
4. How has this project impacted your own educational practices?

Through qualitative data collection, the study aimed to use the data to inform the quantitative data collected to understand the problem of practice better and inform instructional practices to address student fear and anxiety in mathematics.

Data Analyses Plan

The data analyses included integrating data from both strands to determine the most effective instructional practices to help middle school students learn mathematics best. When the intervention concluded, and the qualitative and quantitative data were collected, the researcher integrated the data by comparing the qualitative themes to the quantitative outcomes and drawing correlational conclusions based on both data sets qualitative themes to the quantitative outcomes and drawing correlational findings based on both data sets. Through the use of tables, figures, and narrative explanations, the researcher presented the information in the Improvement Science Dissertation in Practice in such a manner that the participants were not identified directly nor through identifiers linked to the participants themselves.

Limitations

When analyzing the study's outcomes, there were some limitations to consider. The main limitation of the study was generalizability due to the sampling size. The sample population included only one grade level with thirty-two students and two teachers. Furthermore, the study took place in a small private school with no students who qualified for free and reduced lunch and therefore did not include all socio-economic groups.

The intervention took place during the course of four weeks. Therefore, short-term limitations that could have impacted findings included variable maturation of skills and behaviors. Self-regulation and other social and emotional skills could take longer for students to develop and implement. Another limitation to consider included researcher and educator bias due to previous collaborations with students and fellow colleagues.

Chapter Four: Findings

This Improvement Science aimed to identify an effective way to address math anxiety as experienced by middle school students. Following a root cause analysis and environmental scan, it was determined that integrating self-regulation and relaxation techniques into mathematics lesson planning, may help students access their best learning experiences, with an improving potential to increase mathematics comprehension. Improvement science is a systematic approach to solving a problem of practice in an educational setting and helps to understand on a deeper level how their systems work and what positively or negatively affects their improvement reforms (Perry, Zambo, & Crow, 2020). To investigate the effectiveness of the chosen intervention, this Improvement Science Dissertation in Practice (ISDiP) study used a mixed-methods case study research design to answer the research questions.

The following questions guided this research:

- **Quantitative Research Question**:

  What is the effectiveness of a mathematical mindset intervention for improving mathematics achievement?

- **Qualitative Research Question**:

  What are the perceptions of math mindset guided instructions, combined with SEL interventions aimed at improving students' and teachers' experiences with math to reduce mathematics anxiety?

Participants and School Setting

Participants in this study included 31 students in sixth grade (N = 31) and two sixth grade teachers. Table 4.1 shows the student demographics data. The private school where the study took place accepts students from any background with the mutual understanding between parents

and school that the shared goal is a success for each child. The school's mission is to establish a clear and direct conversation with parents to ensure the placement always keeps the student's best interest in mind. In 2009, this school received the Blue-Ribbon Award from the U.S. Department of Education. The Blue-Ribbon Award program honors schools whose students achieve in the top 10 percent of the nation on nationally normed tests. Most students come from affluent families, and the annual tuition at the time of the study was $10,000 a year per student. Tuition assistance is available to students and families who qualify for financial aid. The process to apply for financial aid involves fully registered students, and parents are aware of that step in the process.

Participating students in this study did not require any special services accept four students who received accommodations of preferred seating and extended time when taking tests. The school employs Edmentum assessments to assist teachers in assessment and development of lesson planning based on student performances of students. Edmentum is an online platform designed to empower educators and create a learning environment around the needs of each learner to make personalized learning an achievable reality in every classroom (Edmentum.com, 2022). Edmentum is an online platform utilized by 40 states and more than 8,000 school districts around the country. Founded in 1960 at the University of Illinois, Edmentum was designed to assist students and teachers to enable them access to high-quality education.

The school requires that students are assessed three times a year in September, January, and May. To evaluate the effectiveness of the math mindset with SEL components intervention, the researcher received permission to use January assessment as pre-test and four weeks later to use an additional Edmentum assessment as the post-test.

Assessment results were calculated by Edmentum and reported progression in relation to aggregated national data of students at similar grade level who also have the same assessment. Within this assessment system, four categories are predefined with specific ranges of students score: 0-24th percentile, 25-49th percentile, 50-74th percentile, and 75-99th percentile, and these categories represent where a students' scores fall relative to national norms based on Edmentum assessments. In addition to the quantitative assessment, teachers also received ongoing support integrate mathematical mindset with SEL into their own teaching practice and real time assessment techniques to help students reinforce new content areas and review prior knowledge. At the time when the study took place, it was the third consecutive year that this school used Edmentum, and students and teachers had optimal experience and knowledge about this assessment platform.

Quantitative Results

As shown in Table 4.1, there were similar numbers of boys and girls who participated in the intervention. The sample also reflected similar demographics of the school, with the majority of students being white (77% n=24), followed by minoritized students (23% n=7).

Table 4.1

Demographics of Participants

Students	n	%
Boys	15	0.48
Girls	16	0.52
Ethnicity		

African American	4	13%
Asian	1	3%
Hispanic	4	13%
White	22	71%

n = number of students

As this was a case study analysis of an intervention with one grade level, only two teachers were included in the sample. The two middle school teachers were female with 22- and 9-years teaching experience.

Intervention Preparation and Mathematics Lessons

The researcher explained to the students and discussed in greater detail with them the benefits of self-regulation, self-management, and strategies to develop mathematical mindsets. Furthermore, the researcher practiced breathing techniques for seven consecutive school days before conducting math lessons. During this time, the students practiced self-regulation and breathing techniques. Student feedback was requested during class lessons and students reported feeling comfortable utilizing the new skills during mathematics class, as well as other subjects. On the first day of the intervention, the student completed the midyear assessment from Envision Mathematics (Savvas Learning Company – Prentice Hall Publications, Copyright 2021) as a pre-test to determine the quantitative data set. The assessment utilized the Edmentum testing platform that the school used for the past three school years. This measure assessed the dependent mathematical variable (the pre/post-test) and the independent variables (self-

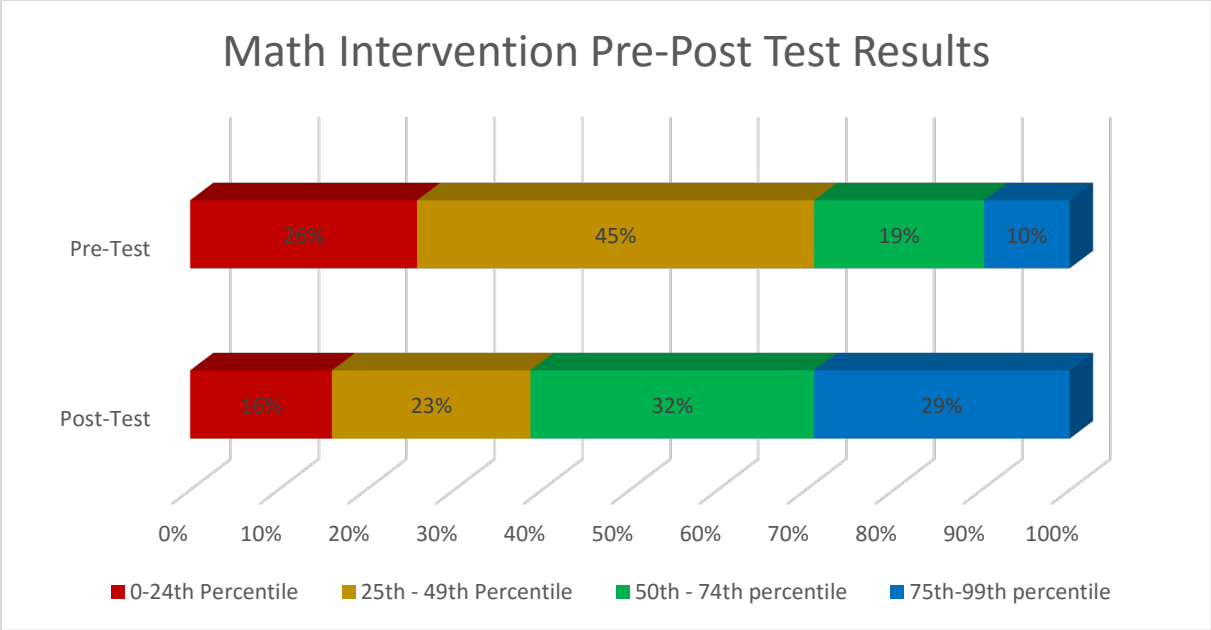
regulation and mathematical mindsets intervention). The post-test was conducted again, approximately four weeks after intervention application, to assess skill retention.

Quantitative Data Analyses

The number of students who took the pre-assessment at the beginning of the intervention was the same as the number of students who took the post-assessment after the intervention. Students were familiar with this type of assessment, and there was no need for special accommodation to complete the pre- and post-assessment. As the student performance data in Table 4.2 shows, the number of students in the 0-24th percentile decreased by 3 or 37.5%, which indicates that more than a third of the students from this group retained math skills and demonstrated growth. The number of students in the 25-49th percentile decreased by 7 or 50%, indicating that half of the students in this group retained math skills and showed growth. The number of students from the 50-74th percentile grew by an additional four students, or 66.67% of the number of students in this group. Students demonstrated the most significant skill retention and growth in the 75-99th percentile. The number of students went from 3 in the pre-test to 9 in the post-test. The student performance data suggests that when students apply self-regulation and SEL skills to a mathematics lesson, they are calmer and demonstrate the growth of their skills and knowledge in the content area they learned in mathematics class.

Table 4.2

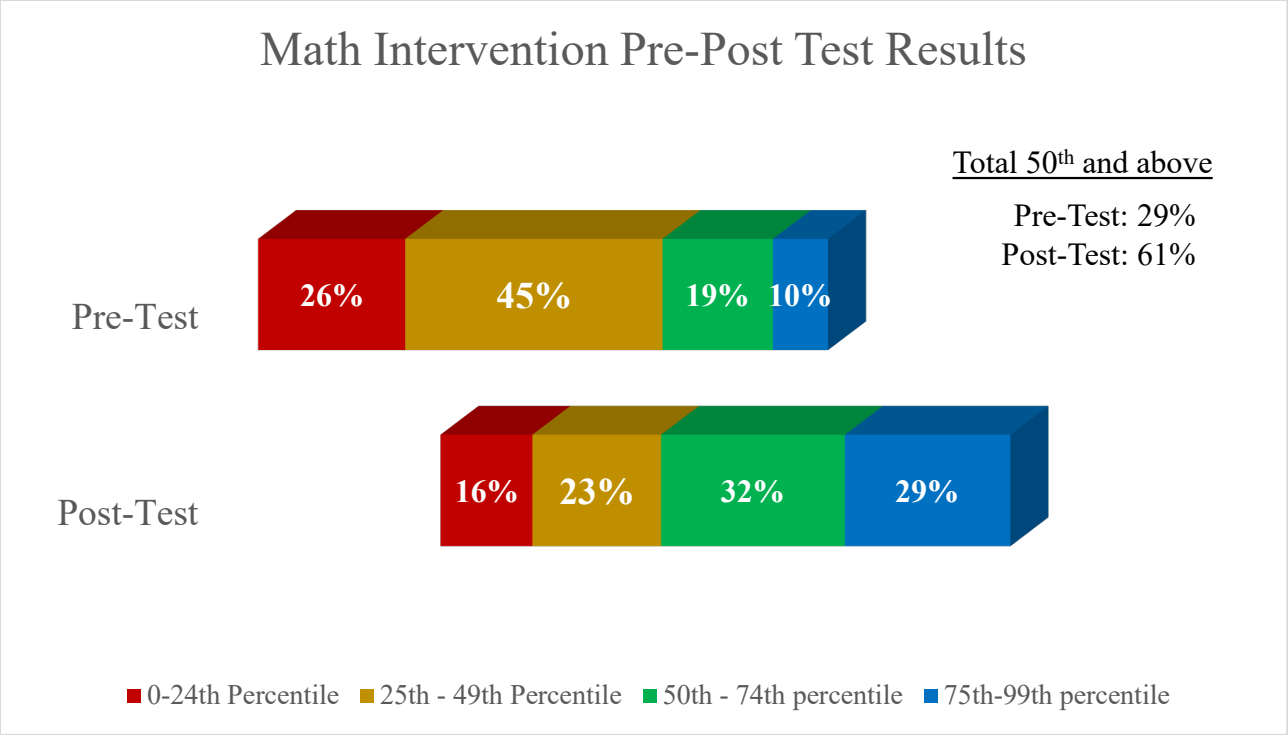
Math Intervention Assessment Results



As shown in Figure 4A, the change in pre to post test scores indicates that students demonstrated an increased performance as measured by Edmentum assessments in January 2022 and then reassessed again four weeks later. Students demonstrated the most significant skill retention and growth in the 75-99th percentile. The number of students went from 3 in the pre-test to 9 in the post-test.

Figure 4A

Comparison of Math Intervention Pre and Post-Test Results to National Data

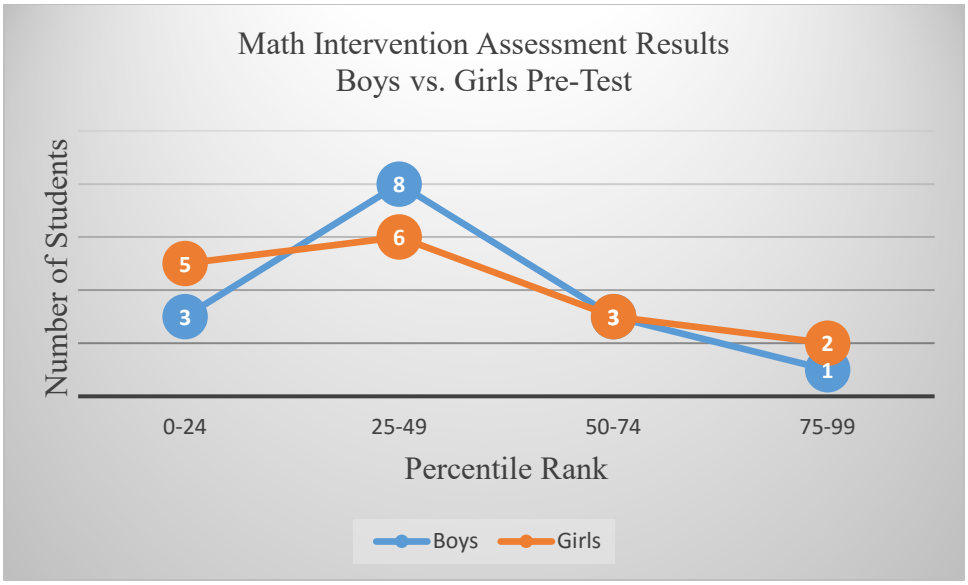


Assessment Results from Boys versus Girls

When comparing assessment results between boys and girls, pre-test results indicate that boys and girls performed similarly, as shown in Figure 4B. The number of boys who perfumed below the 50th percentile was 11, and the number of girls who performed below the 50th percentile was also 11. The number of girls who performed above the 50th percentile was five, and the number of boys who performed above the 50th percentile was 4.

Figure 4B

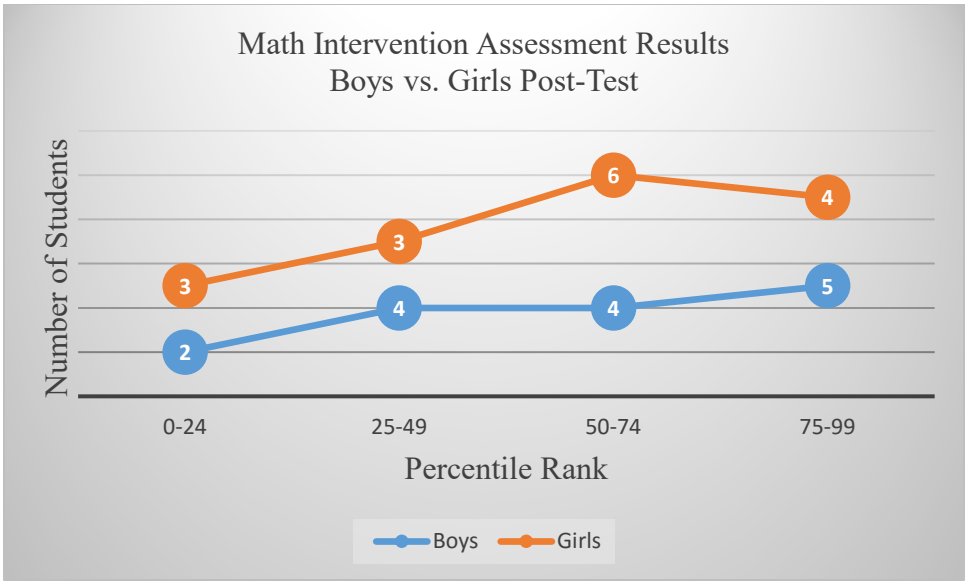
Math Intervention NPR Assessment Results Boys vs. Girls Pre-Test



When comparing assessment results between boys and girls after the intervention, the post-test results indicate that boys and girls performed similarly, as shown in Figure 4C. The number of boys who perfumed below the 50th percentile was six, and the number of girls who performed below the 50th percentile was 6. The number of girls who performed above the 50th percentile was ten, and the number of boys who performed above the 50th percentile was 9.

Figure 4C

Math Intervention NPR Assessment Results Boys vs. Girls Post-Test



Qualitative Data

To answer the qualitative research question of this Improvement Science study, the qualitative data collection involved students' written lesson responses and teacher interviews throughout the intervention. Figure 4B (Appendix L) shows the reflection form that all participating students received and had to complete during the intervention phase. The students were instructed to use breathing techniques to self-regulate during the math lesson and describe their feeling in full sentences. Students received the form before the intervention started and had access to the form in the Google classroom along with other forms and learning materials that they used daily for their school related work. The math teachers assisted the researcher to utilize a randomized system and give each participating student a non-identifying code to group student responses.

Figure 4D

Student Reflection Form

Student Reflection Form*

Student Code: Student C Grade: 6 Week: Jan 10 - 14, 2022

Day	How did I feel **before** my math class?	How did I feel **during** my math class?	How did I feel **after** my math class?
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			

** The researcher developed the student reflection form.*

After the intervention concluded, the researcher collected student responses. Twenty-three participating students completed reflection forms in full and the other eight participants were incomplete or did not provide data that was relevant to the intervention. When analyzing students' responses, several themes emerged, and the researcher grouped student responses according to the following themes. Table 4A shows the four themes that emerged from students'

reflections. Overall, students expressed mostly positive perceptions of the intervention, and an ability to reflect on their emotional state during the lesson. An important finding was how students seemed to be able to identify the connection between how they were feeling and their capacity to learn.

Table 4A

Themes that Emerged from Students' Reflections

Theme #1: Breathing Techniques Helped Me During Math Class	"In the middle of class, I was getting distracted, and I couldn't focus, so I tried to exercise, which **helped me focus**." "The breathing exercises **helped me to relax and feel better**." "I used breathing techniques which helped **me listen more**. I felt calm and relaxed during my class."
Theme #2 I Used Breathing Exercises But Still Felt Anxious	"I used breathing exercises during the math class but still felt anxious and continuously needed to use the breathing exercises. I did not think that breathing exercises worked for me, given the amount of anxiety I was feeling."
Theme #3 Mathematics Mindsets Helped Me Learn When Prepared And Ready For Class	"I was prepared and confident that I would be okay in today's math class. I was ready for my math class and did not feel any stress."
Theme #4	

Interesting Math Topic Helped Me Focus	"I felt interested in the topic during math class and did not have to use the breathing exercises. I felt intrigued and engaged during the entire math class."
Theme #5 Self-Regulation Improved My Learning Experiences In Math And Other Classes	"Using self-regulation and breathing techniques helped me listen to the teacher and learn more. I felt calm and relaxed during my math class. When I was getting ready to go to my next class, I felt happy using these techniques. This led to a good rest of the day."

Teacher Reflections

The researcher collected additional qualitative data through in depth semi structured interviews with the two math teachers and asked them the following questions:

Debriefing questions after each lesson:

1. How engaged/focused do you think students were in the lesson today?
2. What factors do you think affected student engagement/focus and/or learning access in the lesson today?
3. What else did you notice regarding the student's engagement, presentation of the lesson, and/or students' acquisition of the skill being taught?

After follow-up extended post-test skill retention assessment:

1. To what extent has the intervention carried over beyond the lesson implementation?
2. How did the outcomes relate to your observations during lesson implementation?

3. What limitations and/or additional support do you need to use these outcomes to improve your students' self-regulation and overall learning access?
4. How has this project impacted your own educational practices?

When analyzing teachers' responses, several themes emerged, and the researcher grouped their responses based on the following themes.

Table 4B shows the four themes that emerged from teachers' responses.

Table 4B

Themes that Emerged from Teachers' Reflections

Theme#1: Breathing Exercises Helped Students Stay Engaged	"I observed students listening attentively, focused, and practicing breathing exercises as needed. This was observed when a new skill or vocabulary was introduced. Students seemed at ease after the material was reviewed and mastery of practice problems were completed." "Students were engaged, listening, participating, and doing classwork."
Theme #2 Breathing Exercises Did Not Help Every Students To Self-Regulate	"Student "B" had difficulty sitting still, fidgeted during instructional time and made low random noises while working on independent work." "Student "I" needed to be redirected on several occasions and reminded to practice breathing exercises in order to focus."

Theme #3 Self-Regulation Helped Students During Math Assessments	"Students were able to use breathing techniques as needed to self-regulate across the curriculum and especially during assessments. Students were able to increase their overall growth and understanding of the material." "Students are able to use breathing and self-regulation as needed. We begin assessments with the pause, breath, "I CAN DO THIS"; it seems to center them and they approach the task with more confidence."
Theme #4 New Breathing Techniques Helped With Managing My Stress	"I'm able to manage my own stress situations by staying calm and making decisions when not feeling overwhelmed. Focusing on myself allows me to evaluate the situation with a clarity in order to make informed decisions."
Theme #5 Mathematics Mindsets and Self-Regulation Helped Students Learn	"Posting encouraging quotes and visuals as reminders to pause, breath, focus to help students remember they have these tools available to them at all times." "Beginning a lesson with a quick breathing exercise and the "I CAN DO THIS" repeated as they exhale to put the whole class in a calm, relaxed, safe place to begin the lesson."

Summary

The findings shown in chapter four aimed to answer the inquiry questions of this Improvement Science project. The quantitative indicate that students demonstrated an increased performance as measured by Edmentum assessments in January 2022 and then reassessed again four weeks later. The student performance data suggests that when students apply self-regulation and SEL skills to a mathematics lesson, they were calmer and demonstrated the growth of their skills and knowledge in the content area they learned in mathematics class. The qualitative data helped to validate findings from quantitative data. In their responses, students expressed mostly positive perceptions of the intervention, and an ability to reflect on their emotional state during the lesson. An important finding was how students seemed to be able to identify the connection between how they were feeling and their capacity to learn. Similarly, teacher responses indicated that when students apply self-regulation and SEL skills to a mathematics lesson, they were calmer and demonstrated the growth of their skills and knowledge in the content area they learned in mathematics class.

Chapter Five: Discussion

The purpose of this study was to improve the learning experiences of middle school students who struggle with mathematical content and concepts by implementing an intervention to reduce their math fear and anxiety. Using a mixed-methods case study research design, the researcher sought to determine the effects of guided instructions combined with SEL interventions to help middle school students who struggle with math and have deep fears about this subject overcome challenges of math anxiety. The researcher selected this design and utilized qualitative and quantitative data to describe how math fear and anxiety impact students' performance and evaluate an intervention aimed at improving this problem of practice. Before the intervention, the researcher explained to the students and discussed in greater detail with them the benefits of self-regulation, self-management, and strategies to develop mathematics mindsets. Furthermore, the researcher practiced self-regulation and breathing techniques with students before conducting math lessons. Consistent with other research on breathing techniques for self-regulation during mathematics testing (Peper et al., 2016), students expressed that they felt comfortable utilizing the new skills in math class and reported finding these skills useful in other subjects throughout the day. During the intervention phase, the researcher conducted all lessons/interventions and assisted in collecting both strands of data, along with the aid of the teacher participants.

A pretest to establish baseline mathematics skills before the intervention was conducted. Following the intervention, the researcher utilized a post-test, approximately four weeks after intervention application, to assess the skill retention of students. This measure helped assess the dependent variable (the pre/post-test math scores) and the independent variables (self-regulation and mathematical mindsets intervention). Quantitative data were obtained using the Edmentum

assessment system with the pretest in January 2022 and the post-test approximately four weeks later. Qualitative data were obtained through questioners and interviews of all participants in the study. The quantitative data analyses show how guided instructions combined with SEL interventions impacted students' performance in mathematics, whereas the results of qualitative data analyses highlighted important insights of participants' thoughts on the effects of the intervention strategies and students' fear, discomfort, and anxiety during math lessons.

Summary of the Results

The results of quantitative data analyses were discussed in relation to the research question:

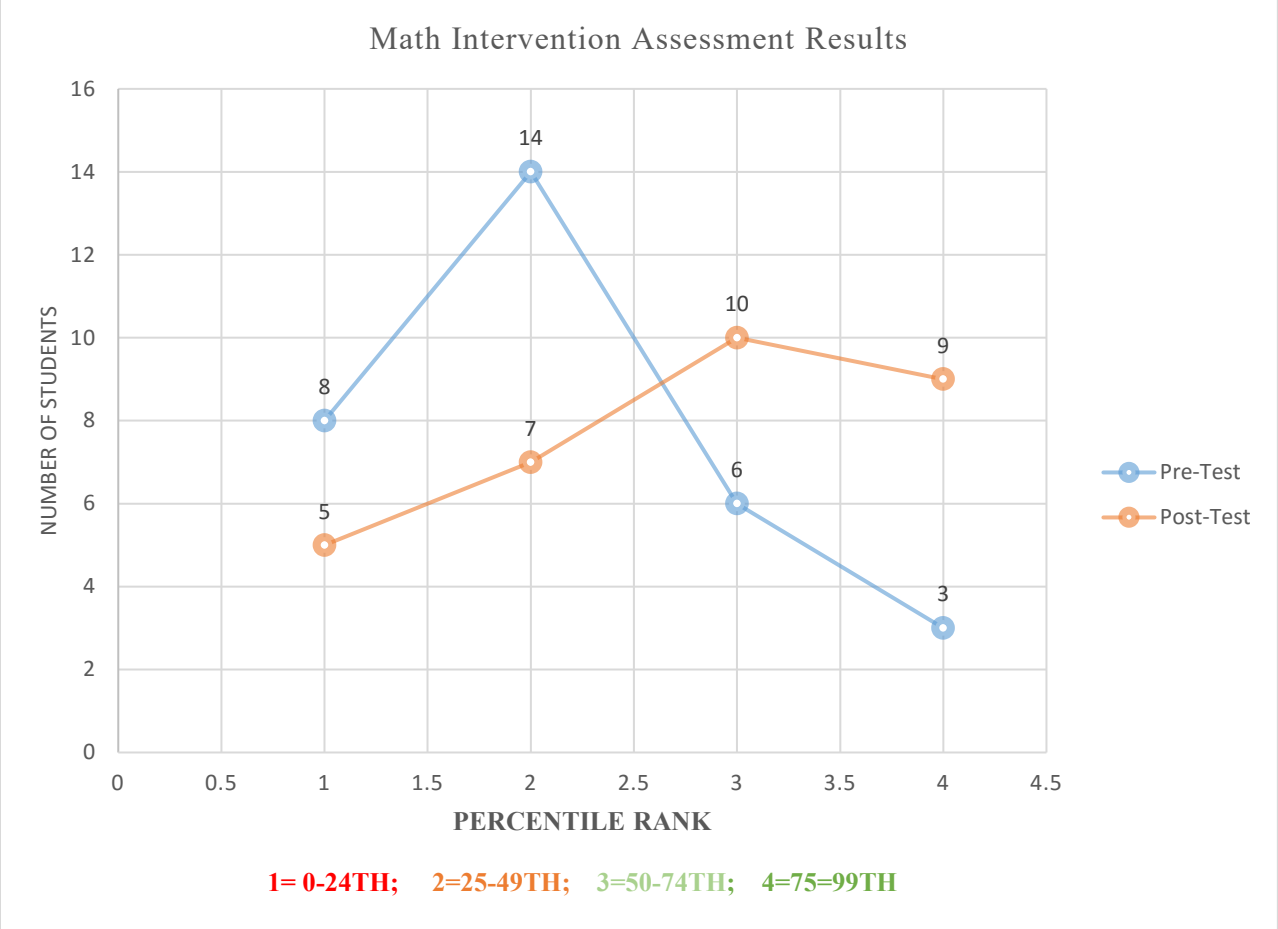
Quantitative Research Question: What is the effectiveness of a mathematical mindset intervention for improving mathematics achievement?

The researcher used SPSS to run a paired t-test to determine if there was a statistically significant difference in the national percentile ranks (NPR) between pretest and post-test scores. Analyses revealed a statistically significant difference between students' performance in the pretest compared to the post-test, where the p-value is merely $p < .001$ (actual value $p = 0.000000531427$). Table 5.1 indicates that the number of students who ranked below the 50^{th} percentile in the pretest decreased by nearly 55%, which shows the change in the number of students from 22 to 12 students in the post-test. At the same time, the number of students in the $50\text{-}74^{th}$ percentile increased by 40%, which shows the change in the number of students from 6 in the pretest to 10 students in the post-test. Students demonstrated the most significant skill retention and growth in the 75-99th percentile. The number of students went from 3 in the pretest to 9 in the post-test. Similar to Boaler's (2016) study of math mindset, the students in this

intervention showed overall improvement in math learning; however, this study utilized a national standardized testing evaluation to assess outcomes. The student performance data shown in Figure 5.1 indicates that when students apply self-regulation and SEL skills to a mathematics lesson, they are calmer and demonstrate the growth of their skills and knowledge in the content area they learned in mathematics class. These findings are similar to Boaler's (2016) suggestions on the impact of teacher awareness of helping students build a strong foundation and mindsets of understanding how important it is to have an open and flexible mind while learning.

Table 5.1

Math Intervention Assessment Results



The results of qualitative data analyses were discussed in relation to the research question:

Qualitative Research Question: What are the perceptions of math mindset guided instructions, combined with SEL interventions aimed at improving students' and teachers' experiences with math to reduce mathematics anxiety?

The qualitative data helped to triangulate findings from quantitative data through more thorough response data through the use of open-ended questions. In their responses, students mainly expressed positive perceptions of the intervention and an increased ability to reflect on their emotional state during the lesson. Several themes emerged when analyzing students' responses, and the researcher grouped student responses into themes. Students reported that breathing techniques helped them to calm down and focus in class more than previously when they did not use these techniques. An important finding was how students seemed to be able to identify the connection between how they were feeling and their capacity to learn. Similar to Hatcher's (2018) findings, this is important because when students are aware of their feelings, they have the power to grow in their ability to focus on learning mathematical concepts.

Furthermore, the students noted that self-regulation and mathematics mindsets positively impacted their overall learning. These findings are similar to Boaler's (2016) suggestions that students need to learn about the benefits of a growth mindset when developing their thinking to overcome math anxiety. It is important to note that three students reported that breathing techniques did not help them as expected to regulate their emotions and lower the level of anxiousness that they felt during math class, which suggests that individual assessment of learning strategies is needed to contribute to equitable learning spaces for students. Therefore, even though the study found that intervention worked for most students but did not work for all students, teachers need to be mindful of multiple strategies when teaching math.

Teacher responses indicated that when students applied self-regulation and SEL skills to a mathematics lesson, they were calmer and demonstrated growth of their skills and knowledge in the content area they learned in mathematics class. Teachers noted that they had to remind a few students to practice breathing techniques because they demonstrated less ability to fully focus during the math class. When teachers reflected on their own emotions and experiences during the intervention, they reported that breathing techniques helped them concentrate and feel more effective in delivering instructions, interacting, and engaging students during class. These findings are similar to Schonert-Reichl's (2019) description of teachers as the engine that drives SEL programs and practices in schools and classrooms and suggests that teachers' social-emotional competencies and well-being strongly influence student performance. Classrooms with warm teacher-child relationships and support can contribute to deep learning and positive social and emotional development among students. Conversely, Schonert-Reichl (2019) argued that when teachers poorly manage the social and emotional demands of teaching, students' academic achievement and behavior both suffer.

Teacher Feedback

The researcher asked teachers to take notes during the intervention and share them as part of their feedback. Teachers indicated that they experienced and witnessed increased students' engagement and focus while observing the researcher teach the lessons. After the intervention, teachers shared with the researcher that students' behavior improved. They reported positive experiences and overall increased student performance, and the quality of teaching improved compared to their teaching before the intervention.

Limitations of the Results

A significant limitation to this study was the duration of the intervention. One week of intervention and four weeks to assess skill retention may not have been enough time to measure the effects of the intervention. Still, it is suggestive of a potential improvement strategy for mathematical instruction. Suggestions for future research include longer interventions and a longitudinal study for more effective measurement of this intervention over a more extended period of time. Self-regulation and other social and emotional skills may take longer for students to develop and implement regularly, so full integration of SEL skills may not have been able to be adequately measured. The researcher and teachers involved in the intervention plan will continue to utilize the interventions that started in this study and provide instruction to other teachers involved in math instruction in the school. An additional limitation to consider included potential researcher and educator bias due to previous collaborations with students and fellow colleagues. To minimize this bias, student surveys were conducted using Panorama Student Survey.

Another limitation of the study was the small sample. The sample population included only one grade level with thirty-one students and two teachers. Furthermore, the study took place in one school with limited diversity related to race, ethnicity, and socioeconomic status. However, the purpose of improvement science was to engage in change ideas in the context of the educational setting that the primary researcher is located in, and it is not meant to generate generalizable knowledge. However, the promising results of this study indicate the need for additional research in this area.

Recommendation for Practice and Further Study

This study revealed robust evidence suggesting that integrating SEL into mathematics instruction had a significant impact on students' perceptions of creating a math mindset, reducing math anxiety, and increasing the effectiveness of teaching methods. Providing ongoing professional development for elementary teachers is necessary to help students develop a desire to learn math and retain math skills and concepts as they move to middle school and beyond. Brackett (2019) suggested that to help students develop social and emotional skills, schools must train adult teachers first and help them develop social and emotional competencies. At the same time, preservice teachers should know the impact of integrating SEL into their teaching and gain the necessary skills to become effective teachers while in college. Zakrzewski (2013) added that teachers' social and emotional training is necessary because it helps teachers develop essential skills to "create warm and safe classroom climates, fostered by strong classroom management skills" (p. 9). When teachers develop their SEL skills, they are better prepared to create a positive learning environment for students.

Students and teachers benefit greatly when schools create a positive climate and culture to make everyone in the school community feel welcomed. Furthermore, school culture, climate, and overall environment are equally important to the curriculum. According to the National School Climate Center (NSCC), school culture can be defined as the beliefs, perceptions, relationships, attitudes, and written and unwritten rules that shape and influence every aspect of how a school function. Positive changes in schools are most effective when school leaders view school through students' eyes and gain a more in-depth insight into their experiences at school. Proactive school leaders focus on establishing a welcoming and nurturing culture and climate early on and make the necessary changes in education programs. According to Hartman et al.

(2017), "An empathetic design approach to school reform provides a stronger point for initiating change than an atmosphere focused on evaluation and accountability" (p. 38). The question, "How are we expecting the students to get through the day if we are not meeting their basic needs?" is key to understanding what students go through in school (Hartman et al., 2017, p.39)

Based on the findings of this study, more research is necessary to explore effective and practical instructional interventions when developing and implementing the math curriculum. Integrating social and emotional learning (SEL) in everyday teaching and creating mathematics mindsets may prove to be the key to unlocking learning for every student. Future research on this topic would be a natural step to build on the analysis provided in this study to help students overcome the challenges of math anxiety and build mathematics mindsets.

Conclusion

This Improvement Science Dissertation in Practice study aimed to analyze the effects of middle school students' self-regulation and mathematical mindsets development to reduce feelings of fear and anxiety when learning mathematics. Overall, the intervention implemented in this study appeared to affect the experiences of participating students and teachers positively. The research design and the intervention approaches were beneficial for the researcher because they did not involve any financial resources and did not require any special accommodations for participants. Although the study results are promising, the researcher will continue to implement further what was learned from this intervention and continue to add to the literature and contribute to education research to help teachers and students overcome the challenges of math anxiety in middle school. Further research on this topic is essential to assist students in the classroom and provide teachers with the necessary training to integrate SEL into their teaching, reduce math anxiety, and increase student achievement in mathematics.

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Appendix A: Electronic Empathy Interview Online Survey Questions

Participant Consent: By completing this survey, the participant accepts the following:

**The researcher will use the data to analyze the root causes of the problem of practice.*

**The data may be presented in table, figure, and narrative form in Chapter 1 of the researcher's Improvement Science Dissertation in Practice study.*

**No participant identifiers will be used nor attached to the data (i.e., no email nor IP addresses, no names, etc.). Only participant roles will be used.*

**Data collected will be kept by the researcher on a password-protected computer.*

**This survey is completely voluntary, and the participant can abort completing the survey at any time.*

Questions

1. What is your current role in the school, and how long have you been in this role?

2. How has students' attention and focus changed over the past four years?

3. What causes do you think have contributed to these changes?

4. How have student outcomes in the subject area of mathematics changed over the past four years?

5. What causes do you think have contributed to these changes?

6. What connection(s) can you make between student attention/focus in mathematics?

7. What else do you want me to know about the areas of student motivation?

Appendix B: Environmental Informant Consultation Protocol

Participant IDNO|__|__|__|__| Gender: □ Male □ Female Date |__|__/__|__/__|__|

Introduction

I am Bardhyl Gjoka, a fellow at The Guardian Angels Catholic Academy colleague, serving as school principal. I am currently pursuing my doctorate through Sacred Heart University in Educational Leadership, focusing on Social-Emotional and Academic Learning. As I enter my final year of the program, I am working on my dissertation, where I plan to conduct research th seeks to determine the effects of guided instructions combined with SEL interventions to help middle school students overcome challenges of math anxiety. However, before this research, I need to determine the root causes and relationships between two prevalent, educational issues: to help best middle school students who struggle with math, have deep fears about this subject, experience math anxiety. I am very interested in your opinions on these matters. Your experien could help me develop an intervention to be used during the second part of my research to help students ready themselves to access their learning more. Your input is invaluable, and I invite y to share some details about your current job and answer a few questions.

Warm up [demographic & work history]

Can I ask for some details about you and your job?

Job Title _____

Now I will ask you some questions about your experiences as an administrator /a teacher this district/school.

Domain	Topic and Probes
Domain 1	1. How have students' attention and focus changed over the past three years? 2. What causes do you think have contributed to these changes?
Domain 2	1. How have student outcomes in the subject area of mathematics changed over the past three years? 2. What causes do you think have contributed to these changes?
Domain 3	1. What connection(s) can you make between student engagement and focus in mathematics? 2. What else do you want me to know about the areas of student motivation?

Closing

Is there anything else you think is important about your school climate and culture that we hav not talked about?

Appendix C: Collaborative Institutional Training Initiative Certificate

g/verify/?wc8db0988-a45b-4dd5-938f-c99c0f54907d-32849119

Appendix D: Permission to Conduct Research at The Guardian Angels Catholic Academy

DIOCESE OF BRIDGEPORT

238 JEWETT AVENUE • BRIDGEPORT, CONNECTICUT 06606 • 203-416-1638 • FAX: 203-372-1961

OFFICE OF THE SUPERINTENDENT OF SCHOOLS

July 13, 2021

To Whom It May Concern:

This signed letter serves as consent from the Diocese of Bridgeport for Bardhyl Gjoka to conduct research in the school system between July 2021 and August 2022, in accordance with the receipt of the Institutional Review Board approval for the purpose of completing an Improvement Science Dissertation in Practice (ISDiP) study as part of the researcher's Doctorate in Educational Leadership with a Focus on Social-Emotional Learning (SEL) through Sacred Heart University.

The research, which will be conducted at The Guardian Angels Catholic Academy, consists of two phases. The first phase will be conducted in July and August 2021. This phase will conduct qualitative data collection through an anonymous online empathy interview survey. The purpose of this data collection will be to gather information regarding how to help best middle school students who struggle with math, have deep fears about this subject, and experience math anxiety. The voluntary survey will be sent to middle school teachers, the dean of student life, and the school counselor at The Guardian Angels Catholic Academy. The outcome of this data collection will serve to defend part of the problem of practice for the larger ISDiP study.

Phase two of the larger ISDiP study will be conducted between January and August of 2022. This phase will conduct a form of action research that seeks to determine the effects of guided instructions combined with SEL interventions to help middle school overcome challenges of math anxiety. The study will require sampling of three middle school classrooms as well as the use of the three teachers of those classrooms. Quantitative data will be collected through pre and post math assessments, as well as qualitative data that will be collected through interviews with the teachers. The researcher will conduct all interventions to allow for treatment fidelity. Participation in the study by students and staff will be strictly voluntary, and informed consent, including the use of de-identified information of the participants, will ensure participant rights and protections are accounted for.

Allowing the researcher to conduct this research at The Guardian Angels Catholic Academy will allow The Guardian Angels Catholic Academy community to view the researcher's defense of the project. Furthermore, the researcher commits to making the study process transparent to the diocese as well as disseminating the results and intervention methods used in the study, which will be available for the diocese to use as it sees fit. The study's overarching goal is to seek best SEL and academic integration instructional practices that could be applied to all grade levels and all subject areas to allow for more equitable learning access for all students.

By signing this document, the Diocese of Bridgeport consents to allowing Bardhyl Gjoka to conduct the research according to the outline above.

Print: Dr. Steven F. Cheeseman Date: July 13, 2021

Signature: 

Appendix E: OPT-OUT Student Participation Informed Consent Letter

January 6, 2022

Dear Guardian Angels Catholic Academy Families,

My name is Bardhyl Gjoka, and I am the principal at The Guardian Angels Catholic Academy. I am conducting research for my Doctorate in Educational Leadership with a Focus on Social-Emotional and Academic Learning through Sacred Heart University in Fairfield, CT. My dissertation project aims to analyze the effects of mathematical mindsets and self-regulation of middle school students to develop the necessary skills to reduce their anxiety and fear when learning mathematics and identify the most effective way to conduct self-regulation techniques to help students access their learning best.

To conduct my research, I will be using the current diocesan mathematics curriculum and educational practices. The researcher will be using the same mathematics learning materials for the math lessons and assessments that students use daily. In addition, the researcher will be using a combination of self-regulation techniques and mathematic mindsets taken from the text "Teaching Mathematics for a Growth Mindset" (2016) from the book Mathematics Mindsets (Boaler and Dweck, 2016). The project will take place in one week in the month of January 2022, as well as a follow-up day in February 2022.

The research findings will be part of my dissertation and will become a published document, however, all participating students will be assigned a unique identifier code, ***NO STUDENT NAMES NOR IDENTIFIERS WILL BE USED***, and all data will be reported in the aggregate (averages, percentages, etc.). Although this is a no-risk research project, you have the right to OPT-OUT your child from participating with no penalty to you or your child. If you wish for your child to OPT-OUT of participating in this research project, please notify your child's teacher by email by January 10, 2022.

This dissertation research project is supported by the Superintendent of Schools at the Diocese of Bridgeport and approved by the Institutional Review Board of Scared Heart. Furthermore, I have been trained through the Collaborative Institutional Training Initiative (CITI- Certificate #32849119) to conduct ethical research. I appreciate your anticipated support of this project. If you have any further questions, please don't hesitate to reach out.

Sincerely,

Bardhyl Gjoka

Bardhyl Gjoka

principal@srles.com

Circle One: 1. Agree 2. Disagree

Appendix F: Teacher Participation Informed Consent Form

January 6, 2022 Dear Guardian Angels Catholic Academy Middle School Teacher:

My name is Bardhyl Gjoka, and I am the principal of The Guardian Angels Catholic Academy. I am conducting research for my Doctorate in Educational Leadership with a Focus on Social-Emotional and Academic Learning through Sacred Heart University in Fairfield, CT. My dissertation project aims to analyze the effects of mathematical mindsets and self-regulation of middle school students to develop the necessary skills to reduce their anxiety and fear when learning mathematics and identify the most effective way to conduct self-regulation techniques to help students access their learning best.

To conduct my research, I will be conducting lessons using the current diocesan mathematics curriculum and educational practices.. In addition, the researcher will be using a combination of self-regulation techniques and mathematic mindsets taken from the text "Teaching Mathematics for a Growth Mindset" (2016) from the book Mathematics Mindsets (Boaler and Dweck, 2016). The project will take place in one week in the month of January 2022, as well as a follow-up day in February 2022.The pre, post, and follow-up assessment will utilize the same mathematics learning materials for the math assessments that students use daily as well as the use of an anecdotal focus/inattention observational checklist (BOSS, 2013, adapted from the Academic Engagement-Non engagement portion). The research findings will be part of my dissertation and will become a published document, however, all participates will be assigned a unique identifier code, ***NO NAMES NOR IDENTIFIERS WILL BE USED***, and all data will be reported in the aggregate (averages, percentages, etc.).

You are being invited to participate in this research project. As a participant, I will need to use your classroom, materials, and students (once permissions are received) to conduct lessons and am asking that you conduct behavioral observations during the lessons and participate in short debriefing interviews following the lessons and again after the follow-up assessment. Although this is a no-risk research project, you have the right to decline participation. Please note, as your peer in the Diocese of Bridgeport Schools System, the decision to decline will not impact your employment nor collegial relationship with me. Please sign and return this consent form by January 6, 2022 with your intentions.

This dissertation research project is supported by the Superintendent of the Diocese of Bridgeport Schools and approved by the Institutional Review Board of Scared Heart. Furthermore, I have been trained through the Collaborative Institutional Training Initiative (CITI-Certificate #32849119) to conduct ethical research. I appreciate your anticipated support of this project. If you have any further questions, please don't hesitate to reach out.

Sincerely,

Bardhyl Gjoka

principal@srles.com

Circle One: 1. Agree 2. Disagree

Appendix G: Pre- and Post-Math Assessment

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

Write the ratio as a fraction in the simplest form.

____ 1. 24 to 20

$\frac{1}{4}$ $\frac{6}{5}$ $\frac{24}{20}$ $\frac{5}{6}$

____ 2. Find 78% of 380. Round to the nearest tenth of a percent if necessary.

3.8 29,640.0 296.4 487.2

____ 3. Emma already has read 6 of 20 books on her summer reading list. What percent of the books on her list has she read already?

23.1% 30.0% 333.3% 0.3%

Write an equation and solve. Round to the nearest tenth where necessary.

____ 4. What percent of 24 is 30?

$n \cdot 24 = 30$; 125% $n = 30 \cdot 24$; 720%

$n \cdot 30 = 24$; 80% $n = 30 \cdot 0.24$; 720%

____ 5. Wren bought a baseball card last year for $2.25. This year the price dropped to $.45. What was the percent of the decrease in the price of the card?

80% 500% 120% 400%

Solve the equation.

____ 6. $\frac{x}{5} + 9 = 4$

65 –25 5 20

____ 7. $0.6(y + 3) = 4.8$

5 3 13 1.8

____ 8. The fare for riding in a taxi is a $3 fixed charge and $0.80 per mile. The fare for a ride of d miles is $6.75. Which equation could be used to find d?

a. 3(6.75 + d) = 3 **c. 3 + 0.80d = 6.75**

b. 0.80 + 3d = 6.75 **d. (0.80 + 6.75)d = 3**

____ 9. Ms. Baker purchased a number of juice packs at a cost of $0.30 each and a loaf of bread that cost $1.19. The total cost of her purchases was $2.99. Which equation can you use to determine how many juice packs Ms. Baker purchased?

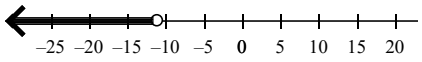
a. 2.99 – 1.19j = 0.30 **c. 1.19j + 0.30j = 2.99**

b. 0.30j + 2.99 = 1.19 **d. 0.30j + 1.19 = 2.99**

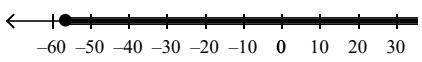
Solve and graph the inequality.

____ 10. $6.7 \geq -0.2x + 4.5$

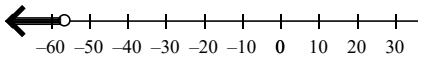
$x < -11$



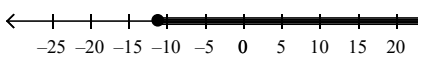
$x \geq -56$



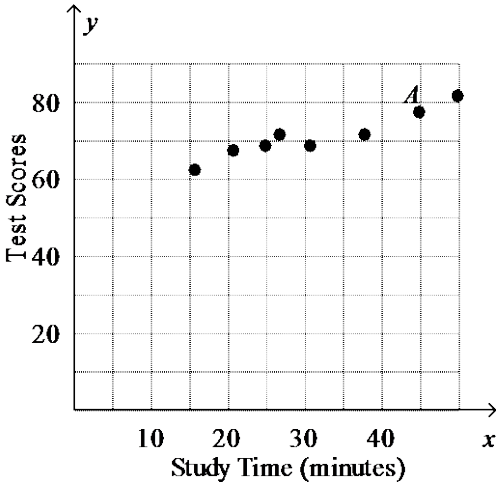
$x < -56$



$x \geq -11$



The scatter plot shows the study times and test scores for a number of students.



The scatter plot shows the study times and test scores for a number of students.

____ **11. Which table matches the scatter plot?**

a.

Study Time (min)	16	21	25	27	31	38	20	50
Test Score	62	67	85	71	68	71	77	81

b.

Study Time (min)	16	21	25	27	31	38	45	50
Test Score	62	75	68	71	68	71	77	100

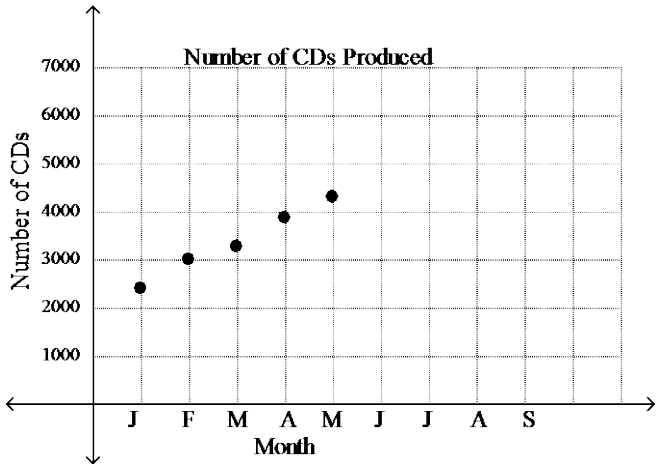
c.

Study Time (min)	16	21	25	27	31	38	45	50
Test Score	62	67	68	71	68	71	77	81

d.

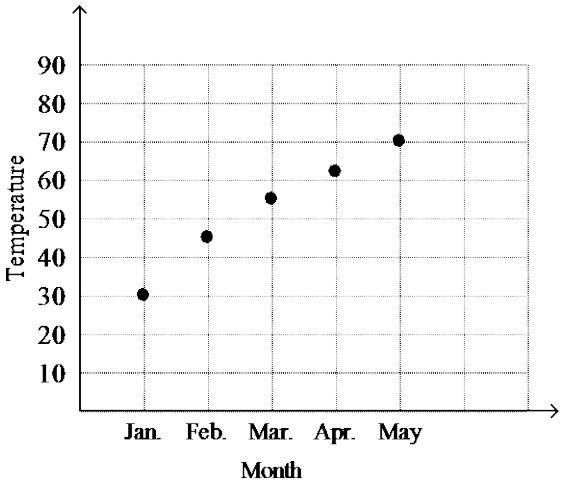
Study Time (min)	62	67	68	71	68	71	77	81
Test Score	16	21	25	27	31	38	45	50

____ **12. The scatter plot shows the number of CDs that Disc–O CD factory produced in different months. What is the best prediction for the month in which they will produce 5,500 CDs?**



a. November b. September c. July d. May

____ **13. The scatter plot shows the average temperature each month in a particular city. What is a good prediction for the temperature in July if the temperature continues to increase until then?**



a. 72 b. 85 c. 98 d. 112

____ 14. Find two numbers with a sum of 20 and a difference of 14.

a. 4 and 18 c. 2 and 16

b. –3 and –17 d. 3 and 17

a. 16.5 ft b. 22.0 ft c. 20.5 ft d. 17.5 ft

____ 15. A number cube was rolled 18 times. The results are shown. Display the data in a frequency table.

2 6 4 5 6 3 1 4 1

4 2 3 5 6 6 2 1 4

.

Number	Frequency
1	3
2	3
3	2
4	4
5	2
6	4

.

Number	Frequency
1	3
2	3
3	1
4	4
5	3
6	4

.

Number	Frequency
1	3
2	2
3	3
4	4
5	2
6	4

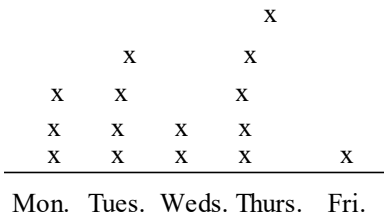
.

Number	Frequency
1	2
2	2
3	3
4	4
5	3
6	4

a. **c.**

b. **d.**

____ 16. The line plot shows on which day of the week you and your classmates were born. Which statement is NOT true?



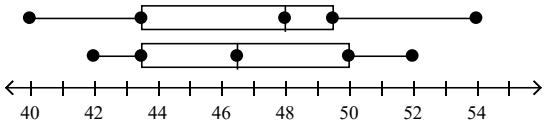
a. Two students were born on a Wednesday.

b. There are 15 students in your class.

c. More students were born on a Tuesday than on a Monday.

d. The range of the data is 5.

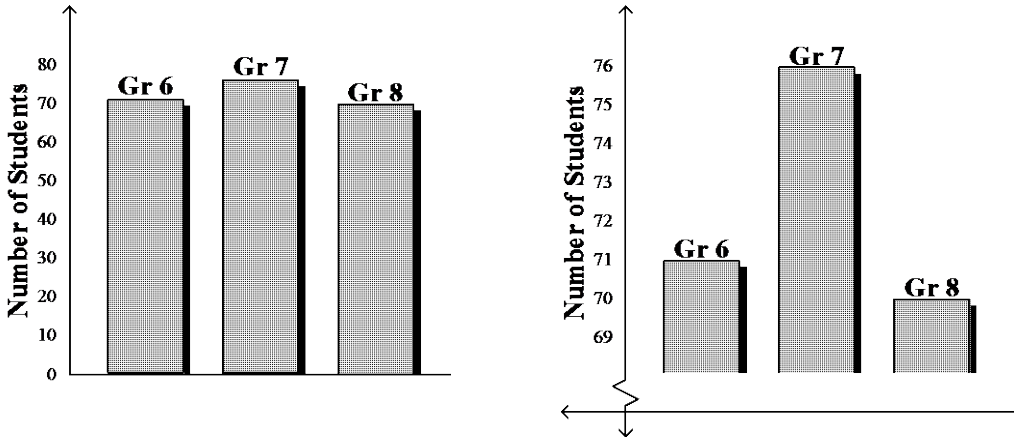
____ **17. Use the two box-and-whisker plots to determine which statement is true.**



a. They have the same median. **c. The upper quartiles are equal.**

b. They have the same range. **d. The lower quartiles are equal.**

____ **18. The graphs show the number of students receiving A's in each grade at Glenwood Middle School. Which statement is true?**



a. The second graph shows greater changes in the number of A's than the first graph.

b. The second graph exaggerates the differences between the numbers of A's.

c. The two graphs are exactly the same.

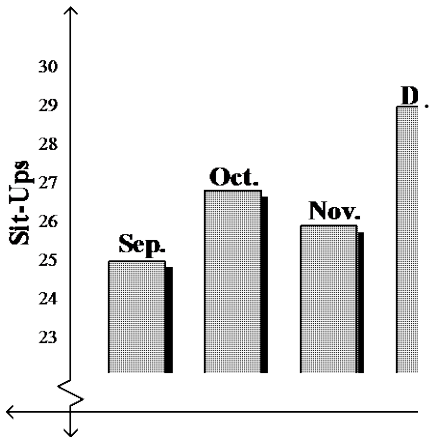
d. The scale of the first graph exaggerates the number of A's because it starts at zero.

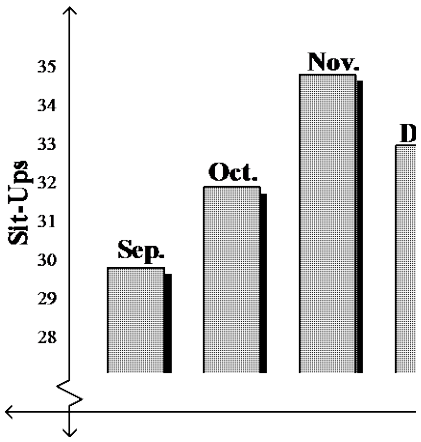
____ **19. Which graph deceptively makes it appear that the number of sit-ups Mark did in November was more than double the number of sit-ups he did in September?**

a. **c.**

b. **d.**

.





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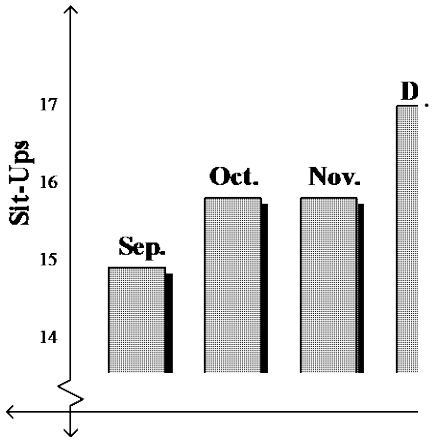
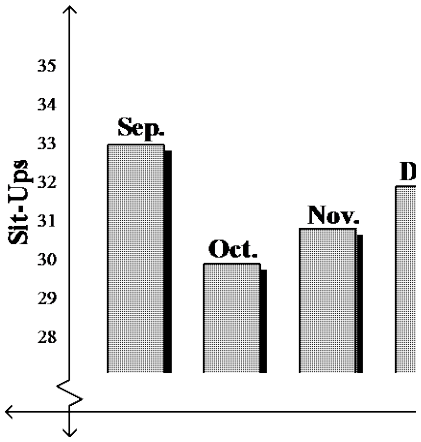




____ 20. There are many different license-plate systems being used in the United States. Which system provides for the greatest possible number of license plates?

a. License plates display three letters and three digits.

b. License plates display two letters and four digits.

c. License plates display five letters.

d. License plates display four letters and two digits.

____ 21. Which describes independent events?

a. You grab two jelly beans from a jar at the same time.

b. You draw a card from a deck, replace it, and draw a second.

c. You draw a card and do not replace it. Then you draw another.

d. You study English every night, and then you get an A on the next test.

You select a card at random. Without replacing the card, you select a second card.

Find the probability.

You select a card at random. Without replacing the card, you select a second card. Find the probability.

____ 22. P(M, then H)

a. b. c. d.

Does the problem involve permutations or combinations? Explain.

____ 23. In how many different ways could a committee of 5 students be chosen from a class of 25 students?

a. Permutations; the order matters.

b. Permutations; the order does not matter.

c. Combinations; the order does not matter.

d. Combinations; the order matters.

____ 24. In how many ways could six horses come in first, second or third in a race?

a. Combinations; the order does not matter.

b. Combinations; the order matters.

c. Permutations; the order does not matter.

d. Permutations; the order matters.

Is the sample described a good sample? Explain.

____ 25. To find the average number of shoppers in a particular store, shoppers are counted on two consecutive Saturday mornings.

a. No; the sample is not selected from the population to be studied.

b. No; the sample is not random.

c. Yes; the sample is selected at random from the population to be studied.

____ 26. You want to find out the favorite subjects of students at your school. Which plan describes a good sample?

a. Interview a group of students on their way to the library.

b. Interview students leaving a classroom.

c. Interview a group of students standing together in the hallway.

d. Interview every tenth student leaving an all-school assembly.

27. Short Answer

Tell whether the two ratios form a proportion. Explain.

28. Amy has a garden covering 900 square feet.

a. If she wants to plant moss roses on 10% of the garden, how many square feet will moss roses cover?

b. If the garden occupies 25% of Amy's yard, what is the area of her yard in square feet?

29. Caitlin had $402 in her bank account. She withdrew $15 each week to pay for a swimming lesson. She now has $237.

a. How many swimming lessons did she pay for?

b. At the time she had $237, the cost of a lesson rose to $19. How many lessons can she pay for with her remaining $237?

30. Display the data in a frequency table.

10 12 11 15 10 13 12 13 10 12

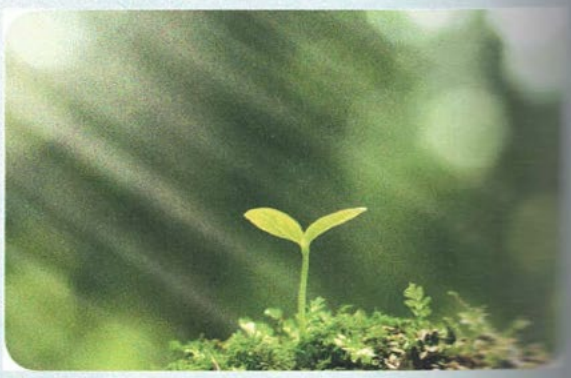
POSITIVE NORMS TO ENCOURAGE IN MATH CLASS

1. Everyone Can Learn Math to the Highest Levels.

   Encourage students to believe in themselves. There is no such thing as a "math person." Everyone can reach the highest levels they want to, with hard work.

2. Mistakes Are Valuable.

   Mistakes grow your brain! It is good to struggle and make mistakes.



3. Questions Are Really Important.

   Always ask questions, always answer questions. Ask yourself: why does that make sense?

4. Math Is about Creativity and Making Sense.

   Math is a very creative subject that is, at its core, about visualizing patterns and creating solution paths that others can see, discuss, and critique.

5. Math Is about Connections and Communicating.

   Math is a connected subject, and a form of communication. Represent math in different forms—such as words, a picture, a graph, an equation—and link them. Color code!

6. Depth Is Much More Important Than Speed.

   Top mathematicians, such as Laurent Schwartz, think slowly and deeply.

7. Math Class Is about Learning, Not Performing.

   Math is a growth subject; it takes time to learn, and it is all about effort.

Show What You Can Do Self-Assessment

What we value from an individual	Justify (if necessary)	
Perseverance • Did you stick with it? • Did you try something else? • Did you ask a question? • Did you describe where you're stuck?		Did it! Approved
Multiple Representations Words Pictures Charts Diagrams Graphs More than one solution process Data Table		Did it! Approved
Clear Expectations • Did you describe your thinking process? • How did you get your answer? *or* Where did you get stuck? • Ideas: arrows, color, words, numbers		Did it! Approved
Product • Did you complete the task, or where did you get stuck? • Did you give the task your best effort?		Did it! Approved

Source: From Ellen Crews.

Reflection

What was the big idea we worked on today?

What did I learn today?

What good ideas did I have today?

In what situations could I use the knowledge I learned today?

What questions do I have about today's work?

What new ideas do I have that this lesson made me think about?

Exit Ticket

Exit Ticket		**Name** **Date**
Three things I learned today …	Two things I found interesting …	One question I have …

Appendix H: Focus/Inattention Observational Checklist – Academic Engagement – Nonengagement Portion

Student Participant	**Engaging in out-of-seat behavior, physically touching another, and/or bodily fidgeting**	**Manipulating objects not related to task (twirling pencil, folding paper, etc.)**	**Making off-task audible sounds (humming, talking, call outs, etc.)**	**Passively listening, but not engaged (staring out window, looking around, etc.)**
Student A				
Student B				
Student C				
Student D				
Student E				
Student F				
Student G				
Student H				
Student I				
Student J				
Student K				
Student L				
Student M				
Student N				
Student O				
Student P				

Pearson. (2013). *Behavioral observation of students in schools (BOSS)*. Pearson, Inc.

Appendix I: Overview of Intervention Steps

The Guardian Angels Catholic Academy: Group A and Group B

Monday	Both Groups: Midyear Standardized Pre-Test: Administered by Researcher		• Teacher observations while researcher conducts lessons.
	Group A	Group B	• Daily follow-up debriefing interviews with teachers.
Tuesday	Lesson 1: Graphing Linear Functions instruction without self-regulation and mathematics mindsets interventions	Lesson 1: Graphing Linear Functions instruction with self-regulation and mathematics mindsets interventions	• Week 3 – Researcher conducts additional post-test with same skills as well as transferrable skills.
Wednesday	Lesson 2	Lesson 2	Final teacher interviews.
Thursday	Lesson 3	Lesson 3	
Friday	Both Groups: Midyear: Standardized Post-Test: Administered by Researcher		

Note: All lessons taught by researcher, are the same, except for embedded self-regulation and mathematic mindset strategies. Multiple lessons are needed to allow for skill acquisition.

Appendix J: Teacher Interview Questions

Debriefing questions after each lesson:

1. How engaged/focused do you think students were in the lesson today?
2. What factors do you think affected student engagement/focus and/or learning access in the lesson today?
3. What else did you notice regarding the student's engagement, presentation of the lesson, and/or students' acquisition of the skill being taught?

After follow-up extended post-test skill retention assessment:

1. To what extent has the intervention carried over beyond the lesson implementation?
2. (Present Findings) How did the outcomes relate to your observations during lesson implementation?
3. What limitations and/or additional supports do you need in order to use these outcomes to improve your students' self-regulation and overall learning access?
4. How has this project impacted your own educational practices?

Appendix K: School Climate and Culture Survey

The Guardian Angels Catholic Academy Climate Survey

Grades 6-8 Students

Please read each question carefully, and circle the number that matches your experiences and opinions. Thank you for taking the time to complete the survey.

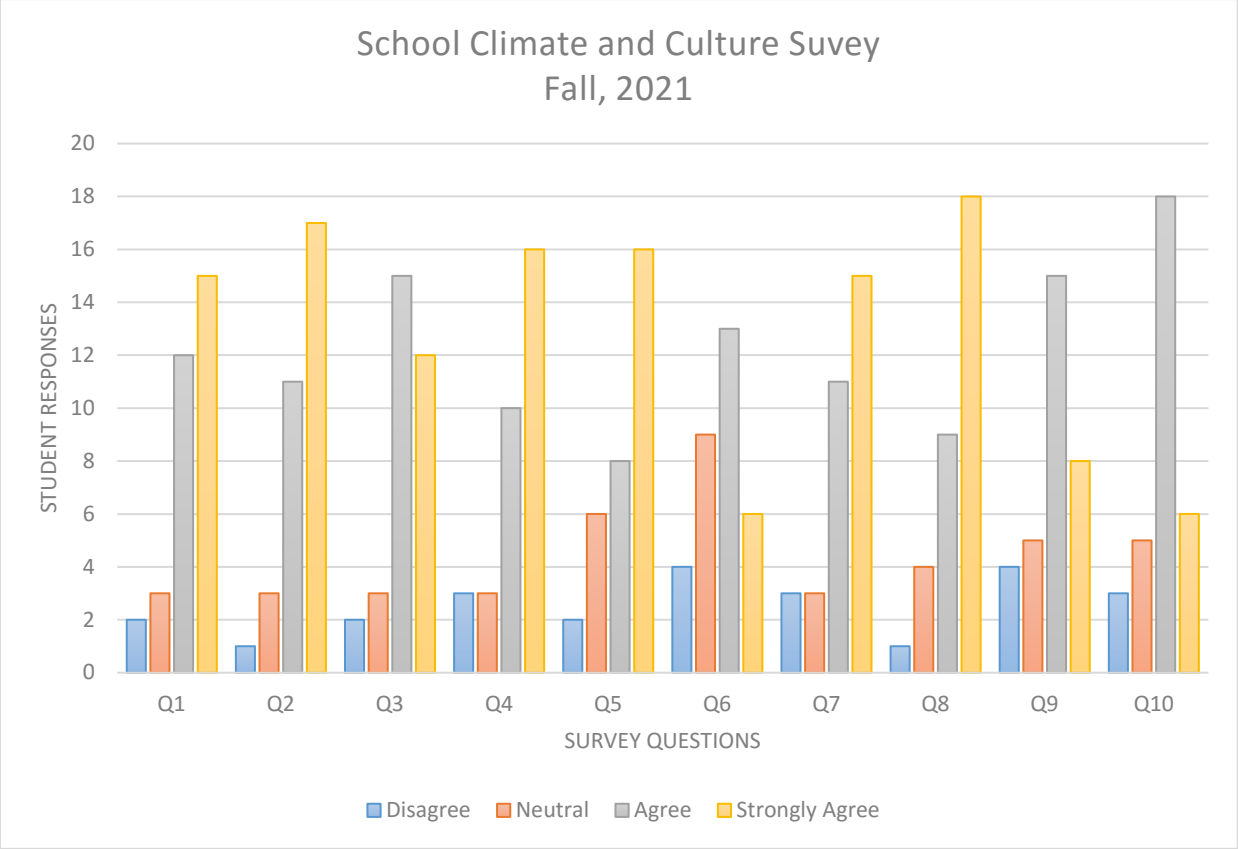
	Disagree		Neutral	Agree	Strongly Agree
1. The Guardian Angels Catholic Academy provides a welcoming environment	1	2	3	4	
2. The Guardian Angels Catholic Academy schedule allows adequate time for students to interact with peers.	1	2	3	4	
3. Students who disagreed with you, respected your views	1	2	3	4	
4. Students at The Guardian Angels Catholic Academy respect each other's differences.	1	2	3	4	
5. I feel supported and appropriately challenged at school.	1	2	3	4	
6. I feel safe outside on the school grounds.	1	2	3	4	
7. I feel safe in the hallways and bathrooms.	1	2	3	4	
8. I feel valued and appreciated in the classrooms.	1	2	3	4	
9. Students at The Guardian Angels Catholic Academy are well-behaved.	1	2	3	4	
10. Students learn in school ways to resolve disagreements with peers.	1	2	3	4	

PLEASE CONTINUE TO THE NEXT PAGE →

Please share any comment how much you agree or disagree with the following statements about your experiences at our school.

Figure 1B

School Climate and Culture Survey Fall, 2021



Note: See Appendix K for Survey Questions

Appendix L: Student Reflection Form

Student Reflection Form*

Student Code: Student C Grade: 6 Week: Jan 10 - 14, 2022

Day	How did I feel **before** my math class?	How did I feel **during** my math class?	How did I feel **after** my math class?
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			

* *The researcher developed the student reflection form.*