Examining the Effects of Mathematics Journals on Elementary Students' Mathematics Anxiety Levels

A dissertation presented to
the faculty of
The Patton College of Education of Ohio University

In partial fulfillment
of the requirements for the degree
Doctor of Philosophy

Trisken N. Emmert
May 2015
© 2015 Trisken N. Emmert. All Rights Reserved.
This dissertation titled

Examining the Effects of Mathematics Journals on Elementary Students' Mathematics Anxiety Levels

by

TRISKEN N. EMMERT

has been approved for

the Department of Teacher Education

and The Patton College of Education by

Eugene Geist

Associate Professor of Teacher Education

Renée A. Middleton

Dean, The Patton College of Education
Abstract

EMMERT, TRISKEN N., Ph.D., May 2015, Curriculum and Instruction

Examining the Effects of Mathematics Journals on Elementary Students' Mathematics Anxiety Levels

Director of Dissertation: Eugene Geist

Elementary students in the United States struggle with mathematics and a source is mathematics anxiety. Young students with mathematics anxiety often have decreased mathematics achievement, avoid higher-level mathematics courses and mathematical careers. The purpose of this quasi-experimental multi-method study was to examine the effects of mathematics journals on third-graders’ mathematics anxiety levels. The theoretical foundation of this study consisted of Vygotsky, Bruner, and Bronfenbrenner in accordance with an ethic of care, as proposed by Noddings and Collins. Thirty third-grade students completed the Anxiety Measure for pre and post-test; paired sample t-tests were used to analyze the results. The paired sample t-tests concluded that the Treatment Group had a statistically significant decrease from pre and post-test along with a statistically significant post-test between the Control and Treatment Group. The qualitative strand of the study for the Treatment Group consisted of researcher observations, researcher created daily mathematics prompts and mathematics thermometer to gauge students’ daily mathematics anxiety levels. Students’ physiological and psychological mathematics anxiety symptoms were recorded. Key results concluded that nine of the 22 days were categorized as high mathematics anxiety while 11 were low mathematics anxiety days. High mathematics anxiety days consisted of assessments, independent work, and little social interaction. Low mathematics anxiety days consisted
of group work, games, computer lab, interactive lessons, and social interaction. A conclusion from this study is that mathematics journals can assist in ameliorating mathematics anxiety in early childhood classrooms. It is recommended that schools schedule professional development to properly train teachers in the implementation of mathematics journals in an affective manner. The inclusion of emotions in mathematics is an outlet for students that can lead to mathematics anxiety reduction.
Dedication

I would like to dedicate my dissertation to the four most influential people in my life: my mom, dad, sister, and brother-in-law. You all have earned this degree as much as I have. Your love and support knows no boundaries.
Acknowledgments

It is with deepest gratitude and heartfelt emotion that I thank my committee members, Dr. Eugene Geist, Dr. Gregory Janson, Dr. Katharine Sprecher, and Dr. Krisanna Machtmes. Your input, guidance, and assistance throughout this process are sincerely appreciated, valued, and acknowledged. Thank you for believing in my idea and forging a new path in research. To Dr. Geist, my committee chair and advisor, thank you for allowing me to pursue my research interest, believing in me, and for the endless support through emails and meetings. You have given me the opportunity to grow professionally and personally in the field of higher education and I am forever grateful. To Dr. Janson, my Dean’s representative, for always having new ideas that helped to further my study and for critically analyzing my research approach. To Dr. Sprecher for her endless knowledge of feminist pedagogy and multicultural education. Thank you for always assisting me in my writing style and countless edits. To Dr. Machtmes for allowing me to utilize a mixed-methods approach and the many hours we spent analyzing the data.

The generosity and kindness of Dr. Gerardo Ramirez of the University of California - Los Angeles for allowing me to utilize his instrument, the Anxiety Measure, throughout the study.

I would like to thank Dr. Karen Oswald who I consider an “honorary” member of my committee for her countless pep talks, insight, support, and shoulder to lean on throughout the dissertation process.

I would like to thank my classmates who became my second family. I am honored to be your peer. Your knowledge and experience helped to shape my educational
philosophy and pedagogy. Thank you for the conversations, laughs, and most importantly the friendships along the way. I look forward to seeing all of your next career steps.

Finally to my mom, dad, sister, and brother-in-law who are my greatest support system. Thank you for always allowing me to follow my dreams no matter how impossible and insurmountable they appear. You all have taught me the value of hard work, selfless hearts, and persistence. The four have you have given me more love throughout this PhD journey than most people receive in a lifetime. Thank you for allowing me to constantly have my nose in a book, article, or computer over the past three years. I love you all and am ready for our next journey.
Table of Contents

Abstract ............................................................................................................................... 3
Dedication ........................................................................................................................... 5
List of Tables .................................................................................................................... 15
List of Figures ................................................................................................................... 18
Chapter 1: Introduction to Study ....................................................................................... 20
  Introduction ............................................................................................................... 20
  Mathematics Anxiety ............................................................................................... 21
  Problem Statement .................................................................................................... 26
Purpose of the Study ........................................................................................................ 27
  Quantitative ............................................................................................................... 27
  Qualitative .................................................................................................................. 28
Limitations ....................................................................................................................... 28
Definitions ....................................................................................................................... 29
Questions .......................................................................................................................... 29
Chapter 2: Literature Review and Theoretical Framework .............................................. 31
  Theoretical Framework ............................................................................................. 31
  Roots of Anxiety ........................................................................................................ 45
    General anxiety ....................................................................................................... 45
  Theoretical Foundation of Anxiety ......................................................................... 46
    Psychoanalytic theory of anxiety. ........................................................................... 46
    Learning/Behavioral theory of anxiety ................................................................. 48
    Physiological theory of anxiety ............................................................................ 48
    Phenomenological/Existential theory of anxiety ................................................... 49
    Cognitive theory of anxiety .................................................................................... 49
    Uncertainty theory of anxiety ............................................................................... 50
  Mathematics Anxiety ............................................................................................... 51
Mathematics Anxiety Theory ................................................................. 52
Causes of Mathematics Anxiety ............................................................. 53
  Origin of mathematics anxiety............................................................... 54
Difference between Anxiety and Mathematics Anxiety ....................... 58
Consequence of Mathematics Anxiety ................................................... 61
Diagnosis of Mathematics Anxiety ......................................................... 62
Exacerbation of Mathematics Anxiety .................................................... 64
Amelioration of Anxiety ......................................................................... 65
Mathematics Anxiety in Children ............................................................ 66
Mathematics Anxiety and the Brain ......................................................... 69
Reducing Mathematics Anxiety ............................................................... 71
Feminist Pedagogy .................................................................................. 75
  Feminist pedagogy roots ....................................................................... 75
  Characteristics of feminist pedagogy ..................................................... 76
  Ethic of care .......................................................................................... 79
  Following ideals .................................................................................... 89
Mathematics Journals ............................................................................ 90
Chapter 3: Methodology ........................................................................ 95
  Introduction to Methodology ................................................................. 95
  Ethnography and the Ethnographical Method ....................................... 95
  Ethical Concerns .................................................................................. 96
  Research Question and Hypothesis ....................................................... 96
  Design of the Study ............................................................................. 97
  Setting and Sample ............................................................................. 98
  Instrumentation ................................................................................... 100
    Questionnaire ................................................................................... 100
    Observation ...................................................................................... 102
    Mathematics journals ......................................................................... 103
  Confounding Variable of General Anxiety ........................................... 107
Paired Samples T-Tests........................................................................................................... 152
  Paired sample t-test for pre-test between control and fixed treatment........ 158
  Paired sample t-test for control. .............................................................................. 158
  Paired sample t-test for fixed treatment. ................................................................. 159
  Paired sample t-test for post-test between control and fixed treatment. ......... 160
Summary................................................................................................................................. 160
Qualitative Analysis............................................................................................................. 162
  Mathematics journals. .............................................................................................. 162
  Observations. .............................................................................................................. 163
  Control classroom. ..................................................................................................... 163
Day One ................................................................................................................................ 163
  End of day. .................................................................................................................. 165
Day Two .............................................................................................................................. 166
  End of day .................................................................................................................... 167
Day Three .......................................................................................................................... 168
  End of day .................................................................................................................... 169
Day Four ............................................................................................................................. 171
  Computation station ............................................................................................... 171
  Computers ................................................................................................................... 172
  Lesson .......................................................................................................................... 172
  End of the day .......................................................................................................... 173
Day Five ............................................................................................................................... 175
  Computation station ............................................................................................... 175
  Computers ................................................................................................................... 176
  Lesson .......................................................................................................................... 176
  End of day .................................................................................................................... 177
Day Six .................................................................................................................................. 179
  Computation station ............................................................................................... 179
  Computers ................................................................................................................... 179
List of Tables

Table 1: Summary of Normality Tests for Pre and Post-Test Control and Treatment Groups ...........................................................................................................................134

Table 2: Descriptive Statistics for Pre and Post-Test of Control and Treatment Groups ...................................................................................................................................135

Table 3: Description of Control Group Mathematics Anxiety Levels for Pre Anxiety Measure.........................................................................................................................137

Table 4: Description of Control Group Mathematics Anxiety Levels for Post Anxiety Measure..................................................................................................................................139

Table 5: Description of Treatment Group Mathematics Anxiety Levels for Pre Anxiety Measure.........................................................................................................................140

Table 6: Description of Treatment Group Mathematics Anxiety Levels for Post Anxiety Measure.........................................................................................................................143

Table 7: Descriptive Statistics and T-Test Results for Pre Test between Control and Treatment Groups........................................................................................................144

Table 8: Descriptive Statistics and T-Test Results for Pre and post-test Control Group .......................................................................................................................................145

Table 9: Descriptive Statistics and T-Test Results for Pre and Post-Test Treatment Group .......................................................................................................................................145

Table 10: Descriptive Statistics and T-Test Results for post-test between Control and Treatment Groups........................................................................................................146

Table 11: Summary of Normality Tests for Fixed Treatment Group ...........................................................................................................................151

Table 12: Descriptive Statistics for Pre and Post-Test of Control and Fixed Treatment Groups ...................................................................................................................................153

Table 13: Descriptive Statistics of Fixed Treatment Group Mathematics Anxiety Levels for Pre Anxiety Measure ........................................................................................................155

Table 14: Descriptive Statistics of Fixed Treatment Group Mathematics Anxiety Levels for Post Anxiety Measure ........................................................................................................157
Table 15: Descriptive Statistics and T-Test Results for Pre Test between Control and Fixed Treatment Groups ........................................................................................................158

Table 16: Descriptive Statistics and T-Test Results for Pre and post-test Control Group .......................................................................................................................................159

Table 17: Descriptive Statistics and T-Test Results for Pre and post-test Fixed Treatment Group ........................................................................................................................................159

Table 18: Descriptive Statistics and T-Test Results for post-test between Control and Fixed Treatment Groups ........................................................................................................160

Table 19: Summary of Descriptive Statistics for Pre and Post-Test Control, Treatment, and Fixed Treatment ..............................................................................................................................161

Table 20: Descriptive Statistics for Pre-Test Control and Treatment Groups ........................................................................................................................................161

Table 21: Descriptive Statistics for Post-Test Control and Treatment Groups ........................................................................................................................................162

Table 22: Mathematics Journal and Mathematics Thermometer Responses for Day 1 .......................................................................................................................................165

Table 23: Mathematics Journal and Mathematics Thermometer Responses for Day 2 .......................................................................................................................................167

Table 24: Mathematics Journal and Mathematics Thermometer Responses for Day 3 .......................................................................................................................................170

Table 25: Mathematics Journal and Mathematics Thermometer Responses for Day 4 .......................................................................................................................................174

Table 26: Mathematics Journal and Mathematics Thermometer Responses for Day 5 .......................................................................................................................................177

Table 27: Mathematics Journal and Mathematics Thermometer Responses for Day 6 .......................................................................................................................................182

Table 28: Mathematics Journal and Mathematics Thermometer Responses for Day 7 .......................................................................................................................................185

Table 29: Mathematics Journal and Mathematics Thermometer Responses for Day 8 .......................................................................................................................................188
Table 30: Mathematics Journal and Mathematics Thermometer Responses for Day 9.....                                                                                                                                                                      191
Table 31: Mathematics Journal and Mathematics Thermometer Responses for Day 10....                                                                                               194
Table 32: Mathematics Journal and Mathematics Thermometer Responses for Day 11...                                                                                                      198
Table 33: Mathematics Journal and Mathematics Thermometer Responses for Day 12....                                                                                                      200
Table 34: Mathematics Journal and Mathematics Thermometer Responses for Day 13...                                                                                                      204
Table 35: Mathematics Journal and Mathematics Thermometer Responses for Day 14...                                                                                                      207
Table 36: Mathematics Journal and Mathematics Thermometer Responses for Day 15...                                                                                                      210
Table 37: Mathematics Journal and Mathematics Thermometer Responses for Day 16...                                                                                                      214
Table 38: Mathematics Journal and Mathematics Thermometer Responses for Day 17...                                                                                                      216
Table 39: Mathematics Journal and Mathematics Thermometer Responses for Day 18...                                                                                                      220
Table 40: Mathematics Journal and Mathematics Thermometer Responses for Day 19...                                                                                                      223
Table 41: Mathematics Journal and Mathematics Thermometer Responses for Day 20...                                                                                                      226
Table 42: Mathematics Journal and Mathematics Thermometer Responses for Day 21...                                                                                                      229
Table 43: Mathematics Journal and Mathematics Thermometer Responses for Day 22...                                                                                                      231
Table 44: Daily Mathematics Anxiety Levels Determined by Mathematics Thermometer                                                                                                                                                                           233
List of Figures

Page

Figure 1: Conceptual Framework .................................................................43
Figure 2: Histogram for Pre Anxiety Measure Control Group ....................126
Figure 3: Boxplot for Pre Anxiety Measure Control Group .........................127
Figure 4: Normal Q-Q Plot for Pre Anxiety Measure Control Group ..........127
Figure 5: Histogram for Post Anxiety Measure Control Group ....................128
Figure 6: Normal Q-Q Plot for Post Anxiety Measure Control Group ..........129
Figure 7: Boxplot for Post Anxiety Measure Control Group .......................129
Figure 8: Histogram for Pre Anxiety Measure Treatment Group .................130
Figure 9: Boxplot for Pre Anxiety Measure Treatment Group ....................131
Figure 10: Normal Q-Q Plot for Post Anxiety Measure Treatment Group ....131
Figure 11: Histogram for Post Anxiety Measure Treatment Group ..............132
Figure 12: Normal Q-Q Plot for Post Anxiety Measure Treatment Group ....133
Figure 13: Boxplot for Post Anxiety Measure Treatment Group .................133
Figure 14: Histogram for Pre Anxiety Measure Fixed Treatment Group ..........148
Figure 15: Normal Q-Q Plot for Pre Anxiety Measure Fixed Treatment Group ....148
Figure 16: Boxplot for Pre Anxiety Measure Fixed Treatment Group ..........149
Figure 17: Histogram for Post Anxiety Measure Fixed Treatment Group ........150
Figure 18: Normal Q-Q Plot for Post Anxiety Measure Fixed Treatment Group ....150
Figure 19: Boxplot for Post Anxiety Measure Fixed Treatment Group .........151
Figure 20: Number Balance Puzzle Example .............................................164
Figure 21: Faces for Mathematics Journal Prompt Day 6 ..........................181
Figure 22: Faces for Mathematics Journal Prompt Day 6 ............................................197
Figure 23: Faces for Mathematics Journal Prompt Day 16 ...........................................213
Figure 24: Faces for Mathematics Journal Prompt Day 20 ..........................................226
Chapter 1: Introduction to Study

Introduction

In the United States, positive experiences with mathematics are only reported by 7% of Americans (Furner and Duffy, 2002). In America, there is the stigmatization that people are born with a mathematics gene, and only certain individuals can succeed with the subject (Devlin, 2000). The negative outlook impacts the educational system in a detrimental manner causing students to avoid mathematics classes, defer to fewer mathematical jobs in their future, and view mathematics as pointless.

Mathematics is stigmatized by how it is presented. School mathematics is a broken version of the subject and has little connection to the subject (Boaler, 2008). Mathematics taught in the classroom is in conflict with the mathematics that is used outside of school. Students often graduate unpreparedly for the world. Many students regard the school classroom as a separate entity from the rest of the world. They are unable to carry and apply this knowledge to a real-world context (Boaler, 2008). Children's interest and achievement are at a low, but that is not the root of the problem. The majority of adults dislike mathematics and will go to all costs to avoid it. Their disposition is in turn being trickled down to their sons and daughters (Boaler, 2008).

Instructional strategies, teacher attitudes, parental dispositions and mathematics curriculum are factors that can alleviate or exacerbate mathematics anxiety in young children (Hembree, 1990). A positive relationship will result in students who are confident in mathematics and enjoy the subject, whereas a negative relationship can cause avoidance and anxiety about the subject (Ashcraft & Moore, 2009). It is pivotal for
elementary students to have positive experiences with mathematics to build a firm foundation for the subject (Ashcraft, 2002).

Mathematics Anxiety

Many young children in public education are suffering from mathematics anxiety. A set definition has not been created for the phobia. Mathematics anxiety defined by Richardson & Woolfolk (as cited in Maloney, Risko, Ansari & Fugelsang, 2010) is a condition, “which individuals experience negative affect when engaging in tasks demanding numerical and mathematical skills” (p. 293). Tobias (1987) described it as “sudden death” when they reach a skill that does not come easy. Mathematics anxiety is an emotional condition and one not concerned with intellectual ability. When discussing mathematical anxiety, it entails the affective domain of a person. Tobias and Weissbrod (1980) defined the term as “the panic, paralysis and mental disorganization that arises among some people when they are required to solve a mathematical problem” (p. 65). From an emotional standpoint, Spicer (2004) stated it as “an emotion that blocks a person’s reasoning ability when confronted with a mathematical situation” (p. 1). However, the most prevalent definition utilized in research is one composed by Richardson and Suinn (1972) viewing the condition as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of ordinary life and academic situations” (p. 551).

Myriad causes of mathematics anxiety range from socioeconomic status to parental background to instructional strategies. Those who suffer from mathematics anxiety can have a variety of symptoms that are psychological or physiological. Psychological symptoms include feeling helpless, disgrace, and being unable to cope
(Plaisance, 2009). Under the physiological domain, individuals will have an increased heart rate, clammy hands, upset stomach, and lightheadedness (Plaisance, 2009).

Statistical evidence has shown that 20% or 1 in 5 individuals, suffer from psychological or physiological symptoms of anxiety when handling numerical information (Eden, Heine & Jacobs, 2013; Ashcraft & Kirk, 2001). The drastic statistic provides evidence that mathematics anxiety is an epidemic that is affecting society. Mathematics anxiety begins early and is caused by a number of intertwining influences (Lyons & Beilock, 2012). Wu, Barth, Amin, Malcarne, & Menon (2012) demonstrated that mathematics anxiety in primary grade children was not only present as early as 2nd grade, but that it had a marked detrimental effect on the subjects achievement in mathematics. Students with mathematics anxiety often have lower test scores and achievement (Ashcraft & Moore, 2009).

The United States could improve student mathematics proficiency and experience an increase in its annual GDP growth per capita. A report from 2011 reported that if students in the United States increased their performance on the PISA to that of Canada and Korea then the growth rate in America would be 0.9 and 1.3 percentage points, respectively (Peterson, Woessmann, Hanushek, & Lastra-Anadon, 2011). Currently, annual growth rates are between two and three percent, and the proposed increment would increase rates to between 30 and 50 percent. In terms of monetary projected value over the next 80 years the United States would gain $75 trillion, roughly $1 trillion a year. Students' mathematics performance in the early grades is pivotal to boosting the American economy (Peterson, Woessmann, Hanushek, & Lastra-Anadon, 2011).
The fear and anxiety of mathematics impedes mathematics achievement and has wider consequences than attainment in the content area. Some individuals who have mathematics anxiety are put in the position to teach mathematics to the next generation. Often for elementary school teachers this is the case. The majority of elementary education majors are female and are reported to have the highest level of mathematics anxiety (Beilock, Gunderson, Ramirez & Levine, 2010).

Student performance in mathematics improves when anxiety is alleviated in the classroom (Ashcraft, 2002). Methods to ameliorate anxiety in the classroom include teacher enthusiasm and content competence, curriculum that is mathematics relevant, effective teaching strategies, inquiry classrooms, and a variety of assessments (Shields, 2005).

Mathematics anxiety has been studied from various viewpoints utilizing quantitative and qualitative methods. Research has been conducted with practicing teachers, pre-service teachers, and K-12 students. When students are taken into account, the majority of work has been placed on middle and high school students. Those studies that involve children, grades K-5, are focused upon pinpointing, which students have mathematics anxiety. Hembree (1990) conducted a meta-analysis of mathematics anxiety research to determine the onset of the phobia. At the time of the study there was no data for elementary grades, K-5. The analysis concluded that mathematics anxiety levels rise starting from 6th grade and peak at 9th grade. A lack of studies with children hinders the ability to locate the onset age of mathematics anxiety. Ramirez, Gunderson, Levine and Beilock (2013) and Harari, Vukovic and Bailey (2013) have shown that mathematics
anxiety can be detected as young as first grade. Studies conducted with 2\textsuperscript{nd} to 4\textsuperscript{th} graders have shown similar results (Gierl & Bisanz, 1995; Krizinger, Kaufmann & Willmes, 2009; Newstead, 1998; Wu, Barth, Amin, Malcome & Menon, 2012). Various work has been completed but there is a lack of methods to alleviate the anxiety in young children. It is important to study mathematics anxiety at this young age to prevent it from increasing with age and maturation. When a student overcomes mathematics anxiety, their achievement can increase from the 50\textsuperscript{th} percentile to the 71\textsuperscript{st} percentile (Ma, 1999).

The culture of the United States is abundant in mathematics anxiety implications. Mathematics is presented as being inherently difficult, one's achievement is valued over effort and the subject is considered to be unimportant and optional in one's life (Ashcraft, 2002). The common myths surrounding mathematics are that there is a mathematics gene, men are better than women at mathematics, mathematics is instantaneous, only one solution is acceptable per problem, and if one succeeds in the language arts then you are bound to fail at mathematics. With these detrimental attitudes, modern society is advancing with technology and data that are in opposition to societal beliefs. American students are not being acclimated to the level of numeracy to thrive in the real world.

Individuals are not comfortable with mathematics yet the world is moving towards more technological advances. The discomfort with mathematics is a hindrance to the advancement of the country. The U.S. Department of Education has issued a plan to increase rigor and achievement of American students in Science, Technology, Engineering and Mathematics (STEM) classes (Committee on STEM Education, 2013). The overarching goal is for Americans to succeed in these departments and enrich the
economy. Schools have begun to focus on these subjects with high intensity, and the evidence is prominent in the media. From a young age, children are being exposed to STEM education as early as preschool. It is under the philosophy that the earlier the exposure, the more familiar they will be with the topics.

According to the Nation's Report Card students are improving in mathematics achievement (National Center for Education Statistics, 2013). As of 2013, scores were higher than any other year. A closer analysis of the trend concludes that our students plateaued in scores beginning in 2005. Overall from 2005 to 2013, students have increased scores from 238 to 242, respectively. The increase is not as impressive when taken from this perspective (National Center for Education Statistics, 2013).

The 2012 Program for International Student Assessment (PISA) was conducted in sixty-five countries worldwide, the United States ranked thirty-six. Students from the United States and 39 other countries were given a mathematical problem-solving test in 2004, which the US scored 29th. The low ranking concurs that American pupils struggle with the problem-solving aspect (Boaler, 2008). The Trends in Mathematical and Science Study (TIMSS) in 2011 showed that mathematical scores from 4th grade to 8th grade decline (Provasnik, Kastberg, Ferraro, Lemanski, Roey, & Jenkins, 2012). The synthesized results concluded that although the United States has issued a call for more STEM courses. Moreover, PISA results have suggested that students’ socioeconomic status correlate with their achievement, in that higher socioeconomic statuses tend to outperform those from a lower socioeconomic status.
Problem Statement

The primary purpose of this study is to examine the use of reflecting in daily mathematics journals on the anxiety level of the participating students. Mathematics anxiety is an epidemic that is sweeping the nation affecting adults and children. It is cyclical in nature with parents or teachers permeating the anxiety to the youth. Young children are disadvantaged initially from societal implications, cultural stereotypes and negative attitudes towards mathematics. It has become accepted and glorified to dislike mathematics due to the myths surrounding the subject. Children need to be given a fair starting point with mathematics, which entails a conducive learning environment. Techniques need to be utilized to assist in the alleviation or prevention of mathematics anxiety. If they are not given these proper tools from the beginning then a snowball effect will likely occur (Ashcraft, 2002). Children will continue to hate mathematics and be anxious about the subject. Once this anxiety has been sown, it is hard to digress. Therefore, eliminating mathematics anxiety must begin from the elementary grades.

A means to counter these negative emotions and attitudes is through journal writing (Maloney & Beilock, 2012). The opportunity to express one's emotions allows for one to alleviate the burden placed upon the mind with negativity. People can re-evaluate the situation and create alternative means to a problem. Park, Ramirez, and Beilock (2011) have found that writing about worries of mathematics resulted in an increase in mathematics test scores.

This study addresses the problem of mathematics anxiety experienced by third-grade students. The anxiety level will be determined by the Anxiety Measure (AM) prior to the treatment. The literature review confirmed that mathematics anxiety does not have
a set definition and the onset and symptoms vary by individual. Through the use of mathematics journals in the mathematics classroom, the ideal situation was to identify a positive change in the Grade 3 mathematics anxiety levels. Both classroom teachers had not used mathematics journals in their curriculum prior to the experiment. The hypothesis of the study involved whether or not using mathematics journals in the classroom would lessen mathematics anxiety in the Grade 3 students.

**Purpose of the Study**

This study focused on third-graders in a rural Midwest elementary school in the United States. The present study was a quasi-experimental multi-method design utilizing ethnography as the qualitative foundation. The quasi-experimental study will employ conceptual problems, mathematics journals and the Anxiety Measure (AM). For this experiment, the third-grade classroom will be considered a culture. Each classroom has a particular approach to education that is unique to each individual classroom. The AM was used to identify mathematics anxiety levels of students in the treatment and control group. Students in both groups were given a conceptual problem to solve at the beginning and end of the treatment.

**Quantitative.** Two third-grade classrooms within the same school were the Control and Treatment group in this study. At the beginning and end of the study, students were given the Anxiety Measure (AM) to designate their individual baseline for mathematics anxiety. AM is composed of 16 items that pose questions pertaining to mathematical tasks and situations in the classroom. Third-graders in both classrooms were given the AM pre and post treatment to determine whether there was a change in their mathematics anxiety level.
Qualitative. The control and treatment group were taught in the manner of the classroom teacher. Students in the treatment group were each given a mathematics journal to document their feelings and attitudes towards mathematics daily. A “Mathematics Thermometer” was provided daily for students to designate where they fell on the scale ranging from 0 to 10. The self-assessment allowed for students to be aware of their anxiety as well as see a longitudinal progression. Students will be given a daily prompt to monitor their feelings and attitudes towards mathematics. Instruction of the Control group was identical to the instruction in the Treatment group. The students in the control group did not receive mathematics journals to document their daily reflections about mathematics. Moreover, the researcher will be in the classroom daily during the experiment to conduct observations that focus on body language of children throughout the mathematics lesson. Assessment will be configured through the same conceptual problem being given at the beginning and end of the treatment.

Limitations

- Test anxiety is a limitation of this study. Like most subjects, mathematics requires tests to gauge achievement. A correlation exists between mathematics anxiety and test anxiety. However, this study will not take into account test anxiety. Mathematics anxiety is an affective reaction, whereas test anxiety is a cognitive reaction.
- The small sample size creates difficulties in generalizing the findings.
- Control and experimental groups are not randomly assigned but in-tact groups created by the elementary school.
• Data collection was over a month-long period. The short instruction time may not allow for attitudinal changes in mathematics.

Definitions

1. Mathematics anxiety: for this study the definition by Richardson and Suinn (1972) will be utilized, “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of ordinary life and academic situations” (p. 551).

2. Conceptual understanding: According to Adding It Up (2001) it is defined as “the comprehension of mathematical concepts, operations, and relations” (p. 118). Students can connect their mathematical knowledge to different topics to further their knowledge. Procedures are taught with understanding and make it easier for students to remember and connect with topics.

3. AM: Anxiety Measure, developed by Ramirez and Beilock in 2014, composed of 16 questions is used to assess mathematics anxiety in early childhood students.

Questions

1. Will there be a significant difference between third-grade students using mathematics journals and third-grade students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure?

   Hₐ: There will be no significant difference between using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.
$H_1$: There will be a significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.

2. Does having students keep mathematics journals decrease the amount of mathematical anxiety in third-grade students as measured through observation and mathematics journals?
Chapter 2: Literature Review and Theoretical Framework

Theoretical Framework

The theoretical framework for this study will utilize Vygotsky, neo-Vygotskians Tharp and Gallimore, Bruner, and Bronfenbrenner. The culmination of these theorists creates a lens and foundation for beginning to understand mathematics anxiety in the early childhood classroom.

Human development is achieved through social interaction (Vygotsky, 1987). Education is the result of social learning through interactions of culture and social relationships. Human cognitive development is a process that is unique to each person (Vygotsky, 1987). Mediation is a teaching method that involves educating and transforming knowledge by means of socialization (Vygotsky, 1987). The teacher does not bestow content; rather transmits learning through social interactions in the classroom (Vygotsky, 1987).

Before the instruction can take place in the classroom setting, teachers must know their students backgrounds. Bronfenbrenner’s “Ecological Systems Theory” takes into account the various facets of individuals' lives (Bronfenbrenner, 1979). The five systems proposed by Bronfenbrenner contribute to the development of every student and influence various means of learning. The microsystem includes the institutions that are closest to the child, in this case, the school. Children are placed in a classroom that becomes their microsystem for the school year and create its culture. The mesosystem’s composition is the connections between the microsystems, such as between the classroom teacher and students' families. Teachers must be aware of students’ home culture and values to implement proper instruction. It is efficacious to have a strong mesosystem to
inform classroom instruction. The exosystem refers to the institution, which the child has no involvement. Teachers' planning composes this level of the system. Direct student involvement does not occur in the lesson planning, but they are direct recipients of the material. The macrosystem is comparable to a shell that is a collection of cultural values and beliefs of students' families and geographic location. Educators must be aware of the demographics and students' lives outside of school to create connections between content and their personal lives. The outermost layer, chronosystem, refers to timely events that may affect a child, such as parental divorce or physiological changes that will vary their reactions to events. A student's physiological changes may deviate by subject-matter and teachers must be cognizant of the varying reactions by pupils. The quality and context of the interaction amongst the five systems is crucial for child development. A valuable learning environment that takes into account students' backgrounds, differences, learning styles, and individuality bolsters the academic pursuits (Bronfenbrenner, 1979). Broader institutions and cultural domains influence students' thinking, not just the classroom (Berk & Winsler, 1995). Children bring assumptions and experiences from prior social experiences that formulate their cognitive, social, and affective facets. Learning environments must be conducive to pupils' social histories and cultural backgrounds (Berk & Winsler, 1995).

Development precedes learning through interactions between one’s cognition and social communications (Vygotsky, 1987). Vygotsky (1987) claimed "learning is a necessary and universal aspect of the process of developing culturally organized, specifically human psychological function” (p. 90). Students must be able to describe their learning on an in-depth level.
Throughout the learning process, discussion should be a pivotal component of learning (Collins, 1990; Noddings, 2012). The time allotted for a productive discussion is priceless. Students can verbalize the material they have processed and share their thoughts with peers. In today's society, there is a struggle with children being able to make reasoning about the processes. Many can complete the mechanics but without evidence to support it. The algorithms are being utilized with the repression of reasoning. A discussion opens up the lines of communication and encourages pupils to use words to describe the process (Noddings, 2012).

Society and culture promote cognitive development through culturally specific tools and signs (Vygotsky, 2012). A tool is considered to be externally oriented. It affords the opportunity for the modification of reality of the social and physical world. On the other hand, a sign is internally oriented and individuals can self-regulate. Children’s cognitive development is promoted through activities designed by adults in society (Vygotsky, 2012). Bruner (1961) and Vygotsky (1987) emphasized a child's environment, namely the social environment.

Vygotsky (1987) proposed that the most important aspect of language was “communication, social contact, influencing surrounding individuals” (p. 45). Signs are further developed through social interaction. Language is first a means of communication that formulate stances leading to intra-communication. Communication in the classroom allows students to express their individual knowledge that can increase academic development (Vygotsky, 1987).

According to Vygotsky (1987) there are two types of mental functions: elementary and higher. Elementary mental functions are genetic and confined to an
individual’s heredity and restricted to the setting. The four elementary functions are
attention, sensation, memory, and perception. The higher mental functions are acquired
and developed through social interaction of a particular culture. Higher mental functions
are culturally mediated. Greater social interaction, more knowledge, more possibilities
for action, more robust mental functions lead to higher mental functions (Vygotsky,
1987).

For Vygotsky principles and concepts appear twice in learning, first as social
(interpsychology) then on an individual level (intrapsychology). Development and social
context cannot be separated. Learning environments promote the synergy between
individuals and authentic tools (Vygotsky, 2012). The mathematics classroom must
involve pupils in a genuine manner that allows them to utilize speech, writing and
symbols properly.

The Zone of Proximal Development (ZPD) is “the distance between the actual
development level as determined by independent problem solving and the level of
potential development as determined through problem solving under adult guidance, or in
collaboration with a more capable peer” (Vygotsky, 1978, p.86). The interaction,
collaboration and discussion with peers, is an effective way of developing these skills.
ZPD contains two levels, 1) the present level of development the child can do without
help and 2) the potential level of development children cannot do alone; the gap between
1 and 2 is the ZPD (Vygotsky, 1987). Cooperative learning is a tool that can be used in
the curriculum to assist pupils in comprehending the material.

Intelligence is formed through instruction, but the teacher is not the only
individual to transmit knowledge (Vygotsky, 2012). A More Knowledgeable Other
(MKO) was essential to the development and can be a teacher, parent, adult, peer, or children. Children’s knowledge and skills are valued in the classroom (Vygotsky, 2012). Education should create experiences that are just outside of the child's development that can be accomplished with the guidance of more knowledgeable others (Berk & Winsler, 1995). The teacher's primary role is to develop tasks that will challenge students to further their achievement (Berk & Winsler, 1995). Cognition is contextualized, developing from children's socializations and activities. Interact with a more knowledgeable allows children to take part in a challenging task while learning their community’s cultural values (Berk & Winsler, 1995).

More recently, two Neo-Vygotskian's have contributed to the ZPD and added four stages for clarification. The four stages are: Stage 1, an individual's performance assisted by others; Stage 2, an individual's performance assisted by the self; Stage 3, where performance becomes automatized; and Stage 4, “where de-automization of performance leads to recursion back through the ZPD” (Tharp & Gallimore, 1988, p. 38). Six methods of assistance have been theorized, “modeling, contingency management, feedback, instruction on what to do, questioning and cognitive structuring” (Tharp & Gallimore, 1988, p. 47). The strategies assist in building critical-thinking and conceptual understanding of mathematics. Through these various techniques, a stronger foundation will be constructed.

Berk (1993) proposed the following guidelines for effective scaffolding within the Zone of Proximal Development:

Joint Problem Solving, engagement in an interesting and culturally meaningful, collaborative problem-solving activity. Intersubjectivity: process whereby two
participants who begin in a task with a different understanding arrive at a shared understanding. Warmth and responsiveness: the emotional tone of the interaction. Keeping the child in the ZPD: achieved by 1) structuring the task and the surrounding environment so that the demands on the child at any given time are at an appropriately challenging level, and 2) constantly adjusting the amount of adult intervention to the child's current needs. Promoting self-regulation: children regulate the joint activity as much as possible. (p. 324)

The establishment of a warm and responsive environment is not “on top” of other things but is the foundation of teaching (Noddings, 2012). A safe and secure climate is an outlet for students to express their attitudes and feelings while being valued within the classroom community. Emotions expressed by students must be validated and accepted (Collins, 1990). Intellect and emotion are not separate entities but form a holistic view of the child (Collins, 1990).

Like Vygotsky, Bruner supported the usage of a more knowledgeable other through the process of scaffolding. Bruner posited that through assistance one will construct knowledge. Once this knowledge is familiar, then the scaffolding will be less frequent and gradually disperse. The concept of scaffolding mirrors Vygotsky's zone of proximal development, often used synonymously. “[Scaffolding] refers to the steps taken to reduce the degrees of freedom in carrying out some task so that the child can concentrate on the difficult skill she is in the process of acquiring” (Bruner, 1978, p. 19). Classrooms can implement guided participation to stimulate cognitive growth (Rogoff, 1990). A culturally guided activity, such as mathematics, can strengthen students' cognition with guidance and support from more knowledgeable others transmitting a
myriad of strategies and skills. Diaz (1990) proposed the zone of executive functioning that permits children to grapple with the material, and the teacher only intervenes when the student is truly stuck. Conceptual questions posed by teachers and MKOs allows children to think independently and utilize higher mental functions.

The teacher's instruction focuses on the experiences and contexts that create readiness and make the student willing and able to learn. Teacher instruction should be designed to grasp the material quickly as well as facilitate exploration to fill in the gaps. Teachers must support students to discover new information on their own and through discussion with peers and the teacher. Bruner, Olver, Greenfield, and Hornsby’s (1966) theory includes: “(1) predisposition towards learning, (2) the ways, which a body of knowledge can be structured so that it can be most readily grasped by the learner, (3) the most effective sequences, which to present material, and (4) the nature and pacing of rewards and punishments” (p.62). Bruner (1961) proposed that learners’ construct their knowledge through organization and categorization of information using a coding system. The creation of coding is through exploration and discovery as opposed to aggregation. Discovery learning, much like constructivist learning, allows students to create their knowledge.

According to Bruner, there are three stages of intellectual development: enactive, iconic, and symbolic (Bruner, 1966). The enactive form knowledge is through motor responses of students physically completing a task rather than describing it. Logical-mathematical knowledge is relationships created by individuals (Bringuier & Piaget, 1980). Each relationship will be different for every child. A lack of logical-mathematical knowledge from the instruction, then students are only able to give physical and
empirical responses that do not promote higher-order thinking. When children can construct their knowledge, they reinvent the mathematics and make meaningful connections (Bringuier & Piaget, 1980).

The iconic stage comprises visual images (Bruner, 1966). The stage helps students begin to see that the connection between symbols, pictures or numbers, to the manipulatives. Development is furthered by having students do mathematics problems without the use of manipulatives. Students can represent their thinking on paper, which can take time. The teacher must be patient with the process and allow students to create their symbols and processes. The pupils are exploring mathematics through their curiosity and unique thinking (Bruner, 1966).

Knowledge in the symbolic stage encompasses words, numbers, or symbols (Bruner, 1966). Mathematical symbols possess meanings in mathematics and language. The introduction of a "standard algorithm" begins at this stage. Students can become comfortable with the algorithm and understand its meaning. Students begin to have independence. The progression of the three stages assists in students forming strong foundational mathematical skills (Bruner, 1966).

The three stages allow the teacher to be a member of the learning community (Bruner, 1966). Children need to be able to express their ideas and processes to the teacher so that they are better able to verbalize their procedures while deepening their cognition. Teachers should be interested in what their students are learning and become excited about it. If students see their instructor's excitement about the knowledge, then they too will want to learn. Teachers should use guiding questions to further student knowledge. Questions as simple as "why" or "how" require students to explain their
thinking and better understand the procedure. The act of questioning can lead to greater student achievement (Boaler, 2010). Students also learn reasoning through being asked questions that helps them to clarify their thinking and make sense of mathematics rather than seeing it as a list of procedures (Boaler, 2010). The role of the teacher is not to relay information by rote learning or the banking model of education, but instead to facilitate the learning process. Teachers design lessons that promote discovery through uncovering relationships amongst the content. Students are given the information they need but without the proper organization (Bruner, 1961).

Bruner's learning theory has direct implications for the learning process. The instruction must be at the appropriate level for all learners. Teachers must plan lessons that allow all students to participate and grasp the material through multiple methods or an open-ended problem that allows for various entries or solutions. Students’ involvement in using their prior experiences and structures to create new knowledge is pivotal for the classroom environment (Bruner, J. S., Olver, R. R., Greenfield, P. M., & Hornsby, 1966).

Jerome S. Bruner created a curriculum that was engaging, used multiple methods of instruction and allowed for critical-thinking. Bruner, Olver, Greenfield, and Hornsby, (1966) stated, "...success in teaching depends upon making it possible for children to have a sense of their interaction" (p. 79). Students must feel valued in the teaching process as opposed to bystanders. Instead of direct instruction, students will be hands-on and interacting with the material in an engaging manner. Children will be permitted to discover on their own. Students should have the freedom and opportunity to comprehend the material in their manner. Bruner's learning theory called for an active learning
process. Students should be able to select and transform the content. Children in the classroom create hypotheses and test if they are effective for the problem. When formulating ideas pupils are utilizing their prior experience and knowledge to develop the new content.

The teacher instruction includes the experiences and contexts that create readiness and make the student willing and able to learn. Instruction allows students to grasp the material as well as facilitate exploration to fill in the gaps. Teachers must support students to discover new information on their own and through discussion with peers and the teacher.

In Vygotsky’s theory, there are three stages of speech: social, egocentric, and inner. During social speech, children utilize their communication for simple thoughts and emotions. Egocentric speech encompasses children talking aloud to themselves. Children are typically in the age range of three to seven and will talk to themselves despite no one being around in order to guide their behavior. Inner speech is the last stage and comprises higher mental functions. It is here that children and adults can direct their behavior internally as opposed to externally, as in the second, stage (Vygotsky, 1987). This study takes into account the second and third stage of speech. Through discussions, children can talk themselves through the mathematical process that will assist in clarifying mistakes or strengthen their understanding. Children utilize inner speech when working individually on a problem. A child must be able to describe their thought process externally and internally to conceptualize the mathematical material.

The stages of speech are related to mathematical journaling. Children must begin the introspection process in order to become self-aware. The process allows them to
monitor their feelings, attitudes and inclinations towards a particular context. Journal writing allows for students to collect their fragmented thoughts into cohesive pieces. A journal assists in organizing their inner thoughts promoting their verbal fluency. The process of journal writing connects perceptions to the reality. Students can begin to process their anxiety about mathematics and in turn begin to pinpoint the effects in reality.

Vygotsky's (2012) stages of speech are related journal writing for mathematics. Children must begin the introspection process in order to become self-aware. Journal writing allows for students to collect their fragmented thoughts into cohesive pieces. A journal assists in organizing their inner thoughts promoting their verbal fluency. The process of journal writing connects perceptions to the reality. Students can begin to process their anxiety about mathematics and in turn begin to pinpoint the effects in reality.

Journal writing is a method utilized to mitigate negative experiences and thoughts. The opportunity to write short expressive pieces has shown to minimize deficits of test performance, especially for students with mathematics anxiety (Ramirez & Beilock, 2011). Being able to express concerns or worries accounts for students feeling more comfortable with a test. Ramirez and Beilock (2011) concluded that, "one short writing intervention that brings testing pressures to the forefront enhances the likelihood of excelling, rather than failing, under pressure" (p. 15). Distress and anxiety can be reduced through writing about emotional topics, such as mathematics anxiety (Pennebaker, 1997; Smythe, 1998). A link between increased academic performance and writing about emotional topics has also been found (Pennebaker, 1997), meaning that students who can
write about emotional experiences are more apt to have higher grades. When a child holds onto negative emotions and feelings, it is stressful but when they can express their feelings it should reduce the stress and anxiety (Pennebaker, 1989).

Private speech is a means to communicate with oneself and learning to self-regulate. When a child is able to guide their own thinking process and actions then they are better able to critically think about material (Vygotsky, 1986). Self-regulation allows children to monitor their emotional reactions (Thompson, 1990), which takes place in the child's chronosystem (Bronfenbrenner, 1979). Private speech is heavily utilized during difficult tasks. Students who are struggling with a task will either talk themselves through the problem or interact with a peer in order to reach a solution. A learning environment that allows children to verbally express their thinking is associated with task improvement (Berk & Winsler, 1995). The gap between social and psychological domains in a child is bridged through children's private speech. Once this bridge has been built then independent thinking, effective writing, and higher mental functions are utilized.

Vygotsky (1987) surmised that learning would be threatened with the presence of tension and anxiety. When mathematics anxiety is present it affects the way children interact with peers and the material. In order to reduce these effects a conducive environment must be present at all times. Past experiences must be taken into account for mathematics anxiety due to the factors they introduce. The combination of teacher and parental beliefs, attitudes and anxiety about mathematics permeate to students and affect their outlook on the subject.
Figure 1. Conceptual Framework.
A conceptual model, Figure 1, was designed for this study from previous findings stated in the literature review in conjunction with the purpose of the study. The conceptual model was a basis for bounding and focusing the data. The design model represented the literature about mathematics anxiety and young children in elementary schools. The data collection was bound through the themes and informed the observation protocol, mathematics journal prompts, and interview questions.

The themes related to mathematics anxiety and young children are drop in performance, low self-esteem, avoidance of mathematics, and harming of a child's social and emotional well-being. The literature affirmed that these effects can be caused by teacher beliefs, instructional strategies, parental beliefs and societal stigma. Only the first two causes can be taken into account for this study. The effects and two causes helped to formulate instructional strategies that can be implemented to alleviate mathematics anxiety in a third-grade classroom. The model served to bind the data and served as a starting point to understand the domain.

The foundation of mathematics anxiety is personality, parental beliefs, teacher beliefs, teaching strategies, and societal beliefs. Each component equivocates to part of each student's ecological system with personality being the microsystem and expanding to the exosystem, societal beliefs. Every student has a mathematics anxiety foundation from these factors even if they are unaware of their presence. It is through the combination of feminist pedagogy, constructivist classroom, and contextual and conceptual problems that will create a warm, caring environment for students to thrive. Students can express their emotions ranging from positive to negative in their mathematics journals. Emotions may change daily, and it is through the mathematics
journal that they can document their reactions. Through this self-reflection, children will reduce their level of mathematics anxiety by becoming aware of the factors that contribute to the exacerbation.

**Roots of Anxiety**

**General anxiety.** In order to identify mathematics anxiety one must have a foundation of anxiety. Anxiety is the most prevalent psychiatric disorder in the world and in the United States an estimated 28% of adults have experienced it in their lifetime (Vanin, 2008). Children can also experience anxiety disorders at a young age. Generalized anxiety disorders first emerge at 5.8 years, specific phobia around 6.3 years and for social phobia at the age of 7.3 years (Costello, Egger & Angold, 2004; Harari, Vukovic & Bailey, 2013). Parenting plays a role in children's anxiety for the development and maintenance of the disorder. Moreover, it has been shown that children are capable of reporting their own anxiety feelings, attitudes, and behaviors (Harari, Vukovic & Bailey, 2013; Niditch & Varela, 2010).

General anxiety is defined as, “chronic fear that persists in the absence of any direct threat” (Pinel, 2011, p. 479). Five types of anxiety disorders exist: generalized anxiety disorder, phobic anxiety disorders, panic disorders, obsessive-compulsive disorders and post-traumatic stress disorder. Experience is a main proprietor of triggering anxiety. The identification of stressful events assists in ameliorating anxiety in individuals. Anxiety has a heritability component, which 30-40% of disorders are due to genetics (Leonardo & Hen, 2006).

As a term, anxiety can have several meanings and be applicable to varying situations (Vanin, 2008). The *Taber's Cyclopedic Medical Dictionary* defines anxiety as,
“a vague, uneasy feeling of discomfort or dread accompanied by an autonomic response” (Vanin, 2008, p. 1; Venes, 2013). Anxiety is influenced by biological, genetic and psychological factors, which effect thoughts, feelings and behaviors. It is often portrayed as nagging with low-level consequences and is difficult to pinpoint due to interactions amongst variables. The source of anxiety can be known, unknown or non-specific appearing as a normal emotion. The physical response of “fight or flight” is associated with the anticipation of danger from the anxiety stimulus. No one specific trigger exists but can include social and performance situations, cognitive mechanisms and memories associated with anxiety (Vanin, 2008).

**Theoretical Foundation of Anxiety**

Six theories of anxiety exist although it is difficult to isolate anxiety to any one theory due to overlap between the definitions, symptoms, and causes. The six theories are categorized as psychoanalytic, learning/behavioral, physiological, phenomenological/existential, cognitive, and uncertainty.

**Psychoanalytic theory of anxiety.** The psychoanalytic theory of anxiety can be traced back to Freud and Jung in their conceptualization of the topic. Although they are not the first theorists to discuss anxiety the two psychologists are pioneers for the physiological standpoint. Sigmund Freud placed importance on anxiety in his psychoanalytic theory (Hall, 1999). According to Freud, “anxiety is a painful emotional experience, which is produced by excitations in the internal organs of the body” (Hall, 1999, p. 61). The stimulation can occur from either external or internal stimuli.

Freud's theory is composed of three types of anxiety: reality, neurotic, and moral anxiety. Mathematics anxiety can be classified within the first two categories. Under
reality anxiety it is found that anxiety is a painful emotional experience akin to external
dangers. The fear is more easily acquired through childhood due to children being unable
to cope with danger (Hall, 1999). In this particular case, mathematics may be seen as a
threat, which can trigger trauma. Students will flee from the pain source because they are
unable to nullify it. Moreover, when mathematics is taught in the classroom the child will
annul the pain by consciously making the decision to not be cognizant. In this way, they
are not apt to the pain of mathematics; yet, the major consequence is that mathematics is
seen as a harmful threat.

Likewise neurotic anxiety pertains to mathematics anxiety and student
interactions with mathematics. Freud posited that neurotic anxiety is generated by
instinctual danger (Hall, 1999). The three forms of mathematics anxiety are free-floating,
phobia and panic reactions, which can all be classified within mathematics anxiety. Free-
floating pertains to an unsuitable environment, which for a child learning mathematics
could be the classroom, school or their textbook. The irrational fear of a phobia is
instilled within a person, specifically arithmophobia, which individuals are irrationally
afraid of numbers. Children do not know why they are afraid of numbers but it is
inculcated in them. The panic reaction to mathematics anxiety is an extreme case and
occurs when pain is intensified within a person and they lose control. Mathematics has
been shown to trigger the pain components of the brain, which can lead to a panic attack.

Carl Jung concluded that all people begin whole (Hall & Nordby, 1999). Jung
also has implications for mathematics anxiety and its inception. Under his theory,
complexes occur as thoughts that preoccupy a person to the point of consumption and
they are unable alter their focus. For mathematics anxiety, students can be fixated on
mathematics and numbers and their brains are wholly consumed. Moreover, this led to the exploration of the collective unconscious. It is here that a person acquires images from their parents and their reactions to the stimulus. For example, if a child's parents have a negative disposition then there child will inherit these feelings. The hereditary viewpoint of mathematics anxiety is one of interest to see if a cycle of mathematics anxiety is probable.

Learning/Behavioral theory of anxiety. Learning/behavioral anxiety originates from the work of Pavlov and Watson. Pavlov and Watson conducted experiments that were tested on animals and applied to humans. Their premise was that external behavior could control reactions to situations (Liddell, 1936; Watson, 1936). Their main hypothesis was to explain punishment and avoidance of the mediator who is often anxiety (Strongman, 1995). The theory has been updated to propose that anxiety can be learned by conditioning individuals through a stimulus-response occurrence (Staats & Eifert, 1990). Students can learn to fear mathematics due to a negative response, such as no teacher or parental support, repetition of material, receiving poor grades or humiliation in front of peers when solving a problem. Individuals begin to associate the negative feelings from mathematics responses and apply them holistically to the subject. Even mentioning mathematics causes anxiety symptoms to emerge.

Physiological theory of anxiety. Physiological theories stem from the field of neuroscience that contain the central nervous system and the sections or parts in association with anxiety (Strongman, 1995). The two primary components of the central nervous system that are associated with anxiety are the amygdala and the anterior cingulate cortex (Pinel, 2011). Gray (1987) proposed that responses escaped the
behavioral inhibition system that are mediated by the hypothalamus. The mediating system suppresses the stimulus only if the perceived outcome is a threat that is equivalent to the fight or flight response. The hippocampus has been shown to coalesce emotion and cognition and is the core of the anxiety mediation (Gray, 1987; Strongman, 1995).

**Phenomenological/Existential theory of anxiety.** The phenomenological/existential theory originated in 1844 and viewed anxiety as a natural state (Strongman, 1995). The premise is that anxiety is unavoidable and from birth through maturation one must face decisions that induce or eliminate anxiety. Kirkegaard (1957) viewed fear and anxiety as separate entities. Under his theory, fear is reliant upon a specific object, whereas, anxiety is through the development of self-awareness and reflection. An individual can avoid an object associated with fear yet with anxiety one is in conflict. Fischer (1970) has since updated the theory to be more applicable with psychological advances. His theory of anxiety is a culmination of previous phenomenological theories and has five premises: 1) Identity – taking the form of events in ways of living and if they are threatened then anxiety is induced, 2) World – a network of relations exists and if they are overwhelming then anxiety results, 3) Motivation – identity and world are maintained and bolstered, 4) Action – the method of overcoming milestones, and 5) Ability – evaluation of uncertain competence (Strongman, 1995). Anxiety is “both anxious experiencing and the experiencing of the self or the other being anxious” (Strongman, 1995, p. 3). The vagueness of the phenomenological/existential theories produce inconclusive claims on anxiety.

**Cognitive theory of anxiety.** Cognitive theorists, Eysenck and Ohman, are credited for creating the field and conceptualizing anxiety.
systems a decision is made of either fear or anxiety. Ohman concluded that there are two types of anxiety, one that blocks responses and the other cannot detect the cause and is in the unconscious (Ohman, 2008). Under this domain. Eysneck, Derakshan, Santos and Calvo (2007) postulated that the cognitive and physiological system are connected and self-schemata are a component of the cognitive system. Long-term memory is a sector of anxiety that can cause individuals to be high or low in trait anxiety causing differences in their cognitive structure (Eysneck, Derakshan, Santos & Calvo, 2007). Those who have higher trait anxiety tend to worry more than less trait anxiety individuals. The justifications as to why this occurs is due to high trait anxiety individuals having frequent and more accessible sets of worries (Strongman, 1995). Ohman (2008) created an information processing theory of anxiety that consisted of five parts. In summary: a stimulus is evaluated by detectors and is assessed as to whether or not it poses a threat. If the stimulus is perceived as a threat it then travels to the arousal system. The arousal system emphasizes the significance and notifies the conscious perception system. Together the systems collaborate with the expectancy system to find the threat in the environment and interpret the event.

Uncertainty theory of anxiety. The final category, uncertainty theories, are based upon emotion. Izard (1991) proposed that fear is the most common feeling associated with anxiety yet other emotions are involved. Moreover, although anxiety is viewed as a unitary phenomenon the other discrete and hidden emotions must be validated. Uncertainty is a cornerstone of anxiety (Izard, 1991). Lazarus (1991) furthered Izard's theory by categorizing fright with anxiety. He suggested that there are various contributions to anxiety including goal relevance, goal incongruence and ego-
Mathematics Anxiety

Mathematics anxiety is a troublesome topic in the field of mathematics education. Many young children in public education are suffering from the epidemic. A set definition has not been created for the phobia. However, the most prevalent definition utilized in research is one composed by Richardson and Suinn (1972) viewing the condition as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of ordinary life and academic situations” (p. 551).

Student performance in the mathematics classroom has been shown to improve when anxiety is ameliorated (Ashcraft, 2002). Mathematics anxiety can be ameliorated through teacher excitement and competence, instructional strategies that employ inquiry techniques, and myriad assessments (Shields, 2005).

It is estimated that 93 percent of Americans have experienced mathematics anxiety in their lifetime (Blazer, 2011). Many young children in public education are suffering from mathematics anxiety. A set definition has not been created for the phobia. Mathematics anxiety defined by Richardson & Woolfolk (as cited in Maloney, Risko, Ansari & Fugelsang, 2010) is a condition, “which individuals experience negative affect when engaging in tasks demanding numerical and mathematical skills” (p. 293). Tobias (1987) described it as “sudden death” when students reach a skill that does not come easy. Tobias and Weissbrod (1980) defined the term as “the panic, helplessness, paralysis and mental disorganization that arises among some people when they are required to solve a mathematical problem” (p. 65). From an emotional standpoint, Spicer (2004)
stated it as “an emotion that blocks a person’s reasoning ability when confronted with a mathematical situation” (p. 1). However, the most prevalent definition utilized in research is one composed by Richardson and Suinn (1972) viewing the condition as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of ordinary life and academic situations” (p. 551).

Mathematics anxiety is considered to be a type of performance-based anxiety related to social phobia and test anxiety. It is categorized by anxious responses to immediate settings, such as mathematics class, or by the anticipation of entering mathematics class or being called on in class, that will result in a negative result of the performance (Ashcraft, Krause & Hopko, 2007; Harari, Vukovic & Bailey, 2013). Diagnostic criteria do not exist for the classification of mathematics anxiety as a clinical disorder. In accordance with performance-based anxiety, mathematics anxiety elicits physiological arousal, avoidance, and negative cognition that result in a decrease in performance. The negative and disproportionate reactions are distinctive of performance-based anxiety (Harari, Vukovic & Bailey, 2013).

**Mathematics Anxiety Theory**

A set theory does not exist for mathematics anxiety but two have been proposed. The first theory created by Zacks (1989) concluded that the presence of a distracting stimuli caused a decrease in cognitive performance. Eysenck and Calvo (1992) posited that cognitive performance will be compromised when experiencing anxiety during working memory tasks. A culmination of the two theories was created and theorized that individuals with high mathematics anxiety do not have poor calculation due to worrisome
thoughts but are unable to disconnect the thoughts from the task at hand (Hopko, Ashcraft, Gute, Ruggiero & Lewis, 1998; Krizinger, Kaufmann & Willmes, 2009).

A mathematics anxiety model has been created to better conceptualize the phenomenon. Within the model there are three domains: social/motivational, intellectual/educational, and psychological/emotional domain with a continuum within each domain. The social/motivational category focuses on society, family, and friends with a behavior continuum that is composed of pursuit and avoidance; the value a person places on mathematics is influenced by others and society. The intellectual/educational domain consists of knowledge and skills an individual has and their perception of success or failure constituted by the achievement continuum. Achievement is comprised of success and failure that evaluates a person's ability. The final domain psychological/emotional contains the emotional history tied to the subject with the feelings continuum that expresses anxiety or confidence. A positive cycle would consist of pursuit, success, and confidence while a negative cycle would contain the avoidance, failure and anxiety (Strawdermann, 1985). Although the model appears to be straightforward and simple there are significant aspects that are missing such as environment and instructional strategies in mathematics.

Causes of Mathematics Anxiety

A range of mathematics anxiety symptoms can be categorized as psychological or physiological. Psychological symptoms include feeling helpless, disgrace, defensive behavior, panicking, going blank on a mathematics task and being unable to cope (Plaisance, 2009; Ruffins, 2007). Under the psychological domain individuals will have an increased heart rate, clammy hands, upset stomach, nervous laughter, crying, frequent
need to use the bathroom, clenched fists, dry mouth and lightheadedness (Plaisance, 2009; Ruffins, 2007). Mathematics anxiety derives from the affective domain yet can be observed through dislike, worry and fear under the attitudinal, cognitive, and fear domains, respectively (Ma, 1999).

Statistical evidence has shown that 20%, or 1 in 5 individuals, suffer from psychological or physiological symptoms of anxiety when having to deal with numerical information (Ashcraft & Kirk, 2001; Eden, Heine & Jacobs, 2013). The drastic statistic provides evidence that mathematics anxiety is an epidemic that is affecting society. Individuals are not comfortable with mathematics yet the world is moving towards more technological advances. The discomfort with mathematics is a hindrance to the advancement of the country.

**Origin of mathematics anxiety.** Devine, Fawcett, Szucs & Dowker (2012) categorized mathematics anxiety origins into three categories: environmental, intellectual and personality. The environmental variables constitute attitudes, stereotypes and teaching styles that affect a child directly. A teacher's negative attitude and lack of student support along with direct instruction can create mathematics anxiety (Ashcraft & Ridley, 2005; Devine, Fawcett, Szucs & Dowker, 2012). It is often assumed that mathematics anxiety is directly correlated to poor mathematics performance, which is often not the case and the variance can be explicated by measures other than cognition (Devine, Fawcett, Szucs & Dowker, 2012; Suinn & Edwards, 1982). Poor visuo-spatial ability and working memory are two main cognitive factors affecting mathematics anxiety (Ashcraft & Moore, 2009; Ramirez, Gunderson, Levine & Beilock, 2013; Witt, 2012). A student's inability to spatially process mathematical content, as well as working
memory being disrupted during calculations, increases the possibility of mathematics anxiety. Personality variables play a role in the origin of mathematics anxiety with the most prevalent being a lack of confidence in situations involving the manipulation of numbers (Stuart, 2000). Students who have low self-efficacy associate low performance with intelligence that in turn will create mathematics anxiety (Bandura & Locke, 2003; Eden, Heine, & Jacobs, 2013).

The origin age of mathematics anxiety varies for each person. Middle school is speculated to be the source of mathematics anxiety (Perina, 2002). Mathematics anxiety has been shown to increase with age (Brush, 1980; Meece, 1981; Wigfield & Meece, 1988). Hembree (1990) conducted a meta-analysis of mathematics anxiety research to determine the onset of the phobia. At the time of the study there was no data for elementary grades, K-5. The analysis concluded that mathematics anxiety levels rise starting from 6th grade and peak at grades 9th-10th. After students passed 10th grade the levels of mathematics anxiety plateau for upper high school through secondary education. A lack of studies with children hinders the ability to locate the onset age mathematics anxiety. Ramirez, Gunderson, Levine and Beilock (2013) and Harari, Vukovic and Bailey (2013) have shown that mathematics anxiety can be detected as young as first grade. Although the results did not show that all students had mathematics anxiety, only those with high working memory. Studies conducted with 2nd to 4th graders have shown similar results (Gierl & Bisanz, 1995; Krizinger, Kaufmann & Willmes, 2009; Newstead, 1998; Wu, Barth, Amin, Malcame & Menon, 2012). Those studies that involve children, grades K-5, are focused upon pinpointing, which students have mathematics anxiety.
Mathematics anxiety begins early and it caused by a number of intertwining influences (Lyons & Beilock, 2012). Wu, Barth, Amin, Malcarne, & Menon (2012) demonstrated that mathematics anxiety in primary grade children was not only present as early as 2nd grade, but that it had a marked detrimental effect on achievement in mathematics. Inducement of mathematics anxiety during elementary school years is furthered by repetition of material and not being given practical applications to their lives (Furner & Meltzer, 1999). Children are not establishing success with mathematics during these influential and critical years often elicited from improper instruction, vague textbooks and worksheets, obfuscation of mathematics and negative feedback (Furner & Meltzer, 1999; Harari, Vukovic & Bailey, 2013; Newstead, 1998). Withal, schools are not the only cause of mathematics anxiety; parenting and societal influences negatively impact children’s attitudes and feelings toward the subject (Harari, Vukovic & Bailey, 2013; McLeod, Wood & Weisz, 2007.)

The societal stereotype of women's lack of mathematical ability is a factor to mathematics anxiety inception. The disposition hinders the accruement of the subject due to stigma placed upon females from birth. A speculation of mathematics anxiety between the different sexes is due to females reporting more anxiety (Ashcraft, 2002). Aschcraft (2002) found that females are more likely to express their fears than men, another effect of societal stereotypes. Boys express a more positive attitude towards mathematics in elementary and middle school years (Aiken, 1976; Wigfield & Meece, 1988), while girls begin to express higher levels of mathematics anxiety in high school and college than males (Brush, 1980; Wigfield & Meece, 1988). Stereotype threat is a condition, which stigmatization dictate how a social group should perform (Beilock, 2008). A common
myth is that girls are bad at mathematics and when this is accepted by parents and teachers then it permeates to the impressionable youth. Girls are socialized from a young age to steer clear of the subject and at the end become mathematics anxious because they are not expected to excel (Bem, 1983).

A study by Beilock, Gunderson, Ramirez, and Levine (2010) analyzed the mathematics anxiety of elementary students and female teachers. The pupils were assessed in the first three months of the school year and during the last two months. At the beginning of the year the students did not show great disparity in their mathematics anxiety. However, at the end of the school year female teacher mathematics anxiety negatively impacted the female students' mathematics achievement. The researchers' speculation was that the girls conformed to the gender stereotype that girls are not as good at mathematics as boys (Beilock, Gunderson, Ramirez & Levine, 2010).

Fewer studies on mathematics anxiety have been conducted on racial differences. The majority of studies' samples are native English speakers from suburban areas. A lack of research on students who speak English as a second language and those from lower socio-economic status backgrounds leads to inconclusive results (August & Shanahan, 2006; Harari, Vukovic & Bailey, 2013). Although the Center for Education Statistics (2014) concluded that individuals from minority backgrounds perform lower than their non-minority peers in mathematics in 4th and 8th grade. Moreover, it has been found that the majority of middle school and high school students in the United States report disliking mathematics despite their economic and cultural background (Burns, 1998; Ramirez, Gunderson, Levine & Beilock, 2013; Zaslavsky, 1994). More exploration must be conducted on this topic to uncover a possible connection to mathematics anxiety.
Difference between Anxiety and Mathematics Anxiety

Mathematics anxiety was first researched by Dreger and Aiken (1957) and labeled as number anxiety, which is defined as, “a syndrome of emotional reactions to arithmetic and mathematics” (p. 344). Many researchers view mathematics anxiety as a subset of test anxiety (Hembree; 1990; Ho, Senturk, Lam, Zimmer, Hong & Okamoto, 2011). The justification is due to the theoretical models of test anxiety addressing similar effects in mathematics anxiety. One model is the interference model, which posits that anxiety affects students' recall during examination, while the other model, the deficit model, proposes that poor performance leads to high anxiety (Ho, et al., 2011). Test anxiety was originally viewed as uni-dimensional but is now considered two-factored: affective test anxiety and cognitive anxiety. The former refers to the emotional aspect of feeling nervous or fearful about tests, while the latter focuses on worry and the negative thoughts generated through testing situations (Liebert & Morris, 1967; Wigfield & Meece, 1988). Through studies, it has been concluded that cognitive test anxiety has a higher correlation with test performance as opposed to affective anxiety (Ho, Et al., 2011). Surveys have been created to uncover discrepancies between test anxiety and mathematics anxiety. The Test Anxiety Questionnaire and Mathematics Anxiety Questionnaire were tested using a multi-trait, multi-method validity. It was found that 24% of the variance on both measures was due to the affective domain while 13% was due to cognitive (Williams, 1994). From these results, it can be concluded that the definitions of affective and cognitive varied.

Mathematics anxiety is hypothesized as a multidimensional construct composed of numerical anxiety, test anxiety, worry, and negative reactions (Harari, Vukovic &
Bailey, 2013; Ho et al., 2011; Wigfield & Meece, 1988). The culmination of the first three constructs identify varying sectors of mathematics anxiety: numerical anxiety pertains to using mathematics in everyday life and academic situations; test anxiety consists of evaluation in mathematics; and worry relates to the negative concerns about the subject. Negative reactions are troublesome physiological reactions to mathematics. However, at this time there is no assessment that measures every domain (Harari, Vukovic & Bailey, 2013). Furthermore, test anxiety is defined as, “an otherwise confident student’s state of panic during a test where self-doubt leads to a failure to realize potential in a testing environment” (Perry, 2004, p. 321). Researchers hypothesize that this subset of anxiety is a component of mathematics anxiety.

When working with young children in elementary school it is inconclusive if mathematics anxiety is multidimensional or unidimensional. Harari, Vukovic and Bailey (2013) proposed that children's mathematics anxiety is composed of numerical anxiety, negative reactions and worry, as defined above. The justification is that children are not familiar enough with tests to have test anxiety. Yet when looking at today's educational system standardized tests are introduced as young as 3rd grade. On the other hand, Beasley, Long and Natali (2011) concluded that mathematics anxiety is uni-dimensional because children are unable to distinguish between different types of mathematics anxiety.

Some researchers describe mathematics anxiety as a subject-specific facet of test anxiety (Bush, 1981; Hembree, 1990). Mathematics anxiety lacks an independent identity from test anxiety due to lack of research. Hembree (1990) conducted a meta-analysis of
the research to uncover similarities and differences between mathematics anxiety and test anxiety. The following are the findings:

1) Mathematics anxiety and test anxieties both relate to general anxiety.

2) The differences in anxiety level regarding student ability, gender, and ethnicity are similar for both constructs.

3) Both forms affect performance in similar fashion.

4) The constructs respond to the same treatment modes, with best relief from behavior-related methods and little result from the cognitive treatment, group counseling.

5) Improved performance relates to the relief of both constructs.

(Hembree, 1990, p. 44).

From the results it appears that researchers studying mathematics anxiety have adopted the theoretical foundation of test anxiety. Both types of anxiety are learned as opposed to behaviorally and cognitively based. Hembree (1990) found that the correlation between mathematics anxiety and test anxiety was 0.52 but Tryon (1980) corrected the value for attenuation, which increased the value to 0.61. The increase corresponded to an $r^2$ value of 0.37 meaning that 37% of variance is explained by the other. This means that 63% of variance can be explained by factors other than test anxiety. Furthermore, mathematics anxiety is not a separate anxiety but overlaps with both general anxiety and test anxiety (Hembree, 1990; Kazelskis et al., 2000).

Mathematics anxiety can affect students who otherwise show no anxiety in other subjects. Hembree's (1990) correlations between mathematics anxiety, general anxiety and test anxiety at the significance level of 0.01 concluded that: 1) mathematics anxiety
and general anxiety are correlated at 0.35, meaning that 35% of the variance in mathematics anxiety can be explained by general anxiety and 2) mathematics anxiety and test anxiety are correlated at 0.52 with 52% of the variance being explained by test anxiety. Measures have not been created that solely measure mathematics anxiety due to convergences of other anxiety subtypes. When researching mathematics anxiety, one must be cognizant that mathematics anxiety will not be the only measured item.

**Consequence of Mathematics Anxiety**

Students with mathematics anxiety enjoy mathematics less and do not see the value of the subject (Ashcraft & Moore, 2009; Hembree, 1990; Vukovic, Kieffer, Bailey, & Harari, 2012). They perceive their mathematical ability to be lower than their peers, which in turn hinders their achievement. Their negative perceptions continue throughout their education as mathematics-anxious students avoid mathematics classes and college and career choices related to mathematics (Hembree, 1990; Vukovic, Kieffer, Bailey, & Harari, 2012).

Students with high mathematics anxiety have lower scores on mathematics achievement tests (Ashcraft, 2002; Ashcraft & Moore, 2009; Das & Das, 2013; Eden, C., Heine, A., & Jacobs, A. M., 2013). The overarching characteristic of individuals with mathematics anxiety is an avoidance of the subject (Ashcraft & Moore, 2009). Poor performance is a consequence of students with mathematics anxiety (Das & Das, 2013). A short-term effect of mathematics anxiety is worrisome thoughts, which hinder a student's ability for calculations (Ashcraft, 2002). Worrisome thoughts affect working memory and attention making it difficult to perform calculations.
The fear and anxiety of mathematics impedes mathematics achievement and has wider consequences than attainment in the content area. Some individuals who have mathematics anxiety teach mathematics to the next generation. Often for elementary school teachers this is the case. The majority of elementary education majors are female and are reported to have the highest level of mathematics anxiety (Beilock, Gunderson, Ramirez & Levine, 2010).

Lyons and Beilock (2012) found that mathematics anxiety is a very real phenomenon with wide-ranging consequences. They found that mathematics anxious people had the same reaction to the anticipation of doing mathematics as they did in the anticipation of a concrete, visceral sensation such as pain. Interestingly, this relation was not seen while actually doing mathematics problems, but rather in the anticipation of doing mathematics suggesting it is not mathematics itself that hurts but rather, the anticipation of mathematics that caused the reaction. Since people tend to avoid pain, it is likely that mathematics-anxious individuals will work very hard to avoid mathematics.

**Diagnosis of Mathematics Anxiety**

Mathematics anxiety is complex and varies in definitions with a wide range of symptoms. Just as there is no set definition or list of symptoms, there is a lack of accepted measure and assessment to diagnose the phenomenon. Surveys and assessments can be used to measure mathematics anxiety. The Mathematics Anxiety Rating Scale (MARS) is the most widely used and cited scale used to measure mathematics anxiety (Suinn & Richardson, 1972). The scale was developed under the hypothesis that individuals who suffer from mathematics anxiety may not be affected by general anxiety. MARS consists of 98 items that focus on numerical manipulation and mathematical
concepts. Researchers have utilized factor analysis to explore various facets of mathematics anxiety. Two factors were discovered that were prevalent in the MARS: Test Anxiety and Numerical Anxiety (Rounds & Hendel, 1980). Questions pertaining to Test Anxiety consisted of feelings before, during and after mathematics tests while Numerical Anxiety pertained to number manipulation.

The main concern of the MARS was the copious amount of questions that participants had to answer (Alexander & Martray, 1989). The Abbreviated Mathematics Anxiety Rating Scale (A-MARS) was developed by Alexander and Martray in 1989 to measure teacher’s mathematics anxiety (Alexander & Martray, 1989). The A-MARS consists of twenty-five items on a five-point Likert-type scale. The resulting 25-item scale proved to be internally consistent and to have high test-retest reliability. The AMARS contains three factors: Factor I, with a 0.96 reliability reflected apprehension about taking or receiving test results in mathematics; Factor II with a 0.84 reliability, items comprising the factor reflected anxiety about executing numerical operations; and Factor III with a 0.86 reliability, items related to mathematics course anxiety. A test-retest reliability was found to be 0.86, based on 62 students over a two-week period (Alexander & Martray, 1989).

Due to various findings it became problematic if the varying scales measured the same factors. Kazelskis (1998) conducted a factor analysis on the three prevailing mathematics anxiety instruments: the Revised Mathematics Anxiety Rating Scale – RMARS (Plake & Parker, 1982), the Mathematics Anxiety Scale – MAS (Betz, 1978), and the Mathematics Anxiety Questionnaire – MAQ (Wigfield & Meece, 1988). Six facets were identified: Mathematics Test Anxiety, Numerical Anxiety, Mathematics
Course Anxiety, Worry, Positive Affect Toward Mathematics, and Negative Affect Toward Mathematics. None of the three tests consisted of all the six factors. Interestingly, Numerical Anxiety arose as specific to only the R-MARS (Kazelskis, 1998). The information is surprising due to the premise that mathematics anxiety scales should measure a factor related to the manipulation of numbers. The most common factor amongst the three tests was Mathematics Test Anxiety with an eigenvalue ranging from 13.02 to 32.63, which accounted for 59.2% of the variance (Kazelskis, 1998). It is evident from these results that the scales measure test anxiety at a far greater rate. One must be cautious when utilizing assessments and scales due to these results. The scales may not encompass all factors of mathematics anxiety but focus half of the questions on one subset. Mathematics anxiety is commonly defined by these measures as mathematics test anxiety without taking into account numerical anxiety.

A difficulty with measuring mathematics anxiety is societal influence that impact students' beliefs towards mathematics. Males are less apt than females to disclose their insecurities and feelings toward the subject due to stigma that males should excel at mathematics (Zettle & Houghton, 1998). The finding suggests that results may be difficult to obtain or generalize for males than for females. The lack of disclosure could lead to males with high mathematics anxiety being labeled low mathematics anxiety due to confirmation to societal ideals.

**Exacerbation of Mathematics Anxiety**

A common practice in today's public education school system is passive learning. Pupils are lectured and expected to absorb the information (Ball, 1990). Some teachers nowadays have taken the approach of “teaching to the test”. They need to ensure that
their pupils know the content on the state exams. Many have stuck to a rigid plan that only incorporates “talking at” the students. The teacher-centered paradigm impedes student learning while exacerbating mathematics anxiety (Hembree, 1990). Students are not afforded the opportunities to be cognizant in their education. They are expected to sit at their desks and memorize the content from their instructor while they become passive learners without ownership of the material (Ball, 1990).

The teacher-centered approach stymies student development and interests in schools. Common characteristics of teacher-centered instruction are: a focus on observable changes in behavior, the teacher as the sole provider of knowledge, utilization of rewards and punishments, and often a stimulus-response reaction (Ball, 1990). B.F. Skinner was a proponent for operant conditioning that constituted utilizing antecedents and consequences to modify behaviors. Skinner deduced that through teacher designed schedules and adjustments that actions would alter in a desirable manner (Skinner, 1953). Pavlov and Watson conducted experiments that were tested on animals and applied to humans. Their premise was that external behavior could control reactions to situations (Liddell, 1936; Watson, 1936). The findings have permeated to education and implemented to mediate behavior and learning.

Amelioration of Anxiety

Classroom settings that are shown to ameliorate mathematics anxiety are constructivist in nature. In a constructivist setting, the instructor provides students with opportunities to learn independently and from one another and guides them in skill advancement. This student-centered approach includes techniques such as “substituting active learning experiences for lectures, assigning open-ended problems and problems
requiring critical or creative thinking that cannot be solved by following text examples” (Froyd & Sampson, 2008, p. 1). When properly implemented, constructivist teaching leads to better understanding, confidence in the subject, more motivation, and better knowledge retention (Collins & O'Brien, 2003).

**Mathematics Anxiety in Children**

McLeod (1993) suggested that the onset and development of mathematics anxiety in children were ages 9 to 10. Further supporting this claim is Newstead (1993) claiming that the ages of 9 to 11 being the critical stage of mathematics anxiety development. The attitudes formed at this age are difficult to change and will more often continue throughout their life (Newstead, 1993). Mathematics anxiety is detectable as early as first grade. Harari, Vukovic, and Bailey (2013) conclude that children might be influenced by environmental factors prior to schooling that contribute to their negative attitudes leading to mathematics anxiety.

An elementary school teacher's attitude and perceptions of mathematics and teaching style influences the anxiety levels of their students, specifically female teacher to female students (Beilock, Gunderson, Ramirez, & Levine, 2010; Ramirez, Gunderson, Levine, & Beilock, 2013; Wu, Barth, Amin, Malcarne, & Menon, 2012). The classroom teacher plays a pivotal role in students' mathematics anxiety; students who like their mathematics teacher report lower mathematics anxiety scores (Yüksel-Şahin, 2008). Teachers who have a more positive, supportive, and conceptual environment help to alleviate mathematics anxiety (Yüksel-Şahin, 2008). Classroom practices employing teacher-centered and direct instruction of mathematical methods increase mathematics anxiety in elementary children (Newstead, 1998). Teachers who place too much emphasis
on memorization and drill and practice create mathematics anxiety in the classroom. A more student-centered approach through collaboration, discussion, and a positive environment can ameliorate mathematics anxiety in the classroom (Newstead, 1998).

If early childhood students are mathematics anxious they are more likely to underachieve in secondary mathematics (Ashcraft, 2002; Witt, 2012), reject the study of mathematics at a younger age (Brown, Brown, & Bibby, 2008; Witt, 2012), continue their mathematics anxiety through life (Brown, Brown, & Bibby, 2008; Witt, 2012), and permeate their mathematics anxiety to their children (Beilock, Gunderson, Ramirez, & Levine, 2010; Witt, 2012). Mathematics anxiety in children does not only affect their performance but also the amount of mathematics content children can learn. Children with higher levels of anxiety will be fewer able to learn as much material as their less anxious peers (Vukovic, Kieffer, Bailey, Harari, 2013; Witt, 2012). Witt (2012) concluded that even the appearance of digits can trigger anxiety in young children. Children with higher levels of mathematics anxiety show a depletion in their central executive working memory (Witt, 2012).

Mathematics anxiety is reported to be higher for children who have lower performance ability (Wu, Barth, Amin, Malcarne, & Menon, 2012). A student's self-perception of their performance expectation, ability in mathematics, and value for the subject directly influence their mathematics anxiety. In other words, those with low expectation, ability, and value will have higher mathematics anxiety, while children with high perceptions of these traits will have low mathematics anxiety (Wu, Barth, Amin, Malcarne, & Menon, 2012). Primary students with high mathematics anxiety have a
negative effect on performance (Krinzinger, Kaufmann, & Willmes, 2009; Ramirez, Gunderson, Levine, & Beilock, 2013).

Childhood mathematics anxiety includes cognitive and affective factors (Ramirez, Gunderson, Levine, & Beilock, 2013). Children who rely heavily on working memory display higher levels of mathematics anxiety. High working memory students utilize retrieval and more sophisticated strategies that are not as taxing on the brain (Ramirez, Gunderson, Levine, & Beilock, 2013).

Gierl and Bisanz (1995) found a relation between third-grade students' mathematics anxiety and their confidence, enjoyment of mathematics, and positive feelings about being successful. Instructional strategies and classroom community can be easily implemented to create a positive learning environment. Third-grade students who were more confident in the subject matter and enjoyed it more had less mathematics anxiety (Gierl & Bisanz, 1995).

Jameson’s (2014) sample consists of three rural schools and one urban school that are predominantly Caucasian. The quantitative findings report that mathematics self-concept is the greatest predictor of mathematics anxiety in second-grade students (Jameson, 2014). Other predictors of gender, parental level of mathematics anxiety, and mathematics activities at home were not statistically significant variables (Jameson, 2014).

Yüksel-Şahin (2008) found that in Turkish fourth and fifth graders that their anxiety level differed by sex with females reporting higher mathematics anxiety than males. Elementary students who enjoy mathematics have lower mathematics anxiety than their peers who dislike the subject (Yüksel-Şahin, 2008). Children who succeed in
mathematics have lower mathematics anxiety scores. Those students who fail in mathematics show an increase in anxiety level and more negative attitudes towards the subject (Yüksel-Şahin, 2008).

**Mathematics Anxiety and the Brain**

Young, Wu and Menon (2012) surmised from fMRIs that for children age’s seven to nine, mathematics anxiety is related to hyperactivity and abnormal connectivity in the amygdala, specifically the right amygdala. This area showed increased connectivity in the ventromedial prefrontal cortex for the high mathematics anxiety group. This portion of the brain is utilized for regulating negative emotion. The posterior parietal cortex, the area of numerical and mathematical problem-solving, demonstrated a decrease in connection to the amygdala in high mathematics anxiety children. Low mathematics anxiety children's fMRI scans displayed stronger connectivity with efficient task processing. Moreover, highly mathematics-anxious students portrayed neural activity and multivoxel patterns in the amygdala. These children also showed a decreased response in cortical and subcortical areas that are related to mathematical and numerical reasoning (Young, Wu, & Menon, 2012).

Pain perception is associated with the dorso-posterior insula (INSp) and midcingulate cortex (MCC) (Lyons & Beilock, 2012). Individuals with higher mathematics anxiety displayed an increase reaction in INSp while anticipating a mathematics problem. The areas that were highlighted are associated with severe rejection in social situations (Lyons & Beilock, 2012).

The Scale for Early Mathematics Anxiety (SEMA) was utilized to score children's mathematics anxiety. The SEMA analysis concluded the increase in right basolateral
amygdala and a decrease in fronto-parietal in accordance with mathematics anxiety (Young, Wu, & Menon, 2012). Cytoarchitectonic maps were used to identify specific areas of the brain associated with mathematics anxiety. The researchers found that the basolateral nucleus was the most eminent site of amygdala activity that is related to learned fear (Young, Wu, & Menon, 2012).

Young, Wu and Menon (2012) supported the claims that mathematics anxiety requires a stimulus-response and is situation specific. Performance is reduced through the working memory, attention and control of cognitive processes while solving mathematical problems. Children with high mathematics anxiety showed reduced responses in the dorsolateral prefrontal cortex, pre-supplementary motor area, and basal ganglia. These children also had a decrease in the posterior parietal cortex associated with mathematical cognition. Mathematics anxiety decreases the resources for cognitive information-processing while performing mathematical tasks. The areas specifically related to the processing component are the intraparietal sulcus that is associated with the manipulation and representation of numbers, the superior parietal lobe and the angular gyrus that affect performance on mathematical tasks (Young, Wu, & Menon, 2012).

Immordino-Yang and Damasio (2007) conducted an experiment, which participants had sustained a lesion to the ventromedial prefrontal cortex that affected their social behavior. The individuals displayed no loss of knowledge, and their IQ remained the same but their emotional domain was compromised (Immordino-Yang & Damasio, 2007). Emotions are often portrayed as secondary and obtrusive to learning or as so eloquently put, “emotions are just messy toddlers in a china shop, running around breaking and obscuring delicate cognitive glassware” (Immordino-Yang & Damasio,
2007, p. 5). However, without emotion then cognition is compromised. Emotion assists children in knowing when and how to relate information learned in school to their daily lives. Emotional feelings rely upon the somatosensory system. When teachers discount emotion, they hinder a student's ability to transfer knowledge to real-life situations and creating knowledge that only exists in a vacuum (Immordino-Yang & Damasio, 2007).

Reducing Mathematics Anxiety

Children are born mathematicians. Every child has the capability to learn and foster a passion for the subject, often referred to as emergent mathematics (Worthington & Carruthers, 1998). According to Butterworth (1999), there is a Mathematical Acquisition Device that allows for all human beings to acquire an understanding of mathematics. It is difficult to impede a child in learning mathematics due to their innate curiosity. In order for them to flourish they must be in an environment that is mathematically stimulating and conducive to the subject.

However, most classrooms in the American public education school system are not utilizing an interactive approach to teaching and learning, but are instead continuing to use teacher-direct techniques, or a more traditional approach. Students are provided with a limited view of mathematics and its purpose, a common problem in modern mathematics instruction. A main factor is the implementation of standardized testing, specifically the Ohio Achievement Assessments (OAA), which young children must take during their academic careers. This process only stymies student development and impedes a passion that students could foster toward learning mathematics. Instead, they become passive learners, focused on attaining a high test score, without ownership or true understanding of the content.
Students who are taught from a traditional manner will often describe mathematics as “a set of rules” with a focus on calculations. (Boaler, 2008). Whereas, if mathematicians view the subject as “a set of patterns or connected ideas”. Mathematics must be brought back to life for students. When they are allowed to pose their questions and explore new directions, then mathematics will come alive. If students are taught with a prescribed curriculum where the answers are predetermined then, only memorization will occur. If questions are posed then, students can take ownership of their work (Boaler, 2008).

Mathematics is an imperative subject for daily life, yet few find it favorable. Several factors can precipitate individual's discontent through their experiences. Karp (1998) opined that innumeracy will be the latest epidemic in the United States. The lack of mathematical knowledge is detrimental not just to individuals but society. The idea of innumeracy does not focus on computing ability of arithmetic facts but instead centers on reasoning logically, interpreting data, and solving novel problems (Karp, 1998).

In a constructivist setting, the instructor provides students with opportunities to learn independently and from one another and guides them in skill advancement. Additionally, teachers get to learn about their students' backgrounds, abilities, and learning styles. Cooperative structures address different student learning styles in every class and use these when planning instruction (Gupta, 2008; Jones, 2007; McCombs & Miller, 2007; Polly & Hannafin, 2011).

Brown (2008) states, “through student-centered learning, students become self-sufficient, creative thinkers, and people who appreciate and value the subject being taught” (p. 34). The components of the construction of learning within a student-centered
classroom are meta-cognition, teacher/student partnership in learning, collaborative learning with peers, and meaningful assessment in real-world contexts (Jones, 2007; McCombs & Miller, 2007).

Student-centered learning allows for the pupils to be the focus of the learning process. In student-centered classrooms, students are active and invested in the discovery of their knowledge (Rallis, 1995). Students begin to take more ownership of the material in the classroom. Letting pupils learn in a manner that is unique to each student allows them to explore the material and world outside of school with more vigor (Deay & Saab, 1994). Teachers described students in this setting as taking charge of what they learned while working to their full potential.

In the learner-centered constructivist paradigm, knowledge is the combined efforts of the teacher and the students. Learner-centered classrooms allow the students to be actively involved in seeking out knowledge. Constructivism allows for students to direct their own learning, ask questions and complete tasks independently. Students become interested learning activities when they can interact with one another and participate actively (Furner and Duffy, 2002; Perina, 2002).

Children are naturally curious and want to know how methods work. When students are allowed to pose their own questions and explore new directions, then mathematics connects to students’ lives (Devlin, 2000). If students are taught with a prescribed curriculum where the answers are predetermined then only memorization, and not real understanding, will occur (Boaler, 2009). If questions are posed, students can take ownership of their work and authentic learning can begin to take shape.
A major setback is that elementary teachers who apply conceptual problems in their classroom lack mathematical content knowledge (Boaler, 2008). Many curriculum guides present mathematics as one size fits all subject and offer one solution. Traditional training of teachers does not provide guidance on how to properly instruct an open-ended problem (Ball, 1990).

Teachers and students have a shared responsibility for the learning and content in the classroom (Deay & Saab, 1994). Research has shown that teachers approach the curriculum content differently with the student-centered approach (Brown, 2008; Jones, 2007; McCombs & Miller, 2007; Tomlinson & Jarvis, 2006; Twomey, 2005). Classrooms tend to be more focused on content implication and concerned about the relevance and usefulness of the subject-matter (Rallis, 1995; Deay & Saab, 1994). The energy created by the shift in focus of the teachers' perspective role in the classroom seemed to renew their appreciation of themselves as educators (Deay & Saab, 1994).

Teachers must formulate a conducive environment for discussion amongst children (Smith & Stein, 2011). The five practices for a mathematical discussion are anticipating, monitoring, selecting, sequencing and connecting. Anticipation requires teachers to attempt to solve the problem in as many ways as possible and predict the errors or misconceptions that may occur. Teachers need preparation for the various strategies and how they connect to the concept. Monitoring consists of a teacher observing how students go about solving a problem and taking into account the multiple strategies in the classroom. Teachers can determine what strategies to focus upon during the group discussion from the monitoring of the room. Selecting entails teachers choosing students to share-based off of their observations in the previous step. Sequencing
connects to the order students present the material in the best manner. The final point of connecting requires teachers to make connections between the students' work (Smith & Stein, 2011). The process of discussion is one with several layers that entails teacher acclimation. It is an intricate process for educators to conduct a proper discussion (Smith & Stein, 2011).

An in-depth analysis of students' work for error requires teachers to be familiar with the content to a profound degree (Ball, Hill & Bass, 2005). Moreover, teachers are in the position of having to explain the methods in simple terms for children and create multiple representations in order to reach every child. It requires educators to put themselves in their students' shoes of understanding the concept for the first time. The connection of concepts is crucial for teacher awareness. Teachers can cognizant of the previous material learned in earlier grades and how to connect or build upon this prior knowledge (Ball, Hill & Bass, 2005).

A hurdle for teachers to enact these types of problems is giving power over to their students. It is often a new concept for students to have control of the lesson, and it can be frightening to some teachers. Teachers must be confident in their students' abilities. It will afford children with the opportunities to express their thinking as opposed to being told what to learn.

**Feminist Pedagogy**

**Feminist pedagogy roots.** Feminist pedagogy is a convoluted term without a set definition. When broken apart the term encompasses two pivotal terms of feminism and pedagogy. Feminism consists of the importance of experiences of women, gender equality, understanding all facets of the human race, and intersectionality that causes
inequalities in society (Crabtree, Sapp & Licona, 2009). Pedagogy refers to the methods and ways of teaching (pedagogy, 2014). According to Crabtree, Sapp and Licona (2009) feminist pedagogy “can be seen as a movement against hegemonic educational practices that tacitly accept or more forcefully reproduce an oppressively gendered, classed, racialized, and androcentric social order” (p. 1). Feminist pedagogy focuses on social transformation based upon assumptions of power and consciousness that lead to oppression through analyzing not only what is taught but how content is taught.

The roots of feminist pedagogy are from critical pedagogy and progressive education. Critical pedagogy or liberatory pedagogy was coined by Paulo Freire, who, critiqued education and teaching classroom practices and compared them to “banking education”, which knowledge is bestowed upon students from their teacher (Freire, 2000). An assumption underlies that children lack knowledge, and the teacher must deposit the content in their minds. Similarities between feminist pedagogy and liberatory pedagogy are the foundation of raising assumptions about disproportionate power in society, including the elementary classroom. The difference between the two is evident in that feminist pedagogy utilizes feminist viewpoints that often differ from Freirian views while also validating teachers’ thought processes as well as each individual student (Crabtree, Sapp & Licona, 2009). Progressive education influenced feminist pedagogy through experiential learning, social responsibility, and education as a means to democracy (Crabtree, Sapp & Licona, 2009).

**Characteristics of feminist pedagogy.** Social practice is a foundation of feminist pedagogy that lends itself to developing thought into action (Cohee, et. Al., 1998; Crabtree, Sapp & Licona, 2009). The ability for an individual’s thought to become reality
assists in empowering people within the larger project. Students feel that they are in control; their thoughts, emotions, and feelings intertwine to influence the action taken (Crabtree, Sapp & Licona, 2009). Emotions and feeling are often subjugated in traditional education and are constructed as synonymous with feminine characteristics (Crabtree, Sapp & Licona, 2009). However, feminist pedagogy seeks to allow children to utilize emotions and feelings as valid outlets for learning that can enrich the knowledge.

Personal experience offers students the opportunity for their voice to be heard and validated. Myriad experiences are validated in this approach, such as personal, communal, and subjective ways of knowledge. Students can express themselves in means that are most comfortable for them.

A classroom enacting feminist pedagogy seeks to foster positive relationships amongst the teachers and students. Learners are cared for holistically as opposed to just academically; the whole child is taken into account (Greene, 1995). All children are expected to thrive, and their excellence develops through support of their classmates. Every student’s experience is taken into account to accomplish mutual and individual goals. Children are free to take risks in their thinking and participation in the classroom. A social component is prevalent in the feminist pedagogy. Students are encouraged to collaborate with each other to extend their thinking (Greene, 1995).

Feminist pedagogy emphasizes classroom relationships that are not marked by power but instead utilize nonhierarchical exchanges; meaning that teachers and students have the power. Pupils are valuable assets to the knowledge base that their peers and teacher can learn from. Through these relations, a community is built that acknowledges all individuals in the classroom as valuable. Teachers resist dominant teaching strategies
that promote dominant culture notions and instead address the intersections of their pupils’ race, ethnicity, sexuality, class, and gender. The “exploration of who we are within these environments necessarily impacts what and how we teach” (Crabtree, Sapp & Licona, 2009, p. 5).

Students can create their knowledge much like in a constructivist classroom. Classmates are valuable assets that can further knowledge incongruence with Vygotsky’s more knowledgeable others (Vygotsky, 1987). It is through others that one can begin to discover themselves. The social interaction deepens and expands knowledge while furthering the social growth of children (Vygotsky, 1987).

Maher and Tetreault (1994) identify four themes in their research with professors that can be implemented in the early childhood classroom. The four themes discussed are mastery, voice, authority, and positionality. Mastery in education frequently is attributed with the educational canons of the dominant society. In other words, student comprehension is based on the teacher’s knowledge and not their own. Feminist pedagogy proposes that mastery includes students’ interaction with the content as well as their peers making interpretations as opposed to conclusions (Maher & Tetreault, 1994). Teachers who solely expect children to master the standards “actually often use that material to silence and master many students instead” (Maher & Tetreault, 1994, p. 17).

*Voice* refers to students being able to voice their concerns and opinions to content (Maher & Tetreault, 1994). Students often make connections between the material and their personal lives yet those in marginalized groups are unable due to their contrasting ideals. Classrooms have become a place where students lose their voice as opposed to
finding it. Each classroom has different students who bring a myriad of cultures but are forced to learn by means of the dominant culture (Nieto & Bode, 2012).

*Authority* in the classroom is often solely utilized by the teacher as the keeper of the knowledge (Maher & Tetreault, 1994). The hierarchical approach does not allow for student’s voice and reduces education to a single answer held by an individual. An open dialogue allows for all individuals to have authority in the classroom while respecting varying viewpoints.

*Positionality* is often ever-evolving due to the factors of the position one occupies (Maher & Tetreault, 1994). It is a relational concept between the marginalized and the central figure that is constantly changing. Teachers must be aware of the marginalized groups as well as the group they represent. Positionality changes daily in the classroom due to the topic, students in attendance, or teaching styles and an educator must be cognizant.

Traditional schooling focuses on masculine ideals and values from theorists and teaching strategies, such as competition, rationality, and individual achievement (Thompson, 2003). The acceptance of these factors has led to the devaluation of nurturing, thus relational or domestic aspects are not relevant to traditional educational frameworks. However, feminist pedagogy recognizes the value of caring in the educational community and feminist educational theorists have produced extensive scholarship addressing an *ethic of care* in education (Collins, 1999; Goldstein, 1998; Martin, 1990; Noddings, 1993).

**Ethic of care.** An ethic of care allows teachers to view their students holistically as opposed to systemic forms (Thompson, 2003). Feminist pedagogy seeks to create a
warm, safe environment for students that recognizes the absolute value of the experience, 
voice and various ways of knowing and learning. Teachers and students create links 
between the curriculum and experience, theory and practice, and thinking and feeling. 
Binaries are extinct, and fluidity is the norm. The content is not based on male hegemony 
but instead includes women and marginalized others, including children (hooks, 1994). 
Authority is not held solely by the teacher; journals are a method for students to express 
their feelings, attitudes, and thoughts, which their teacher can respond to create the 
community and build personal communications. Reflection in action and praxis is utilized 
daily to strengthen the relationships (hooks, 1994).

Curriculum in schools often is one-dimensional and only takes the cognitive 
aspect of learning into account (Dunn & Stinson, 2012). The acceptance of positive 
emotions disregards negative feelings to protect children (Dunn & Stinson, 2012; Hansen 
vivid memories of even trivial events” (p. 160). When emotion is not taken into account 
instruction is losing a pivotal part of child development. Research mainly focuses on the 
negative emotions in children, such as high-stakes testing and test anxiety (Schutz & 
Pekrun, 2007), but does not delve into positive reactions to academic content (Dunn & 
Stinson, 2012). Emotional development and regulation have been studied mainly in the 
arts (Greene, 1995) but not in other content areas.

Emotions for children are a primary source of expression, “an emotion, a passion 
can be a transformation of the world. It can break through the fixities; it can open to the 
power of possibility” (Green, 1986, p. 81). Greene postulates that emotions can be
beneficial in the classroom and assist in academic achievement. Eisner (1982) argues that emotions and cognition cannot be separated:

This case cannot be made because the hard and fast distinction between what is cognitive and what is affective is itself faulty. In the first place, there can be no affective activity without cognition. If to cognize is to know, then to have a feeling and to not know is to not have it. At the very least, in order to have a feeling one must be able to distinguish between one state of being and another. The making of this distinction is a product of thinking, a product that itself represents a state of knowing. (p.20).

Teaching must begin with constructing trusting relationships and instruction builds upon the trust foundation (Noddings, 1993). Teachers and students can learn from each other in a relational pedagogy that takes into account the relations created within the classroom (Sidorkin, 2002). Children's emotions, relationships, and feelings cannot be ignored to focus solely on academic skills (Noddings, 1993). An ethic of care as proposed by Noddings (1993) and Collins (1999) emphasizes care, concern and connection, which align with the core values of early childhood education (Goldstein, 1998; Martin, 1990). A feminist perspective allows all perspectives to be valued in the classroom: teachers and students (Goldstein, 1998). Caring is not a personality trait but instead a relation that one engages in daily (Goldstein, 1998). A teacher who holistically cares for a student is developing a child not only academically but socially and emotionally as well (Goldstein, 1998). Noddings (1992) posits “The primary aim of every teacher must be to promote the growth of students as competent, caring, loving, and lovable people” (p. 154).
Collins (1999) described the three components of the ethic of caring under an Afrocentric ideology. The three components are individual uniqueness, appropriateness of emotions in dialogue and a capacity for empathy. Moreover, emotion is seen as a valuable asset to human experience. Often, emotion is isolated from education, yet many educational scholars assert that, if a student can make an affective connection then interest will rise. Lastly, developing empathy and Noddings' suggestion of student relations with teachers appear aligned. A child must be able to trust their teacher before learning occurs. If a classroom environment is not welcoming and a child does not feel validated, then they will choose to not be cognizant (Noddings, 1993).

Sternberg and Barnes (1988) created a “triangular theory of love” that was composed of intimacy, commitment, and passion. The three components contribute to a teacher's pedagogical approach. Intimacy describes the strong bonds built with students; commitment is to students and the content being taught, and passion describes the joy that one feels when teaching (Goldstein, 1998). C.S. Lewis (1953) discusses the importance of emotions in schooling, and if omitted then the system will be teaching “men without chests”. It is a hindrance to education to develop only the cognitive ability of children and ignore the emotional aspect.

Carol Gilligan (1982) identified four themes for caring: the situation’s moral relevance; practical positions for survival; the essence of power to understand values; and the importance of narratives morally. Thomson (1998) revisited them from a womanist perspective. Womanism stems from the cultural, moral, cultural, and lived experiences of African American women (Walker, 1983). Whereas, traditional theories of care underline innocence, those related to womanism highlight knowledge (Thomson, 1998). Womanists
surmise that oppression is an interlocking system, individual empowerment should be combined with collective action, and seek to liberate all people (Beauboeuf-Lafontant, 2002).

“What tomorrow needs is not masses of intellectuals, but masses of educated men – men educated to feel and as well as to think” (Silverman, 1970, p. 127). Children are one of the most precious resources and are often only valued for their achievement (Noddings, 1993). The knowledge that is considered pivotal for students is created by those in a position of privilege and only takes into account one viewpoint. The emphasis on rationality and abstract reasoning hinders students and does not take into account feelings, concrete thinking, practical activity, or moral action (Noddings, 1988). A classroom with a caring environment not only cares for children but models how students can care for others. A competent teacher does not neglect a student's feelings but builds upon the affective reaction to create stronger and relevant instruction (Noddings, 1993). Students can be given the opportunity and responsibility to express their emotions (Noddings, 1988). Children must express their emotions to relay confusion, angst, or joy to their teacher creating a stronger classroom community. The ability to understand a child's emotions is often discredited and not seen as applicable to the scholarly field (Goldstein, 1998). Mem Fox (2013) theorizes how the affective domain will not go away in teaching:

But the affective won't go away. It's always there, whether researchers admit it or not. The plain old fact of the matter is that teachers and children have hearts, and those hearts play an enormous part in the teaching/learning process. (pp. 3-4)
Teachers' socialization of students' emotions enhance academic success and interpersonal skills (Denham, Bassett & Zinsser, 2012). According to Denham, Bassett, and Zinsser (2012), “Emotion regulation includes abilities to: (1) handle emotions in productive ways: being aware of feelings, monitoring them, and modifying them, when necessary, so that they aid rather than impede coping in varying situations; and (2) expressing emotions appropriately. Children who have difficulties in this area may not have resources to focus on learning, whereas those who can maintain positive emotions may be able to better engage with classroom tasks” (p. 138). Emotional regulation and interpretation can lead to early academic success in students' lives (Denham, Bassett & Zinsser, 2012). The ability for young children to regulate their emotions is as important as social and academic affluence (Denham, Bassett & Zinsser, 2012).

Children with anxiety disorders demonstrate myriad affective reactions (Hannesdóttir, Doxie, Bell, Ollendick, & Wolfe, 2010). When anxious children face emotional conditions, their skills are below their peers (Hannesdóttir, Doxie, Bell, Ollendick, & Wolfe, 2010). Anxious students have lower self-efficacy, unregulated expressions, and more intense emotions (Suveg and Zeman, 2004). Children also have difficulty altering their emotions from an extreme reaction when stimuli are viewed as threatening (Vasey & MacLeod, 2001). Anxiety disorders have increased in children and can be due to lack of emotional development or acknowledgment in their lives (Ekman, 2003).

Affective reactions, or emotions, are “both physiological and psychological feelings that children have in response to events in their world” (Hansen & Zambo, 2007,
Emotions help children to formulate their thinking, direct their attention, and stimulate their physical reactions to adjust to their needs (Izard & Ackerman, 2000). When emotions are ignored or misunderstood then it is detrimental to their development (Ekman, 2003). Affective reactions assist in bolstering academic and interpersonal ability (LeDoux, 1996). Children begin their lives with simplistic emotions that become complex with time (Hansen & Zambo, 2007). When kids are given the opportunity to express themselves emotionally then they will develop a more positive self-concept (Hansen & Zambo, 2007). Teachers must help children learn to think about their feelings, label them and begin to regulate their emotions to instill a healthy affective domain (Hansen & Zambo, 2007).

Thompson (1998) has critiqued Noddings’ ethic of care for not acknowledging white privilege and bias in society and educational theory. Thompson (1998) warns against an ethic of care model that treats the values and ideals associated with White, middle-class experiences as universal and normative, thus ignoring those of traditionally marginalized socio-cultural groups. For example, Noddings’ approach assumes caring and nurturance to be private sphere values; yet, as Thompson demonstrates, African American communities often employ such attributes in public sphere venues through such networks as church, activist, and service organizations (Noddings, 1993; Thompson, 1998). Much like Bronfenbner’s Ecological Systems Model, cultural values and perspectives only work for those who are able to make connections personally and communally (Thompson, 1998).

Theories of care often refer to only women and girls as a generalization, concluding that all females despite race, ethnicity, age, or class require the same form of
care (Thompson, 1998). The ideals are based upon White, middle or upper class values that omit lower class White females. The universal generalizations, as defined by those in power, only work for those who are empowered by the ideals (Thompson, 1998).

Another critique of the ethic of care is power relationships within the classroom. Students of color are often theorized to not receive appropriate support in their private sphere that the teacher must counteract (Thompson, 1998). Thompson (1998) critiques this stereotype as baseless and rooted in hegemonic racial biases, while calling for caring and nurturance of all students.

Noddings’ (1993) framework for an ethic of care stresses the home, private values, as a safe, warm environment yet it may not be the case for all children. For example, Beauboeuf-Lafontant (2002) and Thomson (1998) write that African American homes often extend to the community and surrounding society, much like Bronfenbrenner’s Ecological Systems Model. Caring within this type of community extends beyond the private sphere to include the public sphere. Moreover, Collins (1992) created a list of Ten Teaching Commandments for teachers to utilize the maternal structure:

1. Thou shall love their students as you would love your own children.
2. Do unto your students, as you would have them do unto you.
3. Honor your students, praise as well as criticize constructively.
4. Thou shall not spend so much time being a teacher that you have forgotten what it is like to be a child.
5. Love your students so well that you give your last iota of energy making them good citizens.
6. Thou shall not let any students feel they are failures.

7. Thou shall never, never give busy work.

8. Thou shall never consider yourself in the “land of the done.” You, as a good teacher, will always know that you will always strive to become a better teacher.

9. Thou shall love freely, purely, consistently, and that love will return to you a hundred-fold.

10. Thou shall respect every child and every parent and always be true to the Latin meaning of the word “educator”, which means, “to lead” or “draw out”. (p. 178)

The Ten Commandments allow for the educator to reconsider hegemonic educational practices and make space for voices of oppressed others (Delpit, 1995). Maternal in education has often been disregarded because it conflicted with patriarchal ideals (Beauboeuf-Lafontant, 2002).

Moral relevance must be questioned in “black communities” due to contrasting ideals that contrast with the dominant codes (Beauboeuf-Lafontant, 2002; Thomson, 1998). Thomson (1998) and Beauboef-Lafontant (2002) write that African American mothers view mothering differently than traditional values in that affection is not the only form of caring but monetary gains help to assist their children in surviving. Othermothering is a tradition in these cultures that builds communal bonds to sustain beliefs and ideals. The tradition allows for children to develop holistically, not just academically (Beauboeuf-Lafontant, 2002). The cultural specific and social aspect of
othermothering is comparable to Vygotsky’s sociocultural theory in that children will learn best through interaction in a culture specific context.

Unlike White families, Black families must prepare their children to face racism. Children are not protected from the world’s cruelty but are taught from a young age how to face racism with resilience. Along with innocence, White female values are not emphasized and instead are replaced with strength and knowledge. The aforementioned values bolster the family, community, and society (Thomson, 1998).

Womanism highlights African American women’s experience as leaders in justice. Thomson (1998) stated, “Being womanist is not about being nice, or being a lady, or not upsetting people. Instead it represents a full-bodied view of womanhood encompassing “outrageous, audacious, courageous” and inquisitive behavior” (p. 276). The traditional “nice” behavior of classroom teachers disregards womanism. African American students feel disregarded if teachers avoid discussing race causing difficulty in building relationships (Beauboeuf-Lafontant, 2002; Thomson, 1998).

Often times, early childhood and elementary teachers will avoid discussing race with their students (Thompson, 1998). Teachers will choose to evade the topic and create “racial obliviousness” or deem Whiteness the classroom norm (Thompson, 1998). The method harms all students in the classroom by excluding this trait. Colorblindness perpetuates the ideal that being a different race other than white is shameful and deviant (Thompson, 1998). Children are not able to express their uniqueness but instead are expected to follow White ideals of their colorblind teacher. Thompson (1998) stated, “Colorblindness ignores the structures of race, class, and gender relations that together posit color as a deficit in the first place” (p. 3).
Emotional research with children has focused on emotional regulation in normative populations (Saarni, 1999; Suveg & Zeman, 2004). Typical emotions are being addressed, such as, sadness and happiness, leaving a gap for atypical emotions, such as, worry (Suveg & Zeman, 2004). The sample sizes for emotional regulation are white, middle-class subjects (Saarni, 1999) creating caution for researchers and the assumptions associated with hegemonic approaches. One should be cautious with emotional regulation research due to the hegemonic norm often being utilized on “other” cultures and ethnicities, which can cause assimilation, deculturalization, marginalization, and exclusion.

Narratives in all cultures are powerful. Narratives from African American cultures tend to rebuke the traditional ideology and add a new perspective. Storytelling helps one to connect to their past, present, and future yet in most schools only White tales are being told, which do not encompass all students’ experiences (Thomson, 1998).

Thomson (1998) suggested aspects of a curriculum to rid of the hidden racism in the classroom. Teachers must get to know every student, not just personally, but their backgrounds and situations. Students need aid in creating survival strategies for racism, sexism, homophobia, or ableism. All students must be treated with respect despite their race, culture, sex, class or viewpoints. Teachers need to allow for various narratives to be utilized in learning as opposed to the dominant culture’s form. Last, all viewpoints, new and old, must be embraced. Students must feel that they can express their thoughts without apprehension and that they will be heard and respected. 

**Following ideals.** The American educational system often utilizes techniques that promote competitiveness, assertiveness, and a hierarchical classroom. At times, students
are expected to regurgitate the content permeated from their teacher and the state standards. Students are frequently in conflict with these ideals due to their unique way of thinking and approach to education (Maher & Tetreault, 1994). Their voices are being silenced and one set of knowledge is being accepted.

Education has diverged affective from cognitive in students’ experiences (Maher & Tetreault, 1994). Children are valued by their cognition if it is in accord with the system’s values. Students are being quantified by a test score without acknowledging a child’s social and emotional development.

Many students have diverse gender, class, sex, race, and ethnic identities that do not reflect the dominant education culture (Maher & Tetreault, 1994). However, children are expected to mold to these expectations in order to succeed. Traditional education commences with teacher’s knowledge without considering the students’ knowledge. Instead, curriculum is designed with the teacher as the center and keeper of knowledge with students as voiceless recipients (Maher & Tetreault, 1994). Feminist pedagogy aims to encourage all students, particularly underrepresented groups, to be part of their education. The curriculum would consider their concerns while allowing each child to create their own meaning and voice (Maher & Tetreault, 1994).

**Mathematics Journals**

Vygotsky theorized that learning would be threatened with the presence of tension and anxiety (Vygotsky, 1987). When mathematics anxiety is present it effects the way children interact with peers and the material. In order to reduce these effects a conducive environment must be present at all times. Past experiences must be taken into account for mathematics anxiety due to the factors they introduce. The combination of teacher and
parental beliefs, attitudes and anxiety about mathematics permeate to students and effect their outlook on the subject.

The National Council of Teachers of Mathematics (1989, 1995b) provided techniques for teachers to implement to ameliorate mathematics anxiety:

- Accommodating for different learning styles.
- Creating a variety of testing environments.
- Designing positive experiences in mathematics class.
- Refraining from tying self-esteem to success with mathematics.
- Emphasizing that everyone makes mistakes in mathematics.
- Making mathematics relevant.
- Lettings students have some input into their own evaluations.
- Allowing for different social approaches to learning mathematics.
- Emphasizing the importance of original, quality thinking rather than rote manipulation of formulas.

Supporting the claims of NCTM are Hackworth (1992) and Furner and Berman (2003) who suggest seven additional means of alleviating mathematics anxiety:

- Discussing and writing about mathematics feelings.
- Becoming acquainted with good mathematics instructions as well as study techniques.
- Learning study methods that enable students to recognize different types of information learning.
- Being an active learner and creating problem-solving techniques.
- Evaluating one's own learning.
- Developing calming, positive ways to deal with fear of mathematics.
- Building confidence in mathematics through gradual, repeated success.

The therapeutic value of journals has long been established (Progoff, 1975; Rogers, 1969). When students are writing in a mathematics journal they can be encouraged to reflect their feelings and attitudes towards the subject and help to cope with the negative emotions. Moreover, mathematics journals can be utilized to assist children with new content and skills by giving them the opportunity to reflect upon knowledge of the subject (Borasi & Rose, 1989). Mathematics journals are effective for both cognitive and affective gains (Koirala, 2002). The opportunity to write about traumatic or negative contexts and experiences is beneficial to the participant (Klein & Boals 2001; Smythe, 1998)

The National Council of Teachers of Mathematics (2000) proposed Principles and Standards for School Mathematics that promote children being able to communicate their mathematical thinking. Burchfield, Jorgenson, McDowell, & Rahn (1993) concluded the benefits between writing and mathematics:

“Writing is a natural process, a method of communication between people and a way to express the thoughts and feelings that occur within a person. Its use as a tool for the teaching and learning of mathematics is a recent development, springing in part from the NCTM Standards on Communication.” (p.1).

Writing helps students to 1) increase knowledge and experience for preparation for new activities, 2) reflect on what has been learned, and 3) widen and connect ideas and experiences (Langer & Applebee, 1987). In the classroom, mathematics journals are a tool to document each pupils' personal learning. The ability to put feelings into words is
insurmountable. It has been shown that the opportunity to write about negative feelings is a method to manage the affective domain (Lieberman, Eisenberger, Crockett, Tom, Pfeifer, & Way, 2007). Journals allow students to express how they feel, what they know, what and how they do tasks, and why they do it (Borasi & Rose, 1989; Yinger & Clark, 1981).

Journal writing is a method utilized for mitigating negative experiences and thoughts. The opportunity to write short expressive pieces has shown to minimize deficits of test performance, especially for students with mathematics anxiety (Ramirez & Beilock, 2011). Being able to express concerns or worries accounts for students feeling more comfortable with a test. Ramirez and Beilock (2011) concluded that, “one short writing intervention that brings testing pressures to the forefront enhances the likelihood of excelling, rather than failing, under pressure” (p. 15). Distress and anxiety can be reduced through writing about emotional topics, such as mathematics anxiety (Pennebaker, 1997; Smythe, 1998). A link between increased academic performance and writing about emotional topics has also been found (Pennebaker, 1997), meaning that students who are able to write about emotional experiences are more apt to have higher grades. When a child holds onto negative emotions and feelings it is stressful but when they are able to express their feelings it should reduce the stress and anxiety (Pennebaker, 1989).

Smythe (1998) concluded that in order for journal writing to be an effective technique that it must last over time. Students should not write in a journal once and expect gains in academia; the longer the duration, the stronger the effects. Writing helps students to 1) increase knowledge and experience for preparation for new activities, 2)
reflect on what has been learned, and 3) widen and connect ideas and experiences (Langer & Applebee, 1987). In the classroom, mathematics journals are a tool to document each pupils' personal learning. The ability to put feelings into words is insurmountable.

Furner and Berman (2003) suggest the technique of journal writing to mitigate mathematics anxiety in elementary children. It is also suggested that students write down their worries before taking a mathematics test (Maloney & Beilock, 2012; Park, Ramirez, & Beilock, 2011). When a student is able to convey their feelings, attitudes and understanding of mathematics then it can assist in decreasing their mathematics anxiety. Students can be given the proper tools to self-assess their mathematics anxiety to gain cognitive control (Lyons & Beilock, 2011).

Maloney & Beilock (2012) advocate for mathematics anxiety treatment to focus on the affective as opposed to the mathematical skills of a child. The emotions of elementary students must be taken into account. Emotions encompass sensory processes but also effect cognition (Immordino-Yang & Damasio, 2007). Cognition and emotion both have effects on “learning, attention, memory, decision making, motivation, and social functioning” (Immordino-Yang & Damasio, 2007, p. 7). The aforementioned aspects of learning are affected by the phenomenon of mathematics anxiety.
Chapter 3: Methodology

Introduction to Methodology

This chapter discusses the methodology used in a quasi-experimental multi-methods based study addressing mathematics anxiety related to the usage of mathematics journals. The primary purpose of this study is to explore the impact of daily mathematics journals on third-grade students’ mathematics anxiety levels.

The present study addressed whether or not daily mathematics journals alleviated mathematics anxiety levels amongst third-grade students. The study used the Anxiety Measure (adapted from the MARS-E) (Ramirez, in press) to obtain data to evaluate the mean difference of the Anxiety Measure between pre and post-test administration. Anxiety Measure was utilized to establish the baseline mathematics anxiety level of the students participating in the study. The Anxiety Measures were labeled “1” for pre and “2” for post-test data. Researcher observations were used to improve and bolster the results. This section includes the research questions and hypothesis, the sample, the Treatment and Control group, the instruction and materials, the procedures for collecting, organizing, and analyzing the data, and the role of the researcher.

Ethnography and the Ethnographical Method

Ethnographies focus on a cultural group (Creswell, 2012), which are defined in this study as third-grade classrooms. The qualitative design permits the researcher to, “describe and interpret the shared and learned values, behaviors, beliefs, and language of a culture-sharing group” (Creswell, 2012, p. 123). Participant observation is the pivotal research method and requires the researcher’s immersion in the daily lives of the participants. A realist ethnography approach was utilized in this study. Creswell (2012)
synthesized that a realist ethnography reported from a third-person point of view the
observations and information overheard from the participants. The researcher is in the
background and is equivocated as a reporter.

Prior to collecting data, the researcher selects an issue to study about the group
(Creswell, 2012). The aim of this study is to determine if mathematics anxiety exists in
third-graders and if so do mathematics journals alleviate mathematics anxiety. Data is
collected through a variety of research tools, such as observation, interviews, and
artifacts.

**Ethical Concerns**

When researching children, there is a high concern for confidentiality. Consent
was given by the school principal, mathematics specialist, two classroom teachers, and all
students participating in the study. Parent assent was also given for each student.

Teachers and students participating in this study did not receive compensation for
their participation. Students who chose not to participate were not penalized. Student
names and identities were kept confidential and anonymous. The information and
documents collected from this study were kept on the researcher's computer that was
password protected. The findings of the study were available to teachers, mathematics
specialist, principal and parents upon request.

**Research Question and Hypothesis**

1. Will there be a significant difference between third-grade students using mathematics
   journals and third-grade students not using mathematics journals on mathematics
   anxiety as measured by the Anxiety Measure?
• H₀: There will be no significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.

• Hₐ₁: There will be a significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.

2. Do mathematics journals decrease the amount of mathematical anxiety in third-grade students as measured through observation, interviews and mathematics journals?

**Design of the Study**

The present study was a quasi-experimental design utilizing ethnography as the qualitative foundation. Ethnographies aim to describe a social or a cultural group or system (Greig, Taylor & MacKay, 2013). This study utilized a real-life situation that accentuates the participants' accounts of their experiences. A main feature of the design of the study is the conduction within a natural setting, the elementary classroom, to seek out an account of lived experience. Importance is placed on the actions and contexts within the classroom. A combination of theory and previous research bolster ethnographic studies and allow for existing themes to be tested and used as a basis for research design.

According to Rossman and Rallis (2011) ethnographies entail “data-gathering techniques are multiple and flexible, formal and informal interviews, interpretation of artifacts, and the researcher's own experience of events and processes” (p. 93). For this study, mathematics journals will be defined as the artifacts being interpreted. Due to the
prolonged nature of ethnographies, a mini-ethnography will be conducted over a month long process.

**Setting and Sample**

The elementary school in the present study is located in the Midwestern part of the United States in a rural community. Of the 11.5 million people that live in the state, 64,300 live in this county. Financially, 32.3% of the county makes less than the baseline poverty level. The monetary value affects the school system in that students will not have equitable access to resources or the funding that their peers in other districts will have. Furthermore, while Ohio's average spending per pupil is $9,052, this district can only spend $5,021 per pupil. The dissonance between spending per pupil is over $4,000 (United States Department of Commerce, 2012). The school district does not consist of a diverse student population. The district is comprised of seven schools, which four are elementary schools. According to the district's 2012-2013 Adequate Yearly Progress Report, approximately eighty-nine percent of the students at the elementary school are of white, non-Hispanic backgrounds. Students at the elementary school did not meet the Annual Measurable Objective for the state of 78.5%; the school had a score of 77.2%. Therefore, mathematics achievement must be bolstered to reach this objective.

The sample consists of two 3rd grade classrooms that are in-tact groups designated by the school principal and teachers. The Treatment group consists of 14 students, and the Control group has 16 students with an overall total of 30 students in the study.

The National Council of Teachers of Mathematics (2010) proposed four goals to make professional development and teacher training more attainable. The first goal is to
invest a substantial amount of time. It has been shown that the greatest learning takes place during the first 100 hours. An iterative and incremental change will occur through inquiry, experimentation and reflection. The second goal is systemic support. The principal is viewed as a valuable asset to professional development being successful. Moreover, if the development is aligned with Common Core Standards and aligns with personal goals, then it is more apt to be successful. The third goal is opportunities for active learning. If teachers can watch the proposed development be enacted, then they can see the product. It is beneficial for educators to be a part of the process and understand how it will work in their classroom with the help and support of fellow teachers (National Council of Teachers of Mathematics, 2010).

The teacher training for this study involved the researcher, mathematics specialist, and the two third-grade classroom teachers. The researcher was required to train the teachers in the administration of the Anxiety Measure and mathematics journals. The two third-grade teachers met with the researcher in August for two days of training. The teachers were shown the Anxiety Measure and guided by the researcher for the intended purpose and instructions. Examples were created to give students a reference of how to complete the questionnaire. The references serve as a method for the students to become comfortable with the scale.

The mathematics journal training entailed familiarizing the teachers with the Mathematics Thermometer and daily prompts. Through collaboration, prompts were tweaked to suit the classroom instruction better. It was important to maintain classroom procedure to ensure fluidity with instruction. Both teachers were encouraged to continue with their regular mathematics teaching methods.
**Instrumentation**

*Questionnaire.* The 16-item Anxiety Measure questionnaire was adapted from the Child Mathematics Anxiety Questionnaire (Ramirez, Gunderson, Levine & Beilock, 2013) and the Mathematics Anxiety Rating Scale for Elementary children (Suinn, Taylor & Edwards, 1988). The Mathematics Anxiety Rating Scale for Elementary children (MARS-E) was developed for students in the 4th through 6th grade. The MARS-E is a 26-item questionnaire designed to reflect mathematics anxiety related to situations inside and outside the classroom. Construct validity was confirmed by the questionnaire and the Stanford Achievement Test (SAT). The correlations between MARS-E and SAT were as follows at the significant level or .001, mathematics concept (r = -.29), mathematics application (r = -.26), mathematics computation (r = -.26), and total score (r = -.31). A second approach of factor analysis, principal components analysis, with oblique rotation. Two factors with eigenvalues greater than 1.0 were identified. The two factors were categorized as Mathematics Test Anxiety and Mathematics Performance Adequacy Anxiety, which is in conjunction with the Mathematics Anxiety Rating Scale (Suinn & Richardson, 1972) and Mathematics Anxiety Rating Scale for Adolescents (Suinn & Edwards, 1982). Reliability of the MARS-E was estimated through Cronbach's alpha and was found to be .88 (Suinn, Taylor & Edwards, 1988). A five-point Likert-like scale anchored at points with the statements from “not at all nervous (1)” to “very, very nervous (5)”. The values of the 26 responses were summed to create a total score with a maximum of 130.

In general, the Child Mathematics Anxiety Questionnaire (CMAQ) maintained the original content of the MARS-E but with adjustments to create age appropriate
mathematics problems for first and second graders. Questions posed to children focused upon mathematics-teaching workbooks and specific classroom situations pertaining to mathematics. Children responded to the questions through a sliding scale composed of varying faces; a calm face on the far right, a semi-nervous face in the middle, and a nervous face on the far left (Ramirez, Gunderson, Levine & Beilock, 2013). A numerical scale was not visible to children and values ranged from 1 to 16. The total score was calculated by taking an average of the eight scores. Prior to the administration of the questionnaire, students were given examples as to what it means to be nervous. Reliability was found to be .55 for the CMAQ. Although a score of .70 is generally considered to be acceptable (Hair, 2012), the creators noted that it is often common to find values below the desired level when working with primary children (Ramirez, Gunderson, Levine & Beilock, 2013). A main contribution to the low value is the small amount of items on the questionnaire that is highly influential to Cronbach's alpha.

The Anxiety Measure (AM) is adapted from the MARS-E and extended upon CMAQ. The AM is composed of 16 items that pose questions pertaining to mathematical tasks and situations in the classroom. Anxiety is measured through a smiley-face scale with five faces depicted upon it, ranging from “not nervous at all (1)” with a smiley face, “somewhat nervous (3)” with a semi-nervous face, and “very, very nervous (5)” with a nervous face. Participants select a face that has a corresponding value of 1 – 5. Each score is calculated by taking an average across the 16 items. Prior to administration children, are asked if they understand the term “nervous” and are guided by an explanation of the smiley-face scale as well as through examples. The researcher does not give feedback to the child but only general encouragement (Ramirez, 2014). For this
study, questions on the AM were adjusted for a third-grade level with collaboration from the mathematics specialist.

**Observation.** Structured observations were utilized in this study. A structured observation allows the researcher to watch and record behavior relevant to the study (Greig, Taylor & MacKay, 2013). The purpose of observation in this study is to determine whether or not a treatment alleviates mathematics anxiety. The time sampling method will also be utilized. It allows the researcher to “focus on one activity to discover its frequency” (Greig, Taylor & MacKay, 2013). The body language of children during mathematics is directly observable. The researcher focused on identifying behaviors and body language that are consistent with mathematics anxiety. Those who suffer from mathematics anxiety can have a range of symptoms that are psychological or physiological. Psychological symptoms include feeling helpless, disgrace, defensive behavior, panicking, going blank on a mathematics task and being unable to cope (Plaisance, 2009; Ruffins, 2007). Under the psychological domain individuals have an increased heart rate, clammy hands, upset stomach, nervous laughter, crying, frequent need to use the bathroom, clenched fists, dry mouth and lightheaded (Plaisance, 2009, Ruffins, 2007). Mathematics anxiety derives from the affective domain yet can be observed through dislike, worry and fear under the attitudinal, cognitive, and fear domains, respectively (Ma, 1999). The researcher documented in their notebook when students portray any of the aforementioned behaviors.

Daily observations of the two classrooms were conducted by the researcher. Observations took place during mathematics instruction that occurred at separate times in the two classrooms. The researcher had a checklist with all participants listed and would
watch the classroom for signs of mathematics anxiety behavior. If a student exhibited any symptoms, then a check mark and time and description of the behavior would be noted. Over time, it became evident as to, which students exhibited mathematics anxiety, the cause and a pattern of the time.

**Mathematics journals.** The National Council of Teachers of Mathematics (1989, 1995b) provided techniques for teachers to implement to ameliorate mathematics anxiety:

- Accommodating for different learning styles.
- Creating a variety of testing environments.
- Designing positive experiences in mathematics class.
- Refraining from tying self-esteem to success with mathematics.
- Emphasizing that everyone makes mistakes in mathematics.
- Making mathematics relevant.
- Lettings students have some input into their own evaluations.
- Allowing for different social approaches to learning mathematics.
- Emphasizing the importance of original, quality thinking rather than rote manipulation of formulas.

Supporting the claims of NCTM are Hackworth (1992) and Furner and Berman (2003) who suggest seven additional means of alleviating mathematics anxiety:

- Discussing and writing about mathematics feelings.
- Becoming acquainted with good mathematics instructions as well as study techniques.
• Learning study methods that enable students to recognize different types of information learning.

• Being an active learner and creating problem-solving techniques.

• Evaluating one's own learning.

• Developing calming, positive ways to deal with fear of mathematics.

• Building confidence in mathematics through gradual, repeated success.

The therapeutic value of journals has long been established (Progoff, 1975; Rogers, 1969). When students are writing in a mathematics journal, they can be encouraged to reflect their feelings and attitudes towards the subject and help to cope with the negative emotions. Moreover, mathematics journals can be utilized to assist children with new content and skills by giving them the opportunity to reflect upon knowledge of the subject (Borasi & Rose, 1989). Mathematics journals are effective for both cognitive and affective gains (Koirala, 2002). The opportunity to write about traumatic or negative contexts and experiences is beneficial to the participant (Klein & Boals 2001; Smythe, 1998)

The National Council of Teachers of Mathematics (2000) proposed *Principles and Standards for School Mathematics* that promote children being able to communicate their mathematical thinking. Burchfield, Jorgenson, McDowell, & Rahn (1993) concluded the benefits between writing and mathematics:

Writing is a natural process, a method of communication between people and a way to express the thoughts and feelings that occur within a person. Its use as a tool for the teaching and learning of mathematics is a recent development, springing in part from the NCTM Standards on Communication (p.1).
Writing helps students to 1) increase knowledge and experience for preparation for new activities, 2) reflect on what has been learned, and 3) widen and connect ideas and experiences (Langer & Applebee, 1987). In the classroom, mathematics journals are a tool to document each pupils' personal learning. The ability to put feelings into words is insurmountable. Writing about negative feelings is a method to manage the affective domain (Lieberman, Eisenberger, Crockett, Tom, Pfeifer, & Way, 2007). Journals allow students to express how they feel, what they know, what and how they do tasks, and why they do it (Borasi & Rose, 1989; Yinger & Clark, 1981).

Journal writing is a method utilized for mitigating negative experiences and thoughts. The opportunity to write short expressive pieces has shown to minimize deficits of test performance, especially for students with mathematics anxiety (Ramirez & Beilock, 2011). Being able to express concerns or worries accounts for students feeling more comfortable with a test. Ramirez and Beilock (2011) concluded that, “one short writing intervention that brings testing pressures to the forefront enhances the likelihood of excelling, rather than failing, under pressure” (p. 15). Distress and anxiety can be reduced through writing about emotional topics, such as mathematics anxiety (Pennebaker, 1997; Smythe, 1998). A link between increased academic performance and writing about emotional topics has also been found (Pennebaker, 1997), meaning that students who can write about emotional experiences are more apt to have higher grades. When a child holds onto negative emotions and feelings, it is stressful but when can express their feelings it should reduce the stress and anxiety (Pennebaker, 1989).

Smythe (1998) concluded that in order for journal writing to be an effective technique that it must last over time. Students should not write in a journal once and
expect gains in academia; the longer the duration, the stronger the effects. In the classroom, mathematics journals are a tool to document each pupils' personal learning. The ability to put feelings into words is insurmountable.

Furner and Berman (2003) suggest the technique of journal writing to mitigate mathematics anxiety in elementary children. It is also suggested that students write down their worries before taking a mathematics test (Maloney & Beilock, 2012; Park, Ramirez, & Beilock, 2011). When a student can convey their feelings, attitudes and understanding of mathematics then it can assist in decreasing their mathematics anxiety. Students can be given the proper tools to self-assess their mathematics anxiety to gain cognitive control (Lyons & Beilock, 2011).

Maloney & Beilock (2012) advocate mathematics anxiety treatment to focus on the affective as opposed to the mathematical skills of a child. Emotions encompass sensory processes but also effect cognition (Immordino-Yang & Damasio, 2007). Cognition and emotion both have effects on “learning, attention, memory, decision-making, motivation, and social functioning” (Immordino-Yang & Damasio, 2007, p. 7). The aforementioned aspects of learning are affected by the phenomenon of mathematics anxiety.

In this study mathematics journals were written in daily for a month-long duration, lasting 22 school days. The researcher created Mathematics Thermometer (see Appendix) that was filled out daily to document their feelings and anxiety toward mathematics from 0 to 10; 0 being “not anxious at all” and 10 being “highly anxious”. Daily prompts were utilized to guide students' thinking and students were encouraged to free write once the prompt is completed. The students in this classroom have been taught
self-reflective writing through the school's curriculum and were comfortable with writing about their feelings and attitudes.

**Confounding Variable of General Anxiety**

A problem in studying mathematics anxiety is the confounding variable of different types of anxiety that overlap. Mathematics anxiety is not a black and white topic but a gray continuum that constitutes many facets. One method that can be utilized is to inquire with the classroom teacher as to whether or not any students do have general anxiety. It is important to have this information because it will affect mathematics anxiety. The researcher can interview both classroom teachers to determine whether or not any students in the classroom have general anxiety. In accordance with the current classroom teachers, interviews can be conducted with the previous year's teachers to obtain details on the students' behavior over the previous school year. The data derived from the teachers assists in creating a clearer picture of each student and informs the researcher of students with general anxiety.

A second method is for the researcher to situate themselves in the room at least a week before the study, which allows for direct observation of the students. During this time, the researcher can identify any student who shows symptoms of a general anxiety or mathematics anxiety disorder. It is important that the researcher observe subjects other than mathematics to ensure that it is not subject-specific anxiety.

Observation can also be utilized to ensure homogeneity across classrooms. The researcher directly observes the students as well as the classroom teachers. The teachers were observed to determine the same temperament, instructional strategies, and discipline
techniques were used. It is pivotal to have similarities among teachers to assure that mathematics anxiety is not caused by lack of teacher support or direct instruction.

**Experimental Treatment**

In the Treatment group, 14 students participated. At the beginning and end of the study, students were given the Anxiety Measure to designate their individual baseline for mathematics anxiety. The classroom teacher read the directions and script provided by the Anxiety Measure. The classroom teacher allowed time for students to ask questions of any confusion they had. A total of ten minutes was allotted for students to complete the AM.

Students in this group were each given a mathematics journal to document their feelings and attitudes towards mathematics daily. A “Mathematics Thermometer” was provided daily for students to designate where they fell on the 0 to 10 scale. The self-assessment allowed students to be aware of their anxiety as well as see a longitudinal progression. Daily prompts were provided to the students for responses. The prompts were utilized as a guideline and to ensure that students remained on topic and were allotted time to free write once the prompt was complete.

Students in this group were not familiar with mathematics journals documenting their emotional reactions prior to this study. Children at this elementary school are familiar with reflective writing in other subjects and were comfortable with the concept. The teacher was provided a scripted introduction to introduce mathematics journals to the students over the month long process.

On the final day of the study, students in the Treatment group were given the AM for a post-test. They were reminded of answering the questions earlier in the study. The
classroom teacher read the directions and script provided by the tool. Students were allotted 25 minutes to complete the Anxiety Measure. The questionnaires were collected and given to the researcher.

**Control Group**

The Control group consisted of 16 students. Children in this group were administered the AM at the beginning and end of the study. The Control group continued instruction in the same manner as the Treatment group but without the implementation of mathematics journals.

The instruction of the Control group was identical to the instruction in the Treatment group. The students in the Control group did not receive mathematics journals to document their daily affective reflections about mathematics.

On the final day of the study, students in the Control group were given the AM. They were reminded of answering the questions earlier in the study. The classroom teacher read the directions and script provided by the tool. Students were allotted 25 minutes to complete the Anxiety Measure. The questionnaires were collected and given to the researcher.

**Data Collection**

The researcher arrived in the classroom one-week prior to the start of the study for the students to become acclimated to their presence, pinpoint students with general or mathematics anxiety, and assure homogeneity across the two classrooms. The researcher would sit in the back of the classroom daily and take notes on body language and interactions of the students. Due to separate class times, the researcher observed both classrooms.
The data for this study were collected during a month long, five-week, period. The AM was administered on the first day of the study. Students in both the Treatment and Control groups were given the AM. The researcher went over the scale and procedures as a whole group followed by reading aloud the 16 questions to the students while they designated a smiley-face. Students were given 25 minutes to complete the questionnaire.

In the Treatment group, mathematics journals were passed out daily with the designated prompt of the day and mathematics thermometer. Students were allotted ten minutes daily to reflect upon the prompts. The mathematics journals stayed in the classroom and would only leave with the researcher. The researcher coded mathematics journals and mathematics thermometers daily to determine any students who showed signs of mathematics anxiety.

Structured observations took place daily in both classrooms. The researcher would focus on all students and behavior that exhibited mathematics anxiety tendencies. The frequency chart allowed the researcher to know, which students portrayed more mathematics anxiety behavior and at what point during instruction were students more prone to mathematics anxiety.

After an analysis of observations, mathematics journals and the Anxiety Measure, the researcher selected participants to interview in a semi-structured manner. Students were taken to the back of the classroom where interviews were recorded for further analysis. The classroom was selected as the location in order to remain in the students' comfort zone. Children were asked the three questions to determine changes toward mathematics.
On the final day of data collection the Anxiety Measure was administered to the Treatment group and the Control group was administered one day later over a two-day period. The classroom teachers followed the same protocol as day one. The questionnaires were collected by the researcher for further analysis.

**Data Analysis**

1. Will there be a significant difference between third-grade students using mathematics journals and third-grade students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure?

   - $H_0$: There will be no significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.
   - $H_{a1}$: There will be a significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.

For research question, number one, the students in this study received the Anxiety Measure questionnaire that included scripted instructions that were read by the teachers and additional directions for completing the AM. Example statements were written on the board to help students with clarification before they began the questionnaire. Students were verbally instructed to read directions before starting the AM. The AM was used to identify a baseline for each third-grade student. The data of the Anxiety Measure were analyzed through SPSS using paired-samples t-tests for the overall mean difference between pre and post-test, as well as, a paired-samples t-test for individual students' differences.
The independent variable for this study was mathematics journals, third-grade students, and the dependent variable was the students' mathematics anxiety and the pre and post-test of the Anxiety Measure. To investigate the mathematics journal's effectiveness, a paired-samples t-test was used to compare the mean of the overall AM pretest and post-test scores for each group. An alpha level of .05 was used to reject the null hypothesis.

2. Do mathematics journals decrease the amount of mathematical anxiety in third-grade students as measured through observation and mathematics journals?

Observations were coded based upon frequency of mathematics anxiety behavior being displayed in the classroom setting during mathematics time. The researcher had a classroom seating chart and would tally whenever a child displayed signs of mathematics anxiety. Detailed notes were also taken of the type of behavior exhibited by child during the occurrence. Spradley (1980) suggests nine steps to take when recording observational data:

1. Space: the physical place or places
2. Actor: the people involved
3. Activity: a set of related acts people do
4. Object: the physical things that are present
5. Act: single actions that people do
6. Event: a set of related activities that people carry out
7. Time: the sequencing that takes place over time
8. Goal: the things people are trying to accomplish

All observation notes followed included the nine provisions to ensure consistency across the data.

Mathematics journals were coded based upon emerging themes that children would create. They were categorized into emotional reactions to mathematics. The interviews, observations and mathematics journal were coded under the same thematic schema.

The modified method of Moustakas’ van Kaam analysis was used for coding the observation, interview and mathematics journal data (Moustakas, 1994). The method is composed of the following steps:

- “Horizontalization: Listing and Preliminary Grouping: list every quote relevant to the experience.

- Reduction and Elimination: determine the invariant constituents by testing each expression for two requirements:
  - Does it contain a moment of the experience that is a necessary and sufficient constituent for understanding it?
  - Is it possible to abstract and label it? If yes, it is a horizon of the experience.

Expressions not meeting the above requirements are eliminated. If expressions overlap, repeat, and are vague then they are also eliminated or presented in more exact descriptive terms. The horizons that remain are the invariant constituents of the experience.

- Clustering and Thematizing the Invariant Constituents.
• Validation: Final Identification of the Invariant Constituents and Themes by Application.

• Check the invariant constituents and themes against the complete record of participants and ask:

• Are they expressed explicitly in the complete transcript?

• Are they compatible if not explicitly expressed?

• If they are not explicit or compatible, they are not relevant to the participants' experience and should be deleted.

• Using the relevant, validated invariant constituents and themes, construct an Individual Textural-Structural description of the experience. Include verbatim examples from the transcribed interview.

• Construct for each participant an Individual Structural Description of the experience based on the Individual textural description and imaginative variation.

• Construct for each research participant a textural-structural description of the meanings and essences of the experience, incorporating the invariant constituents and themes. From the individual textural-structural descriptions, develop a composite description of the meanings and essences of the experience, representing the group as a whole.” (Machtmes, et al., 2009; Moustakas, 1994, p.120-121).

Data analysis for ethnographies often begin with broad domains that help to construct the analysis (Rossman & Rallis, 2011). The analysis relied on observation,
interviews, and artifacts that are mathematics journals. The process requires “bringing order, structure, and meaning to the mass of collected data” (Rossman & Rallis, 2011).

The analysis of ethnographic data both quantitative and qualitative start from items and variables (units) to factors (patterns), domains (structures) and paradigms. A unit can be a simple, alternate response (yes or no) to a complex response (a Likert-like scale). Patterns are the relationships among the units that are measured. Structures are the relationships among the patterns (LeCompte & Schensul, 1999, pp. 114-115). The structure assisted in connecting the Anxiety Measure to the multi-methods of observation, interviews, and mathematics journals.

Triangulation was achieved through a peer debriefer and a member of the community of practice. Participants (or research class) were given copies of the interview transcripts to ensure validity and credibility. Rossman & Rallis (2011) define a “peer debriefer” or “critical friend” as a person who “serves as an intellectual watchdog” to assist with analytic categories and building explanations (p. 65). The peer debriefer would regularly with the researcher to ensure validation of the data and credibility of the study. For this study the peer debriefer was Dr. Machtmes, the methodologist of the committee. Dr. Machtmes would validate emerging themes and categories, make corrections and provided additional supporting information to help explain the study. The colleague from the community of practice was a classmate and fellow researcher who is familiar with the process.

Role of the Researcher

The researcher is a licensed teacher in the state of Ohio for grades preschool to fifth with experience teaching preschool and fourth grade. Plans were made to meet
weekly with the two classroom teachers to ensure students' reactions to the lessons and methods to decrease negative emotions. If themes arose from researcher's nightly analysis, then discussions would take place promptly with the classroom teachers. A time for questions, answers, and concerns with the classroom teachers and mathematics specialist was also provided.

The researcher situated themselves in the classrooms a week prior to the beginning of the study in order for the students to be familiar with a new adult in the classroom. This helped for the researcher, teacher and students to be acclimated to the change. The researcher collaborated with the Mathematics Specialist at the elementary school as well as the two third-grade teachers. Through the collaboration with the mathematics specialist, a professional development plan was created to be implemented for the teacher of the classroom that will utilize mathematics journals. The one-day process allowed the teacher to become familiar with mathematics journals and how they will be used to collect data.

Henstrand (2006) regarded the role of the researcher in ethnographic studies to penetrate the emotions of the subjects. Individuals act and are motivated by their emotions. It is through the researcher that emotions can be uncovered and begin to understand the meaning.

During the month-long study, collected data was stored on the researcher's password protected laptop as well as in a locked closet when not in use. Mathematics journals were taken home nightly by the researcher to analyze for themes or strong reactions to the mathematics content and feelings. The mathematics journals were also
kept in the locked closet after use. The researcher collected and analyzed the data to share the results with those interested (Hatch, 2002).

**Threats to Validity**

A threat to validity was that the Control and Treatment groups were not randomly assigned, but in-tact groups created by the elementary school. Moreover, due to the small sample size generalizability will be limited.

A second threat is that test anxiety and general anxiety cannot be separated from mathematics anxiety. This is acknowledged as a problem inherent to this research.

The research will adhere to a strict protocol to allow for replication by other researchers. The rigor and transferability will assist future researchers in studying mathematics anxiety in young children.


Chapter 4: Results and Data Analysis

Introduction

The aim of the present quasi-experimental study was to examine the effects of mathematics journals on third-graders’ mathematics anxiety levels. The study was conducted from September through November for a total of 8 weeks. This section discusses the research tools, data analysis, and findings. Two major research questions were investigated.

1. Will there be a significant difference between third-grade students using mathematics journals and third-grade students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure?
   - $H_0$: There will be no significant difference between using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.
   - $H_{a1}$: There will be a significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.

2. Does having students keep mathematics journals decrease the amount of mathematical anxiety in third-grade students as measured through observation and mathematics journals?

Research Tools

Thirty third-grade students participated in this research study conducted during the fall semester. The Control group was comprised of 16 students, 11 girls and 5 boys, and the Treatment group included 14 students, 8 boys and 6 girls, for a total $n = 30$. All
third-grade students participated with consent from parents and assent from students. The students were exposed to mathematics journals for cognitive use, not affective, prior to study approval from the IRB. Researcher utilized in-tact classroom determined by school personnel prior to the research. The independent variable was the mathematics journal, and the dependent variable was the third-grade students’ mathematics anxiety levels as measured by the Anxiety Measure.

School Demographics

Data was collected in a Midwestern, rural elementary school within two third-grade classrooms. A total of 263 students were enrolled at the school. The school was comprised of 229 (87.1%) White, non-Hispanic, 18 (6.9%) multiracial, and 16 (6%) were not calculated due to an enrollment fewer than ten for American Indian/Alaskan Native, Asian or Pacific Islander, Black, non-Hispanic, and Hispanic. No citation in order to protect participants.

Data Collection

During fall semester the researcher conducted classroom observations two weeks prior to the treatment to become acclimated to the classrooms, as well as the students. During the first week, the researcher observed the Control and Treatment classrooms during their respective mathematics time in order to determine that structure and content were similar between the two rooms. The second week of classroom observations was limited to the Treatment group. At this time, the researcher observed the students in Writing Workshop, Social Studies, and Mathematics to determine if there was a difference in behavior due to varying subjects. During these two weeks, detailed field
notes were taken in a personal notebook as well as a chart designed for each participant. The behavior of the 14 students in the Treatment group was similar across disciplines.

**Classroom Structure**

**Control group.** The classroom teacher, Beth (pseudonym), has an earned Master’s Degree in Early Childhood Education with 12 years of teaching experience. Beth has worked at the elementary school for 12 years and has experience teaching third-grade for 12 years. A resource teacher visited the room daily to assist the two students that are on Individualized Education Programs (IEPs) and pulled these students out when they are struggling.

The student desks were arranged in three large groups with five desks in two groups and one group of six, see Appendix B. During typical mathematics time, the students were divided into three groups based on ability and given designated areas. The three stations were comprised of teacher lesson, computers, and a problem of the day. The teacher lesson always began with a Number Talk and was followed by a short lesson. A Number Talk involved the teacher posing a mathematical equation, e.g., 27 +15, to their students, which they compute mentally. Students were given the opportunity to discover mentally a strategy or strategies that work best for them. Once students had a strategy, they shared their method with their peers. Number Talks allowed students to clarify their thinking, investigate and apply mathematical relationship, build upon their methods, and learn new strategies. At the computers, students worked on First in Mathematics, a software program that assists students in learning their mathematics facts. The problem of the day consisted of a conceptual problem that students discussed collaboratively or worked independently pending on their learning style. An example of a
Problem of the Day: 512 ants have discovered a watermelon. 1,000 ants are needed to carry it away. How many more ants are needed? The time at each station varied by day and ranged from 15 to 25 minutes per station.

After mathematics, students were given time to reflect in their mathematics journals on a cognitive level to teacher-led journal questions. An example prompt from the Control classroom was, what did you learn in mathematics today? The questions were aimed at examining if students understand the lesson and concept by showing how to solve a problem or writing a struggle they had with the material. None of the journal prompts focused on the affective aspect of the students.

On Fridays, students went to the computer lab to complete Just the Facts 100 on First in Mathematics. The program gave students five minutes to correctly answer 100 mathematics problems for either addition, subtraction, multiplication or division. The classroom teacher emphasized that students must beat their previous score during this time.

Treatment group. The classroom teacher, Hillary, has an earned Master’s Degree in Early Childhood Education with six years of teaching experience. Hillary has worked at the elementary school for six years and has experience teaching third-grade. The treatment classroom was a split position between Hillary and Amanda. Amanda taught Reading and Writing to the students while Hillary focused on Social Studies and Mathematics. The resource teacher assisted in the classroom daily with students on Individualized Education Programs (IEPs) for three students with a learning disability, and those who were nominated for testing, three students. At times, the resource teacher took these students out of the classroom and worked with them in her classroom.
The Treatment group had a similar structure to that of the Control Group. Desks were arranged in three clusters, ranging from five to seven desks per cluster, see Appendix C. Students’ mathematics groups changed daily pending on Hillary’s preference. The groups were arranged by ability, mixed ability, students who worked well together, or student choice. During mathematics, the main form of instruction was three stations: teacher lesson, computers, and computation station. The lesson consisted of a Number Talk followed by a lesson taught by Hillary. Students at the computer station worked on First in Mathematics to master their daily facts. At Computation Station, students work on Problem of the Day, Go Mathematics! worksheets, or unfinished work. The Problem of the Day consisted of a conceptual problem such as, in my pocket I have 75 cents. What coins might I have? Go Mathematics! worksheets were from the classroom curriculum and focused on students answering questions from information provided. The worksheets were set up to reflect and prepare students for a standardized test. Unfinished work consisted of papers that were assigned, but students had not finished yet.

During three out of the 22 days, students were instructed through whole-class instruction. The whole-class instruction involved interactive mathematical concepts, which students were directly involved. Participants counted the number of pockets they had individually as well as a whole class total and created a bar graph. A second whole class activity was a read aloud that connected to students’ names and the amount of letters in their first name. The data collected was turned into a bar graph and questioned about the range, median, mode, etc. The third whole-group activity was a game to introduce multiplication called Circles and Stars. Students were in pairs and played the
game for the entirety of the lesson. Circles and Stars involved one partner rolling one die that designated the amount of circles to draw, e.g., if a five was rolled then five circles were drawn. Next, the same partner rolled the die again and this number designated the amount of stars inside of each circle, e.g., if a three was rolled then three stars would be inside each of the five circles. The student must then calculate the total number of stars drawn. The second partner then repeated the steps, and this continued for six rounds. Once the six rounds were completed, they calculated a grand total of their stars and together they must find the difference between the two sums.

Prior to treatment, students wrote in their journals seven out of ten days prior to researcher’s mathematics journal treatment. The journals were used to ask questions students about how to properly use mathematical tools or to gauge what a student knew about a concept. Mathematics journals were utilized to inform Hillary if students grasped the concept of the lesson. It was not a means for students to express their feelings and attitudes towards mathematics but whether teacher instruction was effective. The prompts focused on the cognitive, e.g., How will Finding Differences help me in mathematics?; What do I know about Base Ten blocks?; and What do I know about balancing number puzzles? Prior to treatment, participants were not exposed to expressing their emotions or feelings towards the mathematics lesson.

Students went to the computer lab on Friday to complete Just the Facts 100 on First in Mathematics. Hillary allowed students to try the program at least once and if time permitted they were able to try again. There was no emphasis on beating previous score but to try their best. Hillary and students would give each other thumbs up or encouraging comments when a peer did well in the game.
Quantitative Administration

Anxiety Measure (Ramirez, 2014) was administered on the first day of treatment to all third-grade students to determine their mathematics anxiety prior to treatment. The questionnaire was given separately to the Control and Treatment group at their designated mathematics times. The Control group was broken into small groups, per Beth’s request, and was completed in three days. Beth requested that students be given the questionnaire in three groups of five and one group of six over three days. The researcher went to the Control classroom for three consecutive days administering the survey to a different group each day. The questionnaire was filled out by one group each day. The Treatment group was administered as a whole class and completed in one day. For each group, the researcher explained the scale of 1 - 5, read each question aloud, and referenced to students when to refer to the pictures for questions 1, 4, and 5. Anxiety was measured by a smiley-face scale with five faces depicted upon it, ranging from “not nervous at all (1)” with a smiley face, “a little nervous(2)” with a slight smile, “somewhat nervous (3)” with a semi-nervous face, “very nervous (4)” with a sad face, and “very, very nervous (5)” with a nervous face. Prior to administration, children were asked if they understood the term “nervous” and were guided through an explanation of the smiley-face scale as well as through examples. The researcher did not give feedback to the child but only general encouragement. Participants selected a face that has a corresponding value of 1 – 5. Each score was calculated by taking an average across the 16 items. The researcher read a script to maintain consistency between groups. Participants wrote the number 1, 2, 3, 4, or 5 to reflect their anxiety level as opposed to drawing the corresponding face. The number assured that the researcher interpreted the correct anxiety level from each
student. The researcher allowed students to ask for clarification on questions. Three students requested clarification for Question 7, How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?. The students questioned using money because they would use “plastic”; the researcher then connected the question to playing Monopoly and if they would have enough money to buy a property. All students answered each of the 16 questions.

The post Anxiety Measure was administered 24 school days after the pre-test on the final day to the Treatment group. The process was completed as a whole group with the researcher reading aloud each question and guiding participants through the questionnaire. The Control group questionnaire was conducted 25 school days after the pre-test; Beth requested that it occur after a class party and class field trip. Students were put into small groups, and the researcher guided them through the questionnaire over a two-day period. The researcher read the same script as the pre Anxiety Measure to ensure consistency. The students were given the opportunity to ask clarifying questions; no students required a clarified statement. All students answered the 16 questions.

**Quantitative Data Analysis: Initial Screening**

The quantitative strand of the research study answered one research question and hypothesis for statistical analysis. Tests of normality were run prior to the analysis of the data. The distributional shape of Anxiety Measure scores for pre and post Control and pre and post-Treatment were examined to determine the extent to, which the assumption of normality was met. The Shapiro-Wilk test was used due to the sample size.

**Pre control.** Skewness (.596, SE = .564), kurtosis (-.306, SE = 1.091), and the Shapiro-Wilk test of normality (S-W = .953, df = 16, p = .531) suggested that normality
was a reasonable assumption. Visually, a left-skewed distribution displayed in the histogram, see Figure 2, as well as in the boxplot, Figure 3. The Normal Q-Q plot had points adhering closely to the diagonal line suggesting normality, Figure 4. Additionally, the boxplot did not suggest the presence of potential outliers. These indices suggested evidence that the assumption of normality was met.

Figure 2. Histogram for Pre Anxiety Measure Control Group
Figure 3. Boxplot for Pre Anxiety Measure Control Group.

Figure 4. Normal Q-Q Plot for Pre Anxiety Measure Control Group.
**Post control.** Skewness (.06, SE = .56), kurtosis (-.85, SE = 1.09), and the Shapiro-Wilk test of normality (S-W = .95, df = 16, p = .53) suggested the data had normality. Visually, a histogram with a peak between 2.00 and 2.50 displayed for 6 of the participants, see Figure 5. The Normal Q-Q plot had points adhering closely to the diagonal line suggesting normality, Figure 6. Additionally, the boxplot did not suggest the presence of potential outliers, Figure 7. These indices suggested that Anxiety Measure scores for post-test Control had normality.

![Histogram](image)

Figure 5. *Histogram for Post Anxiety Measure Control Group.*
Figure 6. Normal Q-Q Plot for Post Anxiety Measure Control Group.

Figure 7. Boxplot for Post Anxiety Measure Control Group.
Pre treatment. Skewness (.823, SE = .564), kurtosis (.556, SE = 1.091), and the Shapiro-Wilk test of normality (S-W = .928, df = 16, p = .224) suggested that normality was a reasonable assumption. Visually, a left skewed distribution with a peak between 1.50 and 2.00 displayed in the histogram, see Figure 8, as well as in the boxplot, Figure 9. The Normal Q-Q plot had points adhering closely to the diagonal line, except two, suggesting normality, Figure 10. Additionally, the boxplot did not suggest the presence of potential outliers. These indices suggested evidence that the assumption of normality was met.

Figure 8. Histogram for Pre Anxiety Measure Treatment Group.
Figure 9. Boxplot for Pre Anxiety Measure Treatment Group.

Figure 10. Normal Q-Q Plot for Pre Anxiety Measure Treatment Group.
Post treatment. Skewness (2.35, SE = .60), kurtosis (5.99, SE = 1.15), and the Shapiro-Wilk test of normality (S-W = .70, df = 16, p = .000) suggested the data has non-normality. Visually, a skewed to the left histogram with a peak between 1.00 and 1.25 displayed for 10 of the participants, see Figure 11. The Normal Q-Q plot had points adhering closely except for one to the diagonal line suggesting non-normality, Figure 12. Additionally, the boxplot suggested the presence of one potential outlier, Figure 13. These indices suggested that Anxiety Measure scores clustered between 1.00 and 1.25. Case 11 was proposed as an outlier; further analysis of the individual case mean and overall Treatment mean must be used to determine the exclusion of Case 11. See Table 1, for a summary of the normality statistics for the pre and post-test of Control and Treatment groups.

Figure 11. Histogram for Post Anxiety Measure Treatment Group.
Figure 12. Normal Q-Q Plot for Post Anxiety Measure Treatment Group.

Figure 13. Boxplot for Post Anxiety Measure Treatment Group.
Table 1
**Summary of Normality Tests for Pre and Post-Test Control and Treatment Groups.**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Skewness Statistic</th>
<th>SE</th>
<th>Skewness*</th>
<th>Kurtosis Statistic</th>
<th>SE</th>
<th>Kurtosis**</th>
<th>Statistic</th>
<th>df</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Control</td>
<td>.60</td>
<td>.56</td>
<td>1.06</td>
<td>-.31</td>
<td>1.09</td>
<td>-.28</td>
<td>.95</td>
<td>16</td>
<td>.53</td>
</tr>
<tr>
<td>Post Control</td>
<td>.06</td>
<td>.56</td>
<td>.11</td>
<td>-.85</td>
<td>1.09</td>
<td>1.63</td>
<td>.95</td>
<td>16</td>
<td>.53</td>
</tr>
<tr>
<td>Pre Treatment</td>
<td>.82</td>
<td>.56</td>
<td>1.46</td>
<td>.56</td>
<td>1.09</td>
<td>.51</td>
<td>.93</td>
<td>14</td>
<td>.22</td>
</tr>
<tr>
<td>Post Treatment</td>
<td>2.35</td>
<td>.60</td>
<td>3.92</td>
<td>5.99</td>
<td>1.15</td>
<td>5.21</td>
<td>.70</td>
<td>14</td>
<td>.00</td>
</tr>
</tbody>
</table>

Note: *Standardized Skewness = Statistic/Standard Error
**Standardized Kurtosis = Statistic/Standard Error

**T-Test Analysis and Results**

Paired sample t-tests were utilized to investigate the effectiveness of mathematics journals on third-graders’ mathematics anxiety levels. The various paired sample t-tests analyzed the pre and post for Treatment, pre and post for Control followed by a separate analyses for the Treatment and Control group. Significance level was measured at .05 level.

The means and standard deviations for the participants’ AM scores of the sixteen questions for pre and post-test are shown in Table 2 for the total sample. For the Treatment group, pretest AM scores mean 1.76 (SD = .70), while post-test AM scores mean 1.61 (SD = .25). The Control group, pretest AM scores mean 2.06 (SD = .68), while post-test AM scores mean 2.02 (SD = .65).
Table 2
Descriptive Statistics for Pre and Post-Test of Control and Treatment Groups

<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>Control Pre M(SD)</th>
<th>Control Post M(SD)</th>
<th>Treatment Pre M(SD)</th>
<th>Treatment Post M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.44(.51)</td>
<td>1.44(1.03)</td>
<td>1.21(.43)</td>
<td>1.36(.93)</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>2.25(1.44)</td>
<td>2.38(1.09)</td>
<td>1.71(1.20)</td>
<td>1.93(1.39)</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.13(.34)</td>
<td>1.19(.40)</td>
<td>1.00(1.00)</td>
<td>1.21(.80)</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.44(.89)</td>
<td>1.56(.81)</td>
<td>1.21(.58)</td>
<td>1.00(0.00)</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>2.25(1.44)</td>
<td>2.63(1.15)</td>
<td>1.93(1.33)</td>
<td>1.86(.31)</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>2.19(1.72)</td>
<td>2.06(1.18)</td>
<td>2.07(1.44)</td>
<td>1.79(1.12)</td>
</tr>
<tr>
<td>7. How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>2.81(1.47)</td>
<td>2.44(1.26)</td>
<td>1.71(.83)</td>
<td>1.79(.21)</td>
</tr>
<tr>
<td>8. How do you feel when your teacher explains to you how to do a mathematics problem?</td>
<td>1.75(.93)</td>
<td>1.69(.60)</td>
<td>1.79(1.25)</td>
<td>1.29(1.07)</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve 27 + 15?</td>
<td>1.56(1.37)</td>
<td>1.63(1.09)</td>
<td>1.57(1.09)</td>
<td>1.29(1.07)</td>
</tr>
<tr>
<td>10. How do you feel when taking a big test in your mathematics class?</td>
<td>3.50(1.51)</td>
<td>2.87(1.41)</td>
<td>2.93(1.44)</td>
<td>2.50(1.45)</td>
</tr>
<tr>
<td>11. How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>2.75(1.57)</td>
<td>2.31(1.25)</td>
<td>1.64(1.01)</td>
<td>2.14(1.61)</td>
</tr>
<tr>
<td>12. How do you feel when you are in mathematics class and you don't understand something?</td>
<td>3.00(1.37)</td>
<td>2.63(1.15)</td>
<td>2.79(1.37)</td>
<td>2.50(1.45)</td>
</tr>
<tr>
<td>13. How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?</td>
<td>1.88(1.59)</td>
<td>1.75(1.00)</td>
<td>1.50(1.16)</td>
<td>1.29(1.07)</td>
</tr>
</tbody>
</table>
Table 2 Continued.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?</td>
<td>1.19(.40) 1.56(.89) 1.14(.36) 1.36(1.08)</td>
</tr>
<tr>
<td>15. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>1.75(1.13) 2.00(1.03) 1.86(1.29) 2.00(1.66)</td>
</tr>
<tr>
<td>16. How would you feel when you have to solve 34 – 17?</td>
<td>2.06(1.44) 2.13(1.03) 2.14(1.56) 1.43(1.09)</td>
</tr>
</tbody>
</table>

Note: N= 30. Missing values replaced with variable mean

*Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous

The means and standard deviations of the responses to each item of the Anxiety Measure were calculated for the pre and post-test of the Anxiety Measure. The item that received the highest level of mathematics anxiety from Control group pre-test participants was “How do you feel when taking a big test in your mathematics class?” with a mean 3.50 (SD= 1.51). The question that received the second highest level of mathematics anxiety from participants was “How do you feel when you are in mathematics class and you don't understand something?” with a mean of 3.00 (SD= 1.37). Using the interpretive scale, both were in the “high anxiety” range. The item with the lowest level of mathematics anxiety was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.13 (SD= 0.34). The item with the second lowest level of mathematics anxiety was “How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?” with a mean of 1.19 (SD= 0.40). The response to both items fell within the “low anxiety” range. Overall, the response to most questions (16 items) fell within the “medium anxiety” range on the
interpretive scale. Table 3 below illustrated the mean scores and standard deviation for each question.

Table 3  
Description of Control Group Mathematics Anxiety Levels for Pre Anxiety Measure

<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>M</th>
<th>SD</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.44</td>
<td>.51</td>
<td>LA</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>2.25</td>
<td>1.44</td>
<td>MA</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.13</td>
<td>.34</td>
<td>LA</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.44</td>
<td>.89</td>
<td>LA</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>2.25</td>
<td>1.44</td>
<td>MA</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>2.19</td>
<td>1.72</td>
<td>MA</td>
</tr>
<tr>
<td>7. How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>2.81</td>
<td>1.47</td>
<td>HA</td>
</tr>
<tr>
<td>8. How do you feel when your teacher explains to you how to do a mathematics problem?</td>
<td>1.75</td>
<td>.93</td>
<td>MA</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve 27 + 15?</td>
<td>1.56</td>
<td>1.37</td>
<td>LA</td>
</tr>
<tr>
<td>10. How do you feel when taking a big test in your mathematics class?</td>
<td>3.50</td>
<td>1.51</td>
<td>HA</td>
</tr>
<tr>
<td>11. How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>2.75</td>
<td>1.57</td>
<td>HA</td>
</tr>
<tr>
<td>12. How do you feel when you are in mathematics class and you don't understand something?</td>
<td>3.00</td>
<td>1.37</td>
<td>HA</td>
</tr>
<tr>
<td>13. How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?</td>
<td>1.88</td>
<td>1.59</td>
<td>MA</td>
</tr>
</tbody>
</table>
Table 3 Continued.

<table>
<thead>
<tr>
<th>Question</th>
<th>LA</th>
<th>MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?</td>
<td>1.19</td>
<td>.40</td>
</tr>
<tr>
<td>15. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>1.75</td>
<td>1.13</td>
</tr>
<tr>
<td>16. How would you feel when you have to solve 34 – 17?</td>
<td>2.06</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Note: N= 30. Missing values replaced with variable mean
a Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous
b Interpretive scale: 1 – 1.60 = low anxiety (LA), 1.61– 2.40 = medium anxiety (MA), and 2.41 – 5.00 = high anxiety (HA)

The means and standard deviations of the responses to each item of the Anxiety Measure part were calculated for the pre and post-test of the Anxiety Measure. The item that received the highest level of mathematics anxiety from Control group post-test participants was “How do you feel when taking a big test in your mathematics class?” with a mean 2.87 (SD= 1.41). The questions that received the second highest level of mathematics anxiety from participants were “See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?” and “How do you feel when you are in mathematics class and you don't understand something?” with a mean of 2.63 (SD= 1.15). Using the interpretive scale, both were in the “high anxiety” range. The item with the lowest level of mathematics anxiety was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.19 (SD= 0.40). The item with the second lowest level of mathematics anxiety was “See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?” with a mean of 1.44 (SD= 1.03). The response to both items fell within
the “low anxiety” range. Overall, the response to most questions (16 items) fell within the “medium anxiety” range on the interpretive scale. Table 4 below illustrated the mean scores and standard deviation for each question.

Table 4  
**Description of Control Group Mathematics Anxiety Levels for Post Anxiety Measure**  

<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>M</th>
<th>SD</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.44</td>
<td>1.03</td>
<td>LA</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>2.38</td>
<td>1.09</td>
<td>MA</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies? How many cubes are in this picture?</td>
<td>1.19</td>
<td>.40</td>
<td>LA</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cans of food Marie collected?</td>
<td>1.56</td>
<td>.81</td>
<td>LA</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>2.63</td>
<td>1.15</td>
<td>HA</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>2.06</td>
<td>1.18</td>
<td>MA</td>
</tr>
<tr>
<td>7. How do you feel when you have to solve 27 + 15?</td>
<td>1.63</td>
<td>1.09</td>
<td>MA</td>
</tr>
<tr>
<td>8. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>2.00</td>
<td>1.03</td>
<td>MA</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve 34 – 17?</td>
<td>2.13</td>
<td>1.03</td>
<td>MA</td>
</tr>
</tbody>
</table>

*Note: N= 30. Missing values replaced with variable mean*  

a Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous  

b Interpretive scale: 1 – 1.60 = low anxiety (LA), 1.61 – 2.40 = medium anxiety (MA), and 2.41 – 5.00 = high anxiety (HA)
The means and standard deviations of the responses to each item of the Anxiety Measure part were calculated for the pre and post-test of the Anxiety Measure. The item that received the highest level of mathematics anxiety from Treatment group pre-test participants was “How do you feel when taking a big test in your mathematics class?” with a mean 2.93 ($SD= 1.44$). The question that received the second highest level of mathematics anxiety from participants was “How do you feel when you are in mathematics class and you don't understand something?” with a mean of 2.79 ($SD= 1.37$). Using the interpretive scale, both were in the “high anxiety” range. The item with the lowest level of mathematics anxiety was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.00 ($SD= 0.00$). The item with the second lowest level of mathematics anxiety was “How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?” with a mean of 1.14 ($SD= 0.36$). The response to both items fell within the “low anxiety” range. Overall, the response to most questions (16 items) fell within the “medium anxiety” range on the interpretive scale. Table 5 below illustrated the mean scores and standard deviation for each question.

Table 5

| Description of Treatment Group Mathematics Anxiety Levels for Pre Anxiety Measure |
|----------------------------------|---|---|---|
| Anxiety Measure Question         | $M^a$ | $SD$ | Category$^b$ |
| 1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected? | 1.21 | .43 | LA |
Table 5 Continued.

<table>
<thead>
<tr>
<th></th>
<th>Item</th>
<th>LA</th>
<th>MA</th>
<th>HA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>1.71</td>
<td>1.20</td>
<td>MA</td>
</tr>
<tr>
<td>3.</td>
<td>How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>4.</td>
<td>How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.21</td>
<td>.58</td>
<td>LA</td>
</tr>
<tr>
<td>5.</td>
<td>See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>1.93</td>
<td>1.33</td>
<td>MA</td>
</tr>
<tr>
<td>6.</td>
<td>How do you feel when you have to sit down and start your mathematics homework?</td>
<td>2.07</td>
<td>1.44</td>
<td>MA</td>
</tr>
<tr>
<td>7.</td>
<td>How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>1.71</td>
<td>.83</td>
<td>MA</td>
</tr>
<tr>
<td>8.</td>
<td>How do you feel when your teacher explains to you how to do a mathematics problem?</td>
<td>1.79</td>
<td>1.25</td>
<td>MA</td>
</tr>
<tr>
<td>9.</td>
<td>How do you feel when you have to solve 27 + 15?</td>
<td>1.57</td>
<td>1.09</td>
<td>MA</td>
</tr>
<tr>
<td>10.</td>
<td>How do you feel when taking a big test in your mathematics class?</td>
<td>2.93</td>
<td>1.44</td>
<td>HA</td>
</tr>
<tr>
<td>11.</td>
<td>How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>1.64</td>
<td>1.01</td>
<td>MA</td>
</tr>
<tr>
<td>12.</td>
<td>How do you feel when you are in mathematics class and you don't understand something?</td>
<td>2.79</td>
<td>1.37</td>
<td>HA</td>
</tr>
<tr>
<td>13.</td>
<td>How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?</td>
<td>1.50</td>
<td>1.16</td>
<td>MA</td>
</tr>
<tr>
<td>14.</td>
<td>How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?</td>
<td>1.14</td>
<td>.36</td>
<td>LA</td>
</tr>
<tr>
<td>15.</td>
<td>How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>1.86</td>
<td>1.29</td>
<td>MA</td>
</tr>
<tr>
<td>16.</td>
<td>How would you feel when you have to solve 34 – 17?</td>
<td>2.14</td>
<td>1.56</td>
<td>MA</td>
</tr>
</tbody>
</table>

Note: N= 30. Missing values replaced with variable mean

*a* Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous

*b* Interpretive scale: 1 – 1.60 = low anxiety (LA), 1.61 – 2.40 = medium anxiety (MA), and 2.41 – 5.00 = high anxiety (HA)
The means and standard deviations of the responses to each item of the Anxiety Measure part were calculated for the pre and post-test of the Anxiety Measure. The items that received the highest level of mathematics anxiety from Treatment group post-test participants were “How do you feel when taking a big test in your mathematics class?” and “How do you feel when you are in mathematics class and you don’t understand something?” with a mean 2.50 (SD= 1.45). The question that received the second highest level of mathematics anxiety from participants was “How do you feel when getting your mathematics book and seeing all the numbers in it?” with a mean of 2.14 (SD= 1.61). Using the interpretive scale, the highest mathematics anxiety questions were in the “high anxiety” range while the second highest mathematics anxiety question was in the “medium anxiety” range. The item with the lowest level of mathematics anxiety was “How would you feel if your teacher asked you how many cubes are in this picture?” with a mean of 1.00 (SD= 0.00). The item with the second lowest level of mathematics anxiety was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.21 (SD= 0.80). The response to both items fell within the “low anxiety” range. Overall, the response to most questions (16 items) fell within the “low anxiety” range on the interpretive scale. Table 6 below illustrated the mean scores and standard deviation for each question.
Table 6
Description of Treatment Group Mathematics Anxiety Levels for Post Anxiety Measure

<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>M</th>
<th>SD</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.36</td>
<td>.93</td>
<td>LA</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>1.93</td>
<td>1.39</td>
<td>MA</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.21</td>
<td>.80</td>
<td>LA</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>1.29</td>
<td>.73</td>
<td>LA</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>1.79</td>
<td>1.12</td>
<td>MA</td>
</tr>
<tr>
<td>7. How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>1.36</td>
<td>.63</td>
<td>LA</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve $27 + 15$?</td>
<td>1.29</td>
<td>1.07</td>
<td>LA</td>
</tr>
<tr>
<td>10. How do you feel when taking a big test in your mathematics class?</td>
<td>2.50</td>
<td>1.45</td>
<td>MA</td>
</tr>
<tr>
<td>11. How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>2.14</td>
<td>1.61</td>
<td>MA</td>
</tr>
<tr>
<td>12. How do you feel when you are in mathematics class and you don't understand something?</td>
<td>2.50</td>
<td>1.45</td>
<td>HA</td>
</tr>
<tr>
<td>13. How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?</td>
<td>1.29</td>
<td>1.07</td>
<td>LA</td>
</tr>
<tr>
<td>15. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>2.00</td>
<td>1.66</td>
<td>MA</td>
</tr>
<tr>
<td>16. How would you feel when you have to solve $34 - 17$?</td>
<td>1.43</td>
<td>1.09</td>
<td>MA</td>
</tr>
</tbody>
</table>

Note: N=30. Missing values replaced with variable mean

\(^a\)Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous

\(^b\)Interpretive scale: 1 – 1.60= low anxiety (LA), 1.61– 2.40 = medium anxiety (MA), and 2.41 – 5.00 = high anxiety (HA)
**Paired sample t-test for pre-test between control and treatment.** A paired samples t-test was conducted to compare pre-mathematics anxiety levels between the Control and Treatment group. There was not a statistically significant difference in the scores for Treatment ($M=1.76$, $SD=.70$) and Control ($M=2.08$, $SD=.69$); $t(15) = -1.217$, $p = .245$, at the .05 significance level, see Table 7. The standardized effect size, $d$, was .46, corresponding to a medium effect size. The 95% confidence interval for the mean difference between the Control and Treatment group was -0.88 to .25. On average mathematics anxiety levels for the Control group were about .32 points higher than from the Treatment group.

| Table 7 |
| Descriptive Statistics and T-Test Results for Pre Test between Control and Treatment Groups |

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Treatment</th>
<th>Control</th>
<th>95% CI for Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Pre Test</td>
<td>1.76</td>
<td>.70</td>
<td>2.06</td>
</tr>
</tbody>
</table>

**Paired sample t-test for control.** A paired samples t-test was conducted to compare pre-mathematics anxiety levels and post mathematics anxiety levels of third-graders in the Control group. There was not a statistically significant difference in the scores for pre ($M=2.06$, $SD=.68$) and post ($M=2.02$, $SD=.65$); $t(15) = 1.97$, $p = .07$, see Table 8. The standardized effect size, $d$, was .06 corresponding to a small effect size. The 95% confidence interval for the mean difference between the pre and post-test was -.003 to .087. On average mathematics anxiety levels were about .03 points lower than from the
pre-test. The data did not show a statistically significant difference between pre-test Control mean versus post-test Control mean, which indicated that classroom instruction with mathematics journals did not lead to a statistically significant decrease in mathematics anxiety levels.

Table 8

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pretest M</th>
<th>Pretest SD</th>
<th>Posttest M</th>
<th>Posttest SD</th>
<th>n</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.06</td>
<td>.68</td>
<td>2.02</td>
<td>.65</td>
<td>16</td>
<td>-0.003</td>
<td>1.97</td>
<td>.07</td>
</tr>
</tbody>
</table>

Paired sample t-test for treatment. Results of the paired-samples t-test concluded that mean anxiety level did not differ statistically significantly between the Treatment group pre-test (M = 1.76, SD = .70) and the post-test (M = 1.61, SD = .90) at the .05 level of significance; t(13) = 1.48, p = .164, see Table 9. The standardized effect size, d, was .19, corresponding to a small effect size. The 95% confidence interval for the mean difference between the pre and post-test was -0.09 to 0.47. Mathematics anxiety levels on average decreased .15 from pre to post-tests.

Table 9

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pretest M</th>
<th>Pretest SD</th>
<th>Posttest M</th>
<th>Posttest SD</th>
<th>n</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.76</td>
<td>.70</td>
<td>1.61</td>
<td>.25</td>
<td>14</td>
<td>-0.09</td>
<td>1.48</td>
<td>.16</td>
</tr>
</tbody>
</table>
**Paired sample t-test for post-test between control and treatment.** Results of the paired-samples t-test concluded that mean anxiety levels do not differ statistically significantly between the Treatment post-test (M = 1.61, SD = .90) and the Control post-test (M = 2.02, SD = .65) at the .05 level of significance; t(13) = 1.43, p = .18, see Table 10. The standardized effect size, d, was .53, corresponding to a medium, effect size. The 95% confidence interval for the mean difference between the pre and post-test was -0.22 to 1.06. Control group post-test mathematics anxiety levels on average were .41 higher than the Treatment group post-test results.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Treatment M</th>
<th>Treatment SD</th>
<th>Control M</th>
<th>Control SD</th>
<th>n</th>
<th>95% CI for Mean Difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-test</td>
<td>1.61</td>
<td>.90</td>
<td>2.00</td>
<td>.65</td>
<td>30</td>
<td>-0.22, 1.06</td>
<td>1.427</td>
<td>13</td>
<td>.18</td>
</tr>
</tbody>
</table>

**Summary**

A paired-samples t-test revealed that AM scores for students in the Treatment group decreased more than AM scores in the Control group; however it was not statistically significant. The paired-samples t-test for the Treatment group posited that students in the Treatment group had a decrease in their AM scores from pre AM to post AM; however it was not statistically significant. The Control group mathematics anxiety level decreased from pre to post-test but was not statistically significant. The Treatment
group post-test mathematics anxiety level was lower than the Control post-test level, 1.61 
($SD = .90$) and 2.02 ($SD = .65$), respectively, yielding $p = .18$.

**Fixed Treatment Group Data Analysis**

Analysis of the Shapiro-Wilk normality test and plots concluded that the post-test 
Treatment group had one outlier. The one case had a mean that was greater than three 
standard deviation points from the overall Treatment mean; Case 11 with an average 
mean of 4.38 with the Treatment group overall average mean $M = 1.61$ ($SD = .90$). 
Therefore, the maximum mean without being over three standard deviations is 4.31; case 
11 was .07 over the limit. Thus, the one case was excluded from further analysis of the 
data.

**Pre-fixed treatment.** Skewness (0.13, SE = .62), kurtosis (-1.62, SE = 1.19), and 
the Shapiro-Wilk test of normality (S-W = .90, df = 13, $p = .13$) suggested the data had 
normality. Visually, the histogram had three peaks with four cases between 1.00 and 
1.13, three cases between 1.88 and 1.94, and three cases between 2.19 and 2.38, see 
Figure 14. The Normal Q-Q plot had points adhering closely to the diagonal line, 
suggesting normality, Figure 15. Additionally, the boxplot suggested the presence of no 
potential outliers, Figure 16. These indices suggested evidence that the assumption of 
normality was met with Case 11 excluded.
Figure 14. Histogram for Pre Anxiety Measure Fixed Treatment Group.

Figure 15. Normal Q-Q Plot for Pre Anxiety Measure Fixed Treatment Group
Post-fixed treatment. Skewness (1.13, SE = .62), kurtosis (0.25, SE = 1.12), and the Shapiro-Wilk test of normality (S-W = .84, df = 13, p = .02) suggested the data has non-normality. Visually, a skewed to the left histogram with a peak between 1.00 and 1.19 displayed for seven of the 13 of the participants, see Figure 17. The Normal Q-Q plot had points adhering closely to the diagonal line, except for two cases at 2.10 and 2.19, suggesting normality, Figure 18. Additionally, the boxplot suggested the presence no potential outliers, Figure 19. These indices suggested that Anxiety Measure scores clustered between 1.00 and 1.25 with Case 11 excluded, therefore the researcher perceived the data as normality distributed. See Table 11 for a summary of the descriptive statistics.
Figure 17. Histogram for Post Anxiety Measure Fixed Treatment Group.

Figure 18. Normal Q-Q Plot for Post Anxiety Measure Fixed Treatment Group.
Figure 19. Boxplot for Post Anxiety Measure Fixed Treatment Group.

Table 11  
Summary of Normality Tests for Fixed Treatment Group

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Skewness Statistic</th>
<th>Skewness SE</th>
<th>Skewness*</th>
<th>Kurtosis Statistic</th>
<th>Kurtosis* SE</th>
<th>Kurtosis* Statistic</th>
<th>Shapiro-Wilk Statistic</th>
<th>Shapiro-Wilk df</th>
<th>Shapiro-Wilk Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Fixed Treatment</td>
<td>0.13</td>
<td>.62</td>
<td>0.21</td>
<td>-1.62</td>
<td>1.1</td>
<td>-1.36</td>
<td>.90</td>
<td>13</td>
<td>.62</td>
</tr>
<tr>
<td>Post Fixed Treatment</td>
<td>1.13</td>
<td>.62</td>
<td>1.83</td>
<td>0.25</td>
<td>1.1</td>
<td>0.21</td>
<td>.84</td>
<td>13</td>
<td>.02</td>
</tr>
</tbody>
</table>

Note: *Standardized Skewness = Statistic/Standard Error
**Standardized Kurtosis = Statistic/Standard Error
**Paired Samples T-Tests**

Paired sample t-tests were re-run to investigate the effectiveness of mathematics journals on third-graders’ mathematics anxiety levels. The various paired sample t-tests analyzed the pre and post-test for Fixed Treatment and separate analyses for pre and post-test Fixed Treatment and Control groups. Significance level was measured at .05 level.

The means and standard deviations for the participants’ AM responses of the sixteen questions for pre and post-test are shown in Table 12 for the total sample. For the Fixed Treatment group, pretest AM scores mean 1.63 (SD = .51), while post-test Fixed AM scores mean 1.36 (SD = .41). The control group’s scores remained the same; pretest AM scores mean 2.06 (SD = .68), while post-test AM scores mean 1.72 (SD = .52).
<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>Control Pre M(SD)</th>
<th>Control Post M(SD)</th>
<th>Treatment Pre M(SD)</th>
<th>Treatment Post M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.44(.51)</td>
<td>1.44(1.03)</td>
<td>1.23(.44)</td>
<td>1.15(.56)</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>2.25(1.44)</td>
<td>2.38(1.09)</td>
<td>1.46(.78)</td>
<td>1.69(1.11)</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.13(.34)</td>
<td>1.19(.40)</td>
<td>1.00(1.00)</td>
<td>1.00(.00)</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.44(.89)</td>
<td>1.56(.81)</td>
<td>1.23(.60)</td>
<td>1.00(0.00)</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>2.25(1.44)</td>
<td>2.63(1.15)</td>
<td>1.69(1.03)</td>
<td>1.15(.56)</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>2.19(1.72)</td>
<td>2.06(1.18)</td>
<td>1.85(1.21)</td>
<td>1.54(.66)</td>
</tr>
<tr>
<td>7. How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>2.81(1.47)</td>
<td>2.44(1.26)</td>
<td>1.77(.83)</td>
<td>1.38(.65)</td>
</tr>
<tr>
<td>8. How do you feel when your teacher explains to you how to do a mathematics problem?</td>
<td>1.75(.93)</td>
<td>1.69(.60)</td>
<td>1.54(.88)</td>
<td>1.00(.00)</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve 27 + 15?</td>
<td>1.56(1.37)</td>
<td>1.63(1.09)</td>
<td>1.31(.48)</td>
<td>1.00(.00)</td>
</tr>
<tr>
<td>10. How do you feel when taking a big test in your mathematics class?</td>
<td>3.50(1.51)</td>
<td>2.87(1.41)</td>
<td>2.77(1.36)</td>
<td>2.31(1.32)</td>
</tr>
<tr>
<td>11. How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>2.75(1.57)</td>
<td>2.31(1.25)</td>
<td>1.69(1.03)</td>
<td>1.92(1.44)</td>
</tr>
<tr>
<td>12. How do you feel when you are in mathematics class and you don't understand something?</td>
<td>3.00(1.37)</td>
<td>2.63(1.15)</td>
<td>2.62(1.26)</td>
<td>2.31(1.32)</td>
</tr>
<tr>
<td>14. How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?</td>
<td>1.19(.40)</td>
<td>1.56(.89)</td>
<td>1.15(.38)</td>
<td>1.08(.28)</td>
</tr>
<tr>
<td>15. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>1.75(1.13)</td>
<td>2.00(1.03)</td>
<td>1.62(.96)</td>
<td>1.77(1.48)</td>
</tr>
<tr>
<td>16. How would you feel when you have to solve 34 − 17?</td>
<td>2.06(1.44)</td>
<td>2.13(1.03)</td>
<td>1.92(1.38)</td>
<td>1.15(.38)</td>
</tr>
</tbody>
</table>
The means and standard deviations of the responses to each item of the Anxiety Measure were calculated for the pre and post-test of the Anxiety Measure. The item that received the highest level of mathematics anxiety from the Fixed Treatment group pre-test participants was “How do you feel when taking a big test in your mathematics class?” with a mean 2.77 (SD = 1.36). The question that received the second highest level of mathematics anxiety from participants was “How would you feel when you have to solve 34 – 17?” with a mean of 1.92 (SD= 1.38). Using the interpretive scale, the highest mathematics anxiety score was in the “high anxiety” range while the second highest mathematics anxiety level score was in the “medium score” range. The item with the lowest level of mathematics anxiety was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.00 (SD= 0.00). The item with the second lowest level of mathematics anxiety was “How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?” with a mean of 1.15 (SD= 0.38). The response to both items fell within the “low anxiety” range. Overall, the response to most questions (16 items) fell within the “low anxiety” range on the interpretive scale. Table 13 below illustrated the mean scores and standard deviation for each question.
Table 13
Description of Fixed Treatment Group Mathematics Anxiety Levels for Pre Anxiety Measure

<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>M</th>
<th>SD</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.23</td>
<td>.44</td>
<td>LA</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>1.46</td>
<td>.78</td>
<td>LA</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.23</td>
<td>.60</td>
<td>LA</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>1.69</td>
<td>1.03</td>
<td>LA</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>1.85</td>
<td>1.21</td>
<td>MA</td>
</tr>
<tr>
<td>7. How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>1.77</td>
<td>.83</td>
<td>MA</td>
</tr>
<tr>
<td>8. How do you feel when your teacher explains to you how to do a mathematics problem?</td>
<td>1.54</td>
<td>.88</td>
<td>LA</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve 27 + 15?</td>
<td>1.31</td>
<td>.48</td>
<td>LA</td>
</tr>
<tr>
<td>10. How do you feel when taking a big test in your mathematics class?</td>
<td>2.77</td>
<td>1.36</td>
<td>HA</td>
</tr>
<tr>
<td>11. How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>1.69</td>
<td>1.03</td>
<td>LA</td>
</tr>
<tr>
<td>12. How do you feel when you are in mathematics class and you don't understand something?</td>
<td>2.62</td>
<td>1.26</td>
<td>HA</td>
</tr>
<tr>
<td>13. How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?</td>
<td>1.23</td>
<td>.60</td>
<td>LA</td>
</tr>
<tr>
<td>14. How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?</td>
<td>1.15</td>
<td>.38</td>
<td>LA</td>
</tr>
<tr>
<td>15. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>1.62</td>
<td>.96</td>
<td>MA</td>
</tr>
<tr>
<td>16. How would you feel when you have to solve 34 – 17?</td>
<td>1.92</td>
<td>1.38</td>
<td>MA</td>
</tr>
</tbody>
</table>

Note: N = 30. Missing values replaced with variable mean

a Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous

b Interpretive scale: 1 – 1.75 = low anxiety (LA), 1.76 – 2.30 = medium anxiety (MA), and 2.31 – 5.00 = high anxiety (HA)
The means and standard deviations of the responses to each item of the Anxiety Measure part were calculated for the pre and post-test of the Anxiety Measure. The items that received the highest level of mathematics anxiety from Fixed Treatment group post-test participants were “How do you feel when taking a big test in your mathematics class?” and “How do you feel when you are in mathematics class and you don't understand something?” with a mean 2.31 (SD = 1.32). The question that received the second highest level of mathematics anxiety from participants was “How do you feel when getting your mathematics book and seeing all the numbers in it?” with a mean of 1.92 (SD = 1.44). Using the interpretive scale, the three mathematics anxiety questions were in the “medium anxiety” range. The items with the lowest level of mathematics anxiety were “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?”, “How would you feel if your teacher asked you how many cubes are in this picture?”, “How do you feel when your teacher explains to you how to do a mathematics problem?”, “How do you feel when you have to solve 27 + 15?”, and “How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?” with a mean of 1.00 (SD = 0.00). The item with the second lowest level of mathematics anxiety was “How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?” with a mean of 1.08 (SD = 0.28). The response to all items fell within the “low anxiety” range. Overall, the response to most questions (16 items) fell within the “low anxiety” range on the interpretive scale. Table 14 below illustrated the mean scores and standard deviation for each question.
Table 14
Descriptives of Fixed Treatment Group Mathematics Anxiety Levels for Post Anxiety Measure

<table>
<thead>
<tr>
<th>Anxiety Measure Question</th>
<th>M</th>
<th>SD</th>
<th>Category^b</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. See this graph. It shows how many cans of food each student collected for the canned food drive. How would you feel if you were asked to say how many cans of food Marie collected?</td>
<td>1.15</td>
<td>.56</td>
<td>LA</td>
</tr>
<tr>
<td>2. How do you feel when you are in mathematics class and your teacher is about to teach something new?</td>
<td>1.69</td>
<td>1.11</td>
<td>LA</td>
</tr>
<tr>
<td>3. How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>4. How would you feel if your teacher asked you how many cubes are in this picture?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>5. See this clock. How would you feel if you were asked to say what time will it be in 20 minutes?</td>
<td>1.86</td>
<td>.31</td>
<td>LA</td>
</tr>
<tr>
<td>6. How do you feel when you have to sit down and start your mathematics homework?</td>
<td>1.54</td>
<td>.66</td>
<td>LA</td>
</tr>
<tr>
<td>7. How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink?</td>
<td>1.79</td>
<td>.21</td>
<td>LA</td>
</tr>
<tr>
<td>8. How do you feel when your teacher explains to you how to do a mathematics problem?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>9. How do you feel when you have to solve 27 + 15?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>10. How do you feel when taking a big test in your mathematics class?</td>
<td>2.31</td>
<td>1.92</td>
<td>HA</td>
</tr>
<tr>
<td>11. How do you feel when getting your mathematics book and seeing all the numbers in it?</td>
<td>1.92</td>
<td>2.31</td>
<td>MA</td>
</tr>
<tr>
<td>12. How do you feel when you are in mathematics class and you don't understand something?</td>
<td>2.31</td>
<td>1.32</td>
<td>HA</td>
</tr>
<tr>
<td>13. How would you feel if you were given this problem: You scored 15 points. Your friend scored 8 points. How many more points did you score than your friend?</td>
<td>1.00</td>
<td>.00</td>
<td>LA</td>
</tr>
<tr>
<td>14. How would you feel if you were given this problem: There are 13 ducks in the water. There are 6 ducks in the grass. How many ducks are there in all?</td>
<td>1.08</td>
<td>.28</td>
<td>LA</td>
</tr>
<tr>
<td>15. How do you feel when you get called on by the teacher to explain a mathematics problem on the board?</td>
<td>1.77</td>
<td>1.48</td>
<td>MA</td>
</tr>
<tr>
<td>16. How would you feel when you have to solve 34 – 17?</td>
<td>1.15</td>
<td>.38</td>
<td>LA</td>
</tr>
</tbody>
</table>

Note: N= 30. Missing values replaced with variable mean
^a Response scale: 1 = not nervous at all, 2 = a little nervous, 3 = somewhat nervous, 4 = very nervous and 5 = very, very nervous
^b Interpretive scale: 1 – 1.75= low anxiety (LA), 1.76– 2.30 = medium anxiety (MA), and 2.31 – 5.00 = high anxiety (HA)
**Paired sample t-test for pre-test between control and fixed treatment.** A paired samples t-test was conducted to compare pre-mathematics anxiety levels between the Control and Fixed Treatment group. There was not a statistically significant difference in the scores for Control (M= 2.07, SD=.71) and Fixed Treatment (M=1.63, SD=.51); t(12) = -1.817, p = .094, at the .05 significance level, see Table 15. The standardized effect size, d, was .71, corresponding to a medium effect size. The 95% confidence interval for the mean difference between the Control and Fixed Treatment group was -0.98 to .09. On average mathematics anxiety levels for the Control group were about 0.44 points higher than from the Fixed Treatment group.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Fixed Treatment</th>
<th>Control</th>
<th>95% CI for Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Pre Test</td>
<td>1.63</td>
<td>.51</td>
<td>2.07</td>
</tr>
</tbody>
</table>

**Paired sample t-test for control.** A paired samples t-test was conducted to compare pre-mathematics anxiety levels and post mathematics anxiety levels of third-graders in the Control group. There was not a statistically significant difference in the scores for pre (M= 2.06, SD=.68) and post (M=2.02, SD=.65); t(15) = 1.97, p = .07, see Table 8. The standardized effect size, d, was .06 corresponding to a small effect size. The 95% confidence interval for the mean difference between the pre and post-test was -.003 to .09. On average mathematics anxiety levels were about .03 points lower than from the
pre-test. The data did not show a statistically significant difference between pre-test Control mean versus post-test Control mean, which indicated that classroom instruction with mathematics journals did not lead to a statistically significant decrease in mathematics anxiety levels.

Table 16

Descriptive Statistics and t-test Results for Pre and post-test Control Group

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pretest M</th>
<th>Pretest SD</th>
<th>Posttest M</th>
<th>Posttest SD</th>
<th>n</th>
<th>95% CI for Mean Difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.06</td>
<td>.68</td>
<td>2.02</td>
<td>.65</td>
<td>16</td>
<td>-.003, 0.09</td>
<td>1.97</td>
<td>15</td>
<td>.07</td>
</tr>
</tbody>
</table>

Paired sample t-test for fixed treatment. Results of the paired-samples t-test for the Fixed Treatment group showed that mean anxiety level differed statistically significantly between the pre-test (M = 1.63, SD = .51) and the post-test (M = 1.36, SD = .41) at the .05 level of significance; t(12) = -2.283, p = .04, see Table 17. The standardized effect size, d, was .58, corresponding to a medium effect size. The 95% confidence interval for the mean difference between the pre and post-test was -0.51 to .01. Mathematics anxiety levels on average decreased .27 from pre to post-tests.

Table 17

Descriptive Statistics and T-Test Results for Pre and post-test Fixed Treatment Group

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pretest M</th>
<th>Pretest SD</th>
<th>Posttest M</th>
<th>Posttest SD</th>
<th>n</th>
<th>95% CI for Mean Difference</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Treatment</td>
<td>1.63</td>
<td>.51</td>
<td>1.36</td>
<td>.41</td>
<td>13</td>
<td>-0.51, 0.01</td>
<td>2.283</td>
<td>12</td>
<td>.04</td>
</tr>
</tbody>
</table>
Paired sample t-test for post-test between control and fixed treatment.

Results of the paired-samples t-test showed that mean anxiety level differ statistically significantly between the Fixed Treatment post-test (M = 1.36, SD = .41) and the Control post-test (M = 2.02 SD = .68) at the .05 level of significance; t(13) = 2.91, p = .01, see Table 18. The standardized effect size, d, was 1.15, corresponding to a large effect size. The 95% confidence interval for the mean difference between the pre and post-test was 0.16 to 1.13. Control group post-test mathematics anxiety levels on average were 0.66 higher than the Fixed Treatment group post-test results.

Table 18
Descriptive Statistics and t-test Results for Post-Test between Control and Fixed Treatment Groups

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Fixed Treatment</th>
<th>Control</th>
<th>95% CI for Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-test</td>
<td>1.36</td>
<td>.41</td>
<td>2.02</td>
</tr>
</tbody>
</table>

Summary

A paired-samples t-test revealed that AM scores for students in the Fixed Treatment group had a statistically significant decrease than AM scores in the Control group. The paired-samples t-test for the Fixed Treatment group concluded that students in the Fixed Treatment group had a statistically significant decrease in their AM scores from pre AM to post-test AM. The Control group mathematics anxiety level decreased from pre to post-test, but it was not statistically significant. The Fixed Treatment group post-test mathematics anxiety level was lower than the Control post-test level, 1.36 (SD = .41) and 2.02 (SD = .68), respectively, and did not yield a statistically significant decrease.
The removal of Case 11 decreased the pre-test Fixed Treatment mean from 1.76 to 1.63, respectively, causing a 0.13 difference in the pre-test average mean. The Fixed Treatment post-test average mean decreased from 0.25 from 1.61 to 1.36, respectively. Case 11’s exclusion caused a statistically significant result between pre and post-test Fixed Treatment. Initially the results concluded were not statistically significant at $p = .16$; yet after the removal of Case 11 the results were statistically significant at $p = .04$, see Table 19.

Table 19

| Summary of Descriptive Statistics for Pre and Post-Test Control, Treatment, and Fixed Treatment |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|
| Outcome                        | Pretest | Post-Test | M   | SD   | M   | SD   | n   | t    | df   | p    |
| Control                        | 2.06    | .68    | 2.02| .65  | 16   | 2.04 | 15  | .06  |       |      |
| Treatment                      | 1.76    | .70    | 1.61| .25  | 14   | 1.48 | 13  | .16  |       |      |
| Fixed Treatment                | 1.63    | .51    | 1.36| .41  | 13   | -2.28| 12  | .04  |       |      |

As stated previously, there was not a statistically significant difference between the pre-test Control and Treatment group, $p = .25$. Moreover, there was not a statistically significant difference post-test Control and Treatment groups, $p = .18$, see Table 20.

Table 20

| Descriptive Statistics for Pre-Test Control and Treatment Groups |
|---------------------------------------------------------------|-------|-------|-------|-------|-------|-------|
| Outcome           | Treatment | Control | M   | SD   | M   | SD   | n   | t    | df   | p    |
| Pre-Test          | 1.76      | .70      | 2.08| .69  | 30   | 1.217| 13  | .25  |      |      |
| Post-Test         | 1.61      | .25      | 2.02| .65  | 30   | 1.43 | 13  | .18  |      |      |
The removal of outlier Case 11 yielded statistically significant results for the post-test Control and Fixed Treatment groups, at \( p = .01 \), see Table 21. The decrease between the pre-test between Control and Treatment and pre-test between Control and Fixed Treatment decreased from .25 to .09, respectively, for a difference of .19. The post-test between Control and Fixed Treatment decreased when Case 11 was excluded for Control and Fixed Treatment; from .66 to .01 for a difference of .65. The removal of the one outlier, Case 11, caused a statistically significant difference between post-test Control and Fixed Treatment. It can be concluded that mathematics instruction in conjunction with affective mathematics journals statistically significantly decreases mathematics anxiety levels compared to the Control Classroom that did not use affective mathematics journals.

Table 21

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Fixed Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Pre Test</td>
<td>1.63</td>
<td>.51</td>
</tr>
<tr>
<td>Post-test</td>
<td>1.36</td>
<td>.41</td>
</tr>
</tbody>
</table>

Qualitative Analysis

Mathematics journals. Mathematics journals were completed daily for students for a total of 22 school days. Participants were given ten minutes at the completion of each mathematics period to reflect on a prompt given by the researcher about their feelings, thoughts, and interactions with mathematics that day. Students were instructed to answer the prompt as well as to circle a number on the Mathematics Thermometer that
corresponded to their mathematics anxiety level. The thermometer initially did not have markings or numbers on it but was open to interpretation by the third-graders. After the first day, the researcher became aware of the confusion caused by the instrument. The remaining thermometers were then given numbers 1-10 for students to reference; 1 being low mathematics anxiety, 5 being medium mathematics anxiety, and 10 being high mathematics anxiety.

**Observations.** The researcher was situated daily in the classroom for the entirety of mathematics. A journal was utilized to record the daily lessons, procedures, and whole class observations. The researcher created a chart that recorded the fourteen students’ actions, as well as physiological and psychological reactions to mathematics.

**Control classroom.** The researcher observed the Control classroom during mathematics for one week prior to the treatment. The purpose of the observations was to ensure similar content, as well as teaching styles. Both teachers utilized stations in their mathematics instruction and taught the same material. The curriculum used for mathematics was Go Mathematics! by Houghton Mifflin Harcourt (Dixon, 2012) and Teaching Arithmetic by Marilyn Burns (Burns, 2001). From the observations, it was concluded that the same material was being taught in both mathematics classrooms with the same curriculum and a similar teaching style.

**Day One**

The first day of treatment students fixed errors and were given time to complete unfinished work. Students were informed that they were not completing Problems of the Day correctly and were given a fill-in-the-blank sentence for future reference. If students finished this assignment, they worked on a Number Balance Puzzle packet provided by
Hillary. An example of a Number Balance would be a scale with a sum on one side and an addend and a blank square on the other, see Figure 20. Students calculated the missing number through addition or subtraction. Other variations were presented to students where there were two blanks, or they were able to create their own number puzzle for peers to solve.

Figure 20. *Number Balance Puzzle Example.*

Initially, only one student correctly filled in the Problem of the Day and was able to get on First in Mathematics as a reward while peers corrected their work. When students were given their Problem of the Day back, six students stared at the problem while laying their head on their desk. A student began breathing heavily when they were unable to explain their thinking in words. Many students became concerned with the wording of the problem that hindered their ability to complete the assignment. Participants became distracted throughout the assignment by hitting their head with their pencil, twirling a necklace, and doodling on their papers.
Many students expressed confusion about the Number Balance Puzzles and would stare at the packet. Three students verbally expressed their confusion and stated either “I don’t get this,” “I’m confused” or “I’m confused about this.” One student who was deemed off-task was sent to a “time out desk” to complete their number puzzle packet. The “time out desk” was in the back of the room isolated from the rest of the class.

**End of day.** The students were given the prompt “Today in mathematics I felt _____ because _______” and were instructed to select their mathematics anxiety level on the Mathematics Thermometer, see Table 22 for students’ responses.

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Today in mathematics I felt great because I got 90% on first in mathematics multiplication.</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Today in mathematics I felt goodish.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Today in mathematics I felt good because of everything.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Today in mathematics I felt great because I got all my work done in my mathematics folder.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Today in mathematics I felt :) great.</td>
</tr>
<tr>
<td>6</td>
<td>3.5</td>
<td>Today I felt good because I got lots of work done.</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>Because it was hard</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Today in mathematics I felt nice and fine because nothing was confusing and I did not have to do mathematics problems!</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>Today in mathematics I felt a little nervous because although I felt happy, I also felt a little behind everyone else.</td>
</tr>
<tr>
<td>10</td>
<td>1.5</td>
<td>Today in mathematics I felt good because it was fun.</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>Today in mathematics I felt confused because a problem confused me.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Today in mathematics I felt happy because I finished work in my mathematics folder.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Today in mathematics I felt like I did a good job because I completed all of my work.</td>
</tr>
<tr>
<td>14</td>
<td>4</td>
<td>Today in mathematics I felt a little nervous because I did not know a mathematics problem because it was confusing.</td>
</tr>
</tbody>
</table>
The mathematics journal responses consisted of nine positive, four negative, and one positive theme about First in Mathematics. The positive themes were feeling good, finding no content confusing, completing work, having fun, and enjoying everything. The negative responses were finding mathematics hard, being nervous because a student felt behind, and two students were confused by the Number Balance puzzles. The one response to First in Mathematics was about the improvement in their score.

The overall mathematics anxiety for the day was 2.93 (SD = .58), calculated by the average of the 14 individual mathematics anxiety scores. The researcher perceived psychological and physiological mathematics anxiety symptoms. Three students had psychological symptoms of anxiety by expressing concern over their ability to do Number Balance Puzzles. One student displayed physiological symptoms when going to the restroom.

Students displayed confusion on the thermometer because it did not have any markings. The researcher then provided equally spaced lines, 1-10, for the concurrent days.

**Day Two**

Mathematics instruction was shortened to twenty minutes today due to students designing maps for an upcoming field trip. During the allotted time, students were led through Number Talks of addition. The first Number Talk presented to the students was 99 + 38, which students answered as either 140 or 137, and the second problem was 98 + 47, and all students gave the answer of 145. Many students throughout the Number Talk become distracted by playing with their shoes, staring off, playing with their name tag, poking classmates, rummaging through peers’ desks and playing with pencils. When told
they would begin Number Talks one student rolled their eyes in response. During the
Number Talk, a student explained their thinking but was told to stop because it was
similar to a peer’s justification. This student then became disengaged with the problem
and did not participate the remainder of class. A second student’s answer was disregarded
due to changing their sum. This child became distracted by their pencil and broke the
pencil’s tip that caused them to leave the discussion to get a new one.

**End of day.** Students were given the journal prompt “I felt _____ because _____”
and selected a number on the Mathematics Thermometer, as seen in Table 23.

Table 23
*Mathematics Journal and Mathematics Thermometer Responses for Day 2*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>I felt awesome today because I did hard work and I feel proud of myself because I did very hard work.</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>I felt goodish because of the number talk.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>I felt awesome because everything.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>I felt great today in mathematics because I loved the number talk and because (name) was here.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>I felt good because number talks.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>I felt good because I got all answers right.</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>I felt OK because all we did the number.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>I felt fine because it was helping my brain. I think these number talks are helping me practice addition.</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>I felt good today in mathematics because it was just really fun.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>I felt good because of when we did the maps and the number talk was good.</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>I felt good because I had fun.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>I felt happy because it was fun.</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>Today I felt okay in mathematics because I got a couple problems wrong. But I felt I did pretty good!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>I felt happy because of number talk.</td>
</tr>
</tbody>
</table>
The mathematics journal responses consisted of thirteen positive and one negative. Positive responses centered on feeling “awesome” because of doing hard work and everything about the session. Seven students had positive remarks about the Number Talks. Three students responded about the fun of the mathematics lesson and one student got all of the answers right. The one negative theme was a student getting answers wrong during the Number Talks.

The overall mathematics anxiety level for the day was 1.57 ($SD = .31$). No students showed psychological or physiological symptoms of mathematics anxiety as perceived by the researcher.

**Day Three**

Students were given a place value assessment composed of two conceptual problems, four number balance puzzles, and extra tasks on place value. The extra tasks on place value were not graded but used as an assessment for upcoming instruction. Three students were instructed to join Hillary at the Group Work table for extra assistance, and one student was taken out of the classroom to work with the Special Education teacher. If students finished the assessment early, they were permitted to complete unfinished work or cursive writing.

Throughout the assessment several students had off-task behavior by staring at the test, tying shoes, moving an eraser like a car, staring at kids outside, hitting their pencil on their chair, or flipping their eraser. Two students peered over at their classmates’ tests throughout the allotted time. While students worked several picked their fingernails, placed their hands on their temples, rubbed their eyes, or gurgled with puffy breaths. Participants would utilize egocentric speech throughout the test and stated “I don’t get
this”, “This is hard. It doesn’t give what I need to solve”, “I don’t know what this means”, “This is way too confusing”, “What? I don’t get it”, and “I don’t get it like this”. Three students worked diligently throughout the test and did not become distracted or express concern over the difficulty. Four students did not finish the place value assessment.

Students who finished their work completed unfinished work that consisted of either Go Mathematics! worksheets or Number Balance puzzles. One student who was working on number balance puzzles stated, “My eyes keep getting watery and won’t stop”. The student then continued to work on the problems but continuously wiped their eyes. Several students would stare off or watch the students who were playing at recess outside the window.

**End of day.** Hillary collected the assessments and students expressed their opinion on the test stating they wished they had more time and felt rushed while others said it caused their entire day to be classified as a bad one. At the conclusion of the day, students were given the mathematics journal prompt “How did you feel about the mathematics assessment?” and circled a number on the Mathematics Thermometer, see Table 24.
The mathematics journal responses consisted of nine positive, two negative, one unsure, and one student was uncategorized. Four students felt good while two students felt great or awesome. Participants felt that the problems were easy, and they knew them. The two negative responses were feeling nervous with one specifying their nervousness for passing third-grade. One student was unsure of how they felt while another was uncategorized due to drawing a swirl.

The overall mathematics anxiety level for the third day of treatment was 2.23 ($SD = .72$). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Students showed four psychological symptoms

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>I felt great because I liked what I did.</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Not sure.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Awesome</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>I felt nervous because I know that it is not a grade but the people that is going to see my work. They know if I am going to pass third-grade.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td><em>drew a smiley face</em></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>I felt really good.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td><em>drew a swirl</em></td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>I felt great because I knew every problem and finished it.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Really good.</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>I felt good.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>I felt good.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>I felt like it was fairly easy. Because I didn’t really zip through it I kind of went slow to take my time. I managed to complete it just in the nick of time!</td>
</tr>
<tr>
<td>14</td>
<td>4</td>
<td>I felt a number 4 because I felt a little nervous.</td>
</tr>
</tbody>
</table>
consisting of expressing their inability to solve problems on the place value assessment. Five students displayed physiological symptoms of using the bathroom or having watery eyes. Other signs of anxiety not classified under psychological or physiological were short, puffy breaths and picking at fingernails.

Students did not have mathematics the next two days due to a class field trip and Hillary being absent. Mathematics instruction resumed to normal the following Monday.

**Day Four**

Mathematics began with Hillary instructing students to get their Mathematics Journals out and flipping to the back cover. She then taped in a piece of paper to each journal that stated, “How you know what a good mathematics paper looks like?” that gave steps for the students to follow. The steps were a reference for students when working on Problems of the Day or a word problem.

After going over the guidelines for writing a mathematics paper Hillary went over the setup for the day. Students would be working in three stations that were each twenty minutes long. The Special Education teacher pulled out two students to take to her classroom.

**Computation station.** At Computation Station students worked on a Problem of the Day: show four correct solutions to “My dog is half as old as me so how old are my dog and I?” If students finished the Dog Problem, they worked on place value problems and number puzzles. Hillary passed out each paper to the participants and instructed them to place them in their folder in the correct order so they would not be confused when they reached this station.
Students at Computation Station groaned at their papers and began looking at other’s work. Three students utilized egocentric speech to talk themselves through the Dog Problem. One of the groups began having off-topic conversations about their dogs and telling each other stories about their dogs’ adventures. When students began working on Number Puzzles two students stated, “What?” and “These are just hard”.

Computers. At the computer station, students played Just the Facts: Whole Numbers to practice their mathematics facts of one of the four basic operations. Students were fixated on the amount of stickers (points) they had and only view getting points as the crux of FIM. One participant clenched the desk and began breathing heavily while working on the computer program. Other students were on the edge of their seat, running fingers through their hair, or tapping their feet. A child did not get the correct answer on addition and hit their legs.

Lesson. For Hillary’s station students went through a Number Talk that focused on the concept of doubling the number. Hillary began with the problem of 5 +5 followed by 8 + 8 and then asked the students if they noticed any similarities between the two problems. A student said that each problem “added the same number together”. She then continued and gave the students 8 + 7 and 17 + 15. Students used the concept of doubling for 8 +7 by adding 7 + 7 and then adding one more or by adding 8 + 8 and subtracting one from the solution. For 17 +15 students utilized friendly numbers by adding 15 + 10 then 25 + 5 and finally 30 + 2. Participants did not know the double of 15 or 17 but were able to use a method that was familiar to them to find the sum.

While working on Number Talks a student became upset when they stated the wrong answer. Many students picked at their fingernails throughout instruction. Students
became distracted by twirling their hair, playing with their necklace, and chatting with their peers.

After Number Talks Hillary informed the students that they were going to work on a Phone Number Problem. She began by discussing area codes and the prefix of a phone number. Students were then prompted to give the area code of their parents’ phone number or a local business. The following prefixes were student provided: 592, 707, 331, and 797. Hillary then asked students, which prefix was the largest and students all answered 797. Participants were then asked to open their mathematics notebooks and write the phone numbers on the board in order from least to greatest. Once this task was completed, they were to add all the digits in each phone number to find, which had the largest sum.

During the lesson, three students began placing their head on the desk, and Hillary had to call their attention back to the board. Several students stared out of the window or around the classroom, mainly at the computers.

**End of the day.** Once students were sent back to their desks, they opened to a blank page in preparation for the mathematics journal prompt. One student came up to me prior to journal writing and said, “I had butterflies in my stomach because I didn’t think I would finish”. The journal prompt for the fourth day of treatment was “How did Mathematics go for you today? Why?” and students were instructed to circle a number on the Mathematics Thermometer, see Table 25.
### Table 25

*Mathematics Journal and Mathematics Thermometer Responses for Day 4*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Awesome because I learned new strategies for adding. Also I just liked mathematics.</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>I liked the number talk.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>It went awesome because I did not get hurt or anybody else.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>It went fine because I earned 20 stickers on FIM.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td><em>drew a sideways ghost</em></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>I felt really good because I had no work in my mathematics folder so I made a balance problem for (name)!!! I did not know the answer at all!!!!!</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>It was good. I mean I got a little nervous but not too bad.</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>Absent</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>I felt like mathematics went pretty great in mathematics today because I finished and understood everything.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>1 - because I had a great time in mathematics. Really fun.</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>I felt good because I got in 3rd in FIM.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Good because I have 800 stickers on FIM. I have no mathematics in my mathematics folder.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Mathematics went well for me today because I finished all of my work in Computation Station. My highest score in FIM was 94%. In lesson I understand everything. I had a great time in mathematics today!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>I felt great because on FIM I got 100% on Just the Facts whole numbers addition.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of nine positive, four negative, and one positive about First in Mathematics. The positive themes were feeling good, finding no content confusing, completing work, having fun, and enjoying everything. The negative responses were finding mathematics hard, being nervous because a student felt behind, and two students were confused by the Number Balance puzzles. The one response to First in Mathematics referenced score improvement.
The overall classroom mathematics anxiety level was 1.79 ($SD = .64$). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Two psychological anxiety symptoms were exhibited when students were working on Number Puzzles and the Dog Problem. Only one physiological anxiety level was displayed, which was a student using the restroom. Two uncategorized anxiety symptoms were identified as picking at fingernails and running fingers through hair.

**Day Five**

Prior to mathematics beginning, Hillary instructed students to tear out a page of their small and large Go Mathematics! Book that they will use for the lesson. Today the lesson was broken into three stations each lasting 25 minutes. Today the local University’s partnership student was in the classroom and led the Number Talk portion at the lesson. Two students left for thirty minutes for speech therapy.

**Computation station.** Hillary revisited the doubles theme from the previous day’s lesson. She asked the students to solve 8 +9 and to show detailed work. The students continued through the mathematics packet that required them to show their detailed work of addition and subtraction while Hillary graded papers. Three students required guidance through the packet.

Throughout the packet students were staring off, tapping their pencils, and hesitant to show their own thinking. When students were asked to show their work, they would lay their head down on their desks. Several students began to play with their hair and poke their heads with their pencils. Two students expressed their thoughts on packet, “I don’t know how I did this improperly, but I tried my method” and “I don’t get it”. 
Computers. Students worked on Skillsets, which is a game consisting of a target number and two wheels that list three numbers. The player must choose the correct wheel to calculate the correct answer. Difficulty levels vary; initially students are just adding three addends but as they advance subtraction and addition are presented together. Students who proceeded farther worked with multiplication, addition, and subtraction.

Several students struggled with the Skillsets game, and if an answer was wrong they would hit their head. One participant began to breathe heavily and then kicked the cabinets, while another student got an answer wrong then proceeded to select a different game but never played the new game. While working at the computer station students stated that “I just don’t know how to do this”, “This game doesn’t make any sense”, “This is hard”, and “This game is too hard. I don’t want to do this”.

Lesson. The lesson began with the partnership student introducing a Number Talk of 9 +9 followed by 8 + 7. The partnership student was not as competent as Hillary in Number Talks and would often confuse students by changing their words to better fit her thinking. The final problem the students worked on was 18 + 19. During Number Talks, students became distracted by doodling and going through desks.

Following Number Talks the students got the two Go Mathematics! pages out of their folders and went over the directions. The two worksheets focused on reading and answering questions about bar graphs. Students sat quietly and worked on the graph worksheets with minimal to no social interaction. Four of the students struggled with the concept and required heavy guidance from the partnership student. Participants have had minimal exposure to graphs and floundered through the worksheets. The guidance on the worksheet steered towards the partnership student’s desired answer. While working on
the graph papers students began to bulge their eyes, sighed deeply at the paper, and rested their hands on their foreheads. One student stated, “I still don’t get it” while squinting their eyes at the worksheet.

**End of day.** Students were dismissed back to their seats 10 minutes prior to the bell ringing. The mathematics journal prompt for the fifth day of treatment was “What was the best part about mathematics today? Why? What was the most challenging part about mathematics today? Why?” Students were instructed to circle a number that corresponded to their mathematics anxiety level on the Mathematics Thermometer, see Table 26.

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Best: When I never got an incorrect answer on FIM because I like to have no correct answers. Challenging: The lesson because there were hard problems, but I solved them!</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Best: Easy because of FIM. Challenging: Nothing!</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Best: Games because I got every answer right. Challenging: The lesson it was a little bit challenging because it was hard to focus because someone was tapping on me.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Best: The best part was that I earned 30 stickers on FIM. Challenging: Doing this thing back at computation station. It was hard because the big numbers that I subtract were hard.</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>Best: FIM Challenging: Mathematics packet</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>Best: The number talks because all of them were easy. Challenging: FIM because Skillsets are confusing.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Best: I earned 13 more stickers. Challenging: I got ten more stickers so I can get player of the day. The game was difficult.</td>
</tr>
<tr>
<td>Student</td>
<td>Action</td>
<td>Best:</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>I liked FIM today because I earned over 100 stickers.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Number talk. Fun.</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>I got 830 stickers on FIM because I start with 799 and got 31 stickers.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Today was a good day because I didn’t really finish my computation station work. But in lesson I got to work on Go Mathematics book thingy.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>The best part today was Skillsets on FIM because I’m on skill sets (2-2) and I was on (1-3).</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of three positive, four negative, and ten about First in Mathematics. The responses exceeded the class total of 14 due to a two question prompt. The positive themes referenced solving hard problems during the lesson and two students enjoyed the Number talks. The negative responses regarded the lesson being challenging, a graph worksheet, and two students referenced the assessment at Computation Station. The FIM responses were coded into positive and negative themes. Positive responses to FIM involved the game being easy, getting correct answers, and earning more stickers. Negative responses were incorrect answers and Skillsets being confusing.

The overall mathematics anxiety score the today was 2.92 ($SD = .86$). The researcher perceived psychological, physiological, and uncategorized mathematics
anxiety symptoms. Five students showed signs of psychological anxiety symptoms that dealt with their confusion on the mathematics packet with Hillary and the graph worksheets at the lesson. Two students portrayed physiological symptoms, which both went to the restroom. One student demonstrated anxiety symptoms of breathing heavily, which was not categorized as psychological or physiological from previous research.

**Day Six**

Mathematics was broken into three stations that were 25 minutes each. Students rotated through computation station, teacher-led lesson and the computers. The Special Education teacher took two students during mathematics.

**Computation station.** Computation Station consisted of a Problem of the Day, completing a Measurement Assessment for prior knowledge and unfinished work in their mathematics folder. The Problem of the Day was: In one week, 128 cell phones were sold. The following week, 37 more cell phones were sold that the week before. How many cell phones were sold in those two weeks? Students read the problem and stated, “What does this even mean?” and “no, I can’t do that”. Three students struggled with the Problem of the Day but were told to catch up.

When students got to the Measurement Test several complained that they had to complete another test. Two students commented “I’m not sure about this” and “What? I need help with this. It is hard”. Several participants did not want to show their work and looked at their peer’s work. One student played with his left ear with his left hand throughout the test’s entirety.

**Computers.** On First in Mathematics, students worked on Just the Facts Whole Numbers on addition, subtraction, or multiplication to learn their basic facts. Students
designed their player badge instead of playing the game. Two students sat on the edge of their seat with their face close to the screen squinting their eyes at the screen. Participants began to rub their fingers over their lips and then pulled on them. One student wiggled in his chair and puffed his cheeks with heavy breaths. When a question was answered wrong, students threw their hands in the air and drug them down their face. A participant commented, “This game is too hard”, and then quit the game and ran their fingers over the keys for the remainder of the time.

**Lesson.** Hillary began the lesson with Number Talks of 49 + 49, 24 + 27, and 36 +37. Throughout the Number Talks, students stared out of the window, rummaged through desks, and put their heads down on the desk.

Once the students completed these tasks, they revisited the Phone Numbers lesson from Day 4. Hillary wrote the number 665-4213 on the board and asked the participants to compute the sum of the seven digits. Students were then given a blank piece of paper and wrote Date and Phone Numbers across the top. Pupils were instructed to find the total of at least four phone numbers that they choose from a pre-written list on the board. The students are reminded to show all of their work and not just the sums. When told they had to compute the sums a student stated, “So we have to add up all those numbers!” and then stuck their tongue out, while another said “this is too hard”.

Two students throughout the Phone Numbers portion struggled with the concept yet were not given guidance by Hillary. They spent their time at the Lesson staring off and not completing any work. Several students walked around the room to get supplies during their time to work on Phone Numbers. Participants pulled and ran their hands
through their hair while their cheeks turned pink. One student asked off-topic questions instead of mathematics.

**End of the day.** Students were sent back to their desks and for the sixth day of treatment were given the prompt, “Pick a face that describes how you felt about Mathematics today? Why?” Participants were given a picture of pre-selected faces by the researcher as seen in Figure 21. Students were asked to circle a number on the Mathematics Thermometer; their mathematics journal responses and corresponding number can be seen in Table 27.

![Figure 21. Faces for Mathematics Journal prompt Day 6](image)
Table 27
*Mathematics Journal and Mathematics Thermometer Responses for Day 6*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Picked a smiling face because I was happy in mathematics today.</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Picked a big smile face because happy because of mathematics.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Picked a smiling face because it looked happy and I was really really happy.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Picked a big smile face. I picked this face because I got ten stickers on FIM. And I got some work done at CS and I had a good day in mathematics.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Picked a content face. Because I like the problems. Happy.</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Picked a happy face. I was happy.</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>Picked a content face. I was really relaxed.</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>Absent</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Picked a smiling face. I picked a happy face because it was good and fun day in mathematics for no particular reason.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Picked a smiling face. I was happy today.</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>Picked a face sticking tongue out. I was disgusted on FIM because it was not fun at all.</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>Picked a surprised face. Because I started with 1,030 now I have 1,101.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Picked a big smile face. I chose that face because I got 97% on FIM. In CS I finished all of my work. I had a great day in mathematics.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Picked a smiling face. Because I had a really good day and it was awesome.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of ten positive and three about First in Mathematics: two positive and one negative. The positive themes were six students feeling happy, two having fun, one student feeling relaxed, and one finishing work. The two positive FIM responses referenced more stickers and a higher score; while the one negative response was not having fun.
The overall mathematics anxiety level for the day was 2.54 ($SD = .82$). Students demonstrated four psychological symptoms of anxiety consisting of confusion and zero physiological symptoms. Three uncategorized symptoms of mathematics anxiety were shown by a student playing with their left ear with left hand and two students pulling on their lips.

**Day Seven**

Students were broken into three groups for mathematics with stations lasting 20 minutes each. The stations consisted of Computation Station, Computers, and Lesson. The Resource Teacher and four students worked in the resource room for mathematics.

**Computation station.** Hillary continued the Number Assessment from the fifth day of Treatment and spent the station time guiding all students through the test. Students were permitted to utilize Base 10 Blocks to assist their thinking. One student inquired about the length of a block and then measured their notebook and other materials instead of doing assigned work. Throughout the assessment students were overheard saying, “I just don’t get this problem” and Hillary told a participant “You need to show all of your work” and they responded with “but I did!” This pupil then put their head on the table and did not complete the assessment. Students began to look at their peer’s papers and began to copy their work. One participant played with his left ear with his left hand.

**Computers.** At First in Mathematics, students worked on Skillsets. Students sat close to the screen on the edge of their seat. Several students quit playing the game and designed their player badge while two students spent their time having a conversation. Three students got an answer wrong and slouched their shoulders while hanging their
head. Common behavior during Skillsets was sighing deeply, tapping feet, and bouncing up and down.

**Lesson.** The lesson began with Number Talks of $19+18$ and $29 + 29$. During Number Talks students played with their necklaces, looked around the room, stared out the window and doodled on their notebooks.

Following Number Talks, students got out their graph worksheets that were completed on the fifth day of Treatment. When students were informed, they would be working on picture graphs one responded with “yuck!” while another stated “but I don’t know what to do”. The partnership student erased one student’s work, which led the participant to not work on mathematics for the remainder of the station. Once the first worksheet was completed, students were given a second to finish.

**End of the day.** Students were sent back to their desks ten minutes prior to lunch and given the prompt “Pick a color that tells how you felt about mathematics today. Why?” Participants were asked to circle a number on the Mathematics Thermometer to show their mathematics anxiety level. Their mathematics journal responses and mathematics anxiety level are shown in Table 28.
<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Green. Because I felt awesome and I got a lot of correct answers and I like to get correct answers because it shows I’m getting smarter.</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Blue. A little confused because of lesson.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Green. Because I felt like good and awesome because it was awesome and fun.</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>I picked yellow because in class (Special Education teacher) when we were done. And we were walking down the hall I was nervous that I couldn’t get on FIM</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Blue - kinda means happy.</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Green because I felt good because I completed skill sets 1 and almost 2.</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>Purple and green because I was chillaxin and good.</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>I picked the color green because in mathematics today I finished a test and finally got 2,000 stickers on FIM.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Green. I felt fun.</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>Green. I felt good because I got Player of the Day.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Green. It was fun.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>I chose this dark green because I had a very good day! I know I always choose green, but mathematics is really working for me. I don’t know why...maybe because it’s fun!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Green. I felt very happy because I did I just had a really good to me and I had no reason.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of nine positive, one negative, and three about First in Mathematics: two positive and one negative. The positive themes involved three students having fun, three other students feeling good, and two participants being happy. One student felt positive for having correct answers and a second student finished their test. The one negative responses referenced the lesson being confusion. Two positive FIM themes were completing Skillsets and getting more stickers. The one negative FIM response was not playing FIM.
The overall mathematics anxiety level for the seventh day of Treatment was 1.77
($SD = .38$). The researcher perceived psychological, physiological, and uncategorized
mathematics anxiety symptoms. Students displayed two forms of psychological
symptoms by demonstrating confusion about picture graphs. Two students portrayed
physiological symptoms by going to the bathroom. Three uncategorized anxiety
symptoms were recorded: playing with hair, pulling single strands of hair out of their
head, and playing with left ear with left hand.

**Day Eight**

Prior to mathematics, an incident occurred between two of the students during
lunch and recess. One student was teasing a peer and in retaliation pushed their classmate
into the wall hurting their elbow. Hillary spent fifty minutes of mathematics handling the
situation and talking with these two students.

Students went to the Computer Lab for 40 minutes to complete Just the Facts
Whole Numbers, which they were given five minutes to complete 100 problems of either
addition, subtraction, multiplication or division. For this group, the majority of students
worked on addition and subtraction; only two students attempted multiplication, and one
student received a perfect score on all operations. Hillary did not require students to
progress from their previous score but try their hardest this week. Once students finished
one round of Just the Facts, they were given the opportunity to try again. Throughout Just
the Facts students sat on the edge of their seat close to the screen. Several students would
get one answer wrong and then restarted the game. When given a problem they did not
know the answer to three students waved and flapped their hands. Participants became
visibly upset when incorrectly answering a problem and would throw their hands in the
air and stomp their feet. Students who received high scores were ecstatic with their performance.

After 40 minutes, the students went back to their classroom and got out their bar graph of Just the Fact scores. Each week students graphed their score to visualize their progress. Students marked on the graph paper their newest score and colored in the bar. Several students shared their scores with classmates.

With an hour remaining in mathematics students prepared for split Physical Education. Every Friday afternoon students went to gym class in two groups in conjunction with the other third-grade class. During the split, the students who were not finished with yesterday’s Number Assessment completed the task and then played the game More. Hillary guided the three students working on their test the entirety of the thirty minutes. One student wound his legs around each other and squeezed his legs together. A participant was asked to explain their thinking and the student did not respond but erased all of their work and placed their head on the table. While working on the assessment a student pulled their hair up and back while breathing loudly.

The game of More is played with a partner, a deck of cards, and unifix cubes. Each partner placed a card down, and they determined, which is larger. Once they calculated the difference, the partner with the greater number counts out the number of cubes that was the difference between the two numbers. They continued taking turns until both were out of cards. The winner of the game was the player with the most cubes. The students appeared to enjoy the game although several would become distracted by creating objects out of the cubes or mixing the cards up and having to pick them up.
End of day. After the second group returned from gym class, the participants were given the prompt, “Draw a face for how you felt in mathematics today. Why?”

Students were asked to circle a number on the Mathematics Thermometer corresponding to their mathematics anxiety level, see Table 29 for students’ responses.

Table 29

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Smiling face because I got on a roll on mathematics today by having...FUN!!</td>
</tr>
<tr>
<td>2</td>
<td>6.5</td>
<td>Straight face. Goodish.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Smiling face because it was fun and why it was fun because no one get hurt.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Smiling. I drew this face because I got some stickers on FIM. I’m almost to a thousand.</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Slight smile. I was happy because I beat Same 2 times in More.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Zig-zag mouthed face with a single tear on cheek. I got 40 stickers.</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Smiling because I picked a smile face because I got 63% on Just the Facts 100 (FIM) today.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Goblin. Felt fine man!</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>Happy face. Because of everything.</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>Surprised face. I had 87 stickers on FIM; #9 had 88.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Smiling. I chose this face because in the computer lab on JTF 100 I got 99% (the highest score you can possibly get is 100%). So I had a good day!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Slightly smiling. Because I felt really happy that we got to go to the computer lab again.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of seven positive and five about First in Mathematics: two positive and one negative. The positive themes involved two students having fun, two other students feeling happy, and others feeling good, fine, and
enjoying everything about mathematics. The five FIM these were all positive and referenced getting more stickers and having a higher score.

Overall the class’s mathematics anxiety level for the eighth day of treatment was 1.63 \( (SD = .47) \). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Students showed zero psychological symptoms of mathematics anxiety and four physiological symptoms when going to the restroom. One uncategorized form of anxiety was demonstrated by a student pulling their hair up and back.

**Day Nine**

Mathematics was only allotted for an hour instead of ninety minutes. Students were given a Number Talk quiz that consisted of the following problems: 48 + 49, 99 + 97, 66 + 33, 98 + 97 + 5, 113 + 56, 216 + 137, 274 + 57, 50 - 29, 70 - 34, and 100 - 74. Participants were instructed to show all of their work and not just the answer. Hillary gave the students 30 minutes to complete the quiz. While students worked on the quiz several participants placed their head on their desk and stared at the paper. Two students bit their fingernails while another chewed on their headband. A participant erased all of their work, and feverishly continued erasing and put a hole in the quiz. The student became more concerned with cleaning the eraser residue off of the desk. Several students tapped their feet and pulled on their lips. Hillary gave the class a ten minute warning and students proclaimed, “but I’m still on #6!” and “what if I don’t get done!” The teacher informed the student that if they did not finish then it would lower the student’s grade. The student did not complete any more questions on the quiz and wrote “I don’t know”
for the last three after being informed by Hillary of the consequences. One student did not finish the Number Quiz.

After completion of the Number Talk quiz, students were given a worksheet on picture graphs. When all students finished the quiz, they took their mathematics folders to the carpet area. Together they went over the answers to a picture graph and line plot worksheet going around the circle to read the question aloud and give their answer. After answering all of the questions, the students headed back to their desk to complete a third worksheet on graphs.

Students worked independently on the graph worksheet for the remainder of the mathematics period. Several students expressed, “I don’t get it” and would place their heads on their desk. Two students struggled with reading the questions on the paper. A participant was reprimanded for doodling on their paper but continued when Hillary was not looking. During this time, two students worked at the Group Work table with the Special Education teacher.

**End of the day.** When ten minutes were left in the mathematics period, the students were instructed to get out their Mathematics Journals and answer the prompt, “Pick an emotion, draw a face, and write thoughts about mathematics”. Participants also circled a number on the Mathematics Thermometer that corresponded to their mathematics anxiety level, see Table 30 for mathematics journal and Mathematics Thermometer responses.
<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Happy. Smiley face. I thought mathematics was good because today I got smarter!!!</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Hard! Sad face. Hard!</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Sad. Sad face. I was sad because I did not feel good.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Happy. Smiley face. I thought that I had a good day because I got Player of the Day. And I never got Player of the Day before. I was excited.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Happy. Smiley elf face. I liked everything in mathematics today.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Good. Slight smiley face. I thought it was easy.</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Fine. Straight face. I was fine. It was mostly easy. But while I was doing my mathematics I had a headache.</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>Challenging. A face saying “I’m feeling challenged!” I thought mathematics today was challenging because we had to do a number quiz and answer and show my work for 10 hard problems.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Good. Smiley face. I felt good in mathematics like happy happy.</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>Horrible. Angry face. The work was too easy because I learned it at school last year.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Great. Shocked face. I draw that because I was so surprised on how I did. I felt great today in mathematics because we did a number talk quiz and I pretty sure I got them right.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Happy. Smiling face. I felt happy because I really love mathematics all the time.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of eight positive and five negative.

Three students felt happy with one specifying that they felt smarter. Other positive themes were mathematics being easy, the Number Talk Quiz, getting Player of the Day, and everything about mathematics. The five negative responses referred to mathematics being hard, challenging, and horrible, confusing, and feeling sad.
The overall mathematics anxiety level for the ninth day of treatment was 2.31 \((SD = .72)\). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Students demonstrated two psychological symptoms through confusion on the graph worksheets and Number Talk quiz; five physiological symptoms were shown by students going to the restroom. Four uncategorized anxiety symptoms were portrayed through twisting hair, squeezing lips, pulling hair, and biting fingernails.

**Day Ten**

Mathematics was divided into three stations: Computation Station, Computers, and a Lesson. The stations lasted for 25 minutes each. One student left for Speech Therapy for 30 minutes and missed Computation Station.

**Computation station.** Hillary was at Computation Station where students worked on a Go Mathematics! worksheet on graphs. The groups struggled with the worksheet and were discussing the problems and tried to help each other. When the students were unable to reach an answer, Hillary tried to guide the participants. However, Hillary was confused by the question and referenced the answer key.

During the worksheet students expressed, “Ummm guys I’m having trouble” and “I don’t even get the first problem”. Several students were twisting their mouth and staring at the paper. A student got reprimanded for not doing their work but insisted they did not understand the problem and cannot complete it.

**Computers.** At computers, the students worked on First in Mathematics Just the Facts Whole Numbers. Several students sat on the edge of their seat close to the screen.
One student sat on their feet and bounced up and down. When students got an answer wrong, they would stomp their feet and start the game over.

**Lesson.** The Lesson was led by the partnership student and began with Number Talks of 58 + 28 and 37 + 26. During the Number Talk, students were doodling on their notebooks and staring out the windows.

Following Number Talks, the students were instructed to work in their Go Mathematics! book on a page about graphs. Students went through each question together at the partnership student’s pace. The participants verbalized that they did not understand the worksheet but were instructed to continue going through the questions. Students made comments that it “doesn’t make any sense”, “I don’t even get this”, and “wait this is impossible”. Two students peered at their classmates’ papers and copied the answers. While circulating the small group, the partnership student noticed that a participant answered a question wrong and said, “You did this on your own and you are wrong”. This student immediately stopped participating and sat at their desk the remainder of the station.

**End of day.** The timer went off with ten minutes left, and students went back to their desks and got out their Mathematics Journals. The prompt for the tenth day of treatment was “How did you feel about mathematics today?”; students were also asked to circle their mathematics anxiety level on the Mathematics Thermometer, see Table 31.
The mathematics journal responses consisted of five positive, six negative, and three positive about First in Mathematics. The positive themes expressed feeling smarter, having fun, finishing work, and feeling good. The main negative response was feeling confused due to the graph worksheet or Computation Station. Other negative themes involved feeling bored, not knowing, or not trying. The three FIM themes were all positive and consisted of getting answers correct and “loving” FIM.

The overall mathematics anxiety level was 3.21 (SD = .86). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety
symptoms. Students displayed 11 psychological symptoms about their confusion of graph
worksheets. Four physiological symptoms were recorded of students going to the
restroom. Three uncategorized anxiety symptoms were shown through hitting chest,
fidgeting hands, and hands in hair and pulling it back.

Day Eleven

Mathematics involved a whole group lesson on the amount of pockets students
were wearing in the class. Hillary gave each student a sticky note and each participant
estimated the total amount of pockets for the entire class. Students were then instructed to
count the number of pockets they had and to write it on the sticky note. The estimations
and pocket amounts were then placed on the board. Hillary questioned students on how
the data should be rearranged. Students gave several suggestions of greatest to least and
least to greatest and decided on least to greatest. Hillary arranged the sticky notes as the
students requested. Participants were asked questions about the range and mode of the
data.

Following the questions, students were told to get out their mathematics
notebooks and to answer the question: After seeing the data do I want to change my
estimate? Why or why not? While students answered the question, Hillary got unifix
cubes for the next step. Each table group got cubes and took the amount of cubes that
matched their amount of pockets, e.g., if a student had four pockets they would take four
cubes. After each participant had built their cube train, the table groups then combined all
of their cube trains and counted the total. The first group had 21 cubes, the second had 19
cubes, and the third group had 18 cubes. Next, student added the three totals for a whole
class total.
Students were instructed to make as many tens as possible with their table group with their amount of cubes, e.g., for 21, there would be two tens and one one. Hillary had the students calculate the amount of tens for the class total of 58. Students answered four tens and 18 ones. Hillary prompted them to see if they could make another ten. The participants determined they could have five tens and eight ones.

Students were then given one more problem to solve: My first estimate was ______. The total number of pockets was 58. The difference between my estimate and the total was _____. Students were then given time to solve the problem and told when they finished to bring their mathematics notebook and folder to be checked off. When students finished this problem, they completed either unfinished work, number puzzles or pages in the front of their Go Mathematics! book. When students completed their worksheets, they said, “I don’t get this.” Many students began to chew and pick at their fingernails. One student began to distract their three tablemates by asking if they preferred cats or dogs. This off-topic conversation continued for five minutes as they shared stories about their pets. Two students pulled their hair while another tapped their feet.

**End of the day.** When there were ten minutes left in the mathematics period students were given the mathematics journal prompt, “Pick a face and explain why”. The participants were given a sheet with various faces that portrayed myriad emotions, as seen in Figure 22. Students circled the number on the Mathematics Thermometer that corresponded to their mathematics anxiety level, see Table 32 for mathematics journal and Mathematics Thermometer responses.
Figure 22. Faces for Mathematics Journal Prompt Day 11.
Table 32
*Mathematics Journal and Mathematics Thermometer Responses for Day 11*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>Happy. Because I had fun today and liked Pockets. I am a little nervous because I think I got an answer wrong on a worksheet.</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Sad. I didn’t like Mathematics!</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Shocked. I picked that face because I was shocked that we didn’t get on First in Mathematics!</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Happy. Because we didn’t have to do rotations. Liked the Pockets activity.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Cool. I felt relaxed and cool.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Chillaxing. I felt chillaxing. Liked the Pocket activity.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Suspicious. Angry. Happy. It is a secret. It is a mystery. But my second mood is Angry. That’s a mystery too. But I was happy in mathematics.</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Cool. I felt cool because I had no pages in my mathematics folder and got everything done.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Miserable and Angry. Someone has a secret about me.</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>Disgusted. I felt disgusted because I just felt disgusted. I have a lot of work to do.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Sleepy. I woke up at 6:00 and could not go to sleep for an hour. I feel good in mathematics.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Eager. Today I felt eager in mathematics because I was always ready for the next worksheet!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Joyful. I felt joyful because of everything. Because I love mathematics and today was fun.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of nine positive, four negative, and one about First in Mathematics. Three students positively referenced the Pockets activity. Other positive themes were finishing work, feeling happy or relaxed, and eager for more work. The negative themes involved a student getting an answer wrong, feeling sad or miserable and having work to complete. The one theme about FIM was a student being upset that they did not have computer time.
The overall mathematics anxiety level for the eleventh day of treatment was 2.08 ($SD = .70$). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Students displayed two forms of psychological anxiety in their confusion of worksheets. Four students went to the restroom, which were categorized as physiological. Two uncategorized anxiety symptoms displayed were pulling hair and biting and picking fingernails.

**Day Twelve**

On the twelfth day of treatment, students were divided into three groups for stations: Computation Station, Computers, and Lesson. Each station was 15 minutes long. The Special Education teacher took four students to her room to work.

**Computation station.** Hillary led the Computation Station that involved students pretending to go to a store and purchasing items with money. Students were given a shopping list to select items and the corresponding prices. Hillary chose one student per rotation to model the activity. The students never made it through all of the directions and did not play the game. Students struggled with comprehending that a customer would need change back at the store. Two students stared at the wall throughout instructions. Two students worked on the Number Talk quiz from when they were absent.

**Computers.** Students worked on new games called “Know and Show” and “Picture This” that worked on graphs. The students cheered when they heard they got to play a new game. Students were on the edge of their seat and close to the computer screen. One student ran their hands through their hair. A participant commented, “This game is too hard for me”.


**Lesson.** The partnership student led the lesson and began with Number Talks of $38 + 17$, $53 + 38$, and $122 + 37$. The Number Talks continued; cumulatively there were eight Number Talks given to each group. Throughout the Lesson, students were doodling on notebooks, playing with their pencils, rolling their eyes, and staring out the window. A student was not called on to share their thinking and put their head on their desk and hid their face.

**End of day.** During the last ten minutes of mathematics, students were given the following prompt for their Mathematics Journal, “Drawing four faces to describe FIM (computers), Lesson, Computation Station and Overall. How did mathematics go for you today?” Participants circled the number on the Mathematics Thermometer that corresponded to their mathematics anxiety level; see Table 33 For both mathematics journal and Mathematics Thermometer responses.

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
</table>
| 1       | 2                             | FIM: smiley face  
Lesson: smiley face  
Computation Station: smiley face  
Overall: smiley face  
Mathematics went good today because I made good progress. |
| 2       | 2                             | FIM: smiley face  
Lesson: sad face  
Computation Station: straight face  
Overall: straight face  
Not that good. |
| 3       | 0                             | FIM: smiley face  
Lesson: question mark  
Computation Station: smiley face  
Overall: question mark  
I felt awesome because of everything because it was fun. |
<table>
<thead>
<tr>
<th>Table 33 Continued.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4</strong></td>
</tr>
<tr>
<td><strong>FIM: sad face</strong></td>
</tr>
<tr>
<td><strong>Lesson:</strong> question mark</td>
</tr>
<tr>
<td><strong>Computation Station:</strong> sad face</td>
</tr>
<tr>
<td><strong>Overall:</strong> sad face</td>
</tr>
<tr>
<td>I felt sad for First in Mathematics because I barely got on First in Mathematics. I felt sad on computation station because we didn’t get to do a game today.</td>
</tr>
</tbody>
</table>

| **5**               |
| **FIM: smiley face** |
| **Lesson:** sad face |
| **Computation Station:** smiley face |
| **Overall:** straight face |
| Mathematics was fun with (Special Education teacher) and it was easy because I got every answer right. Lesson was not fun because you just listened. Games was sucky because I didn’t get to play and there were no more computers. |

| **6**               |
| **FIM: smiley face** |
| **Lesson:** smiley face |
| **Computation Station:** smiley face |
| **Overall:** smiley face |
| I felt really good because everything was good. |

| **7**               |
| **FIM: straight face** |
| **Lesson:** straight face |
| **Computation Station:** smiley face |
| **Overall:** smiley face |
| Feeling awesome. |

| **8**               |
| **FIM: smiley face** |
| **Lesson:** sleepy face |
| **Computation Station:** smiley face |
| **Overall:** smiley face |
| I felt fine. Everything I understood. I was sleepy in computation station. |

| **9**               |
| **FIM: smiley face** |
| **Lesson:** yawning face |
| **Computation Station:** smiley face |
| **Overall:** smiley face |
| Mathematics was fun today because I finished Picture This and Number Zoo in Know and Show on FIM. |

| **10**              |
| **FIM: smiley face** |
| **Lesson:** sad face |
| **Computation Station:** smiley face |
| **Overall:** straight face |
| Really good. |

| **11**              |
| **FIM: smiley face** |
| **Lesson:** sad face |
| **Computation Station:** smiley face |
| **Overall:** straight face |
| I did not get to do the lesson today. |
The mathematics journal responses consisted of seven positive, five negative, and five about First in Mathematics: three positive and two negative. The positive themes involved students making progress, having fun, understanding the content and overall feeling good. The negative responses involved students being confused about the game, feeling bored at the Lesson and not having a good day. Three positive FIM themes were playing a new game and getting more stickers. The two negative FIM themes were either barely having any time on the computer or no time at all.

The twelfth day of treatment’s overall mathematics anxiety level was 2.08 (SD = .70). The researcher perceived psychological and physiological mathematics anxiety symptoms. Students displayed one psychological symptom of confusion about graphs. One student portrayed physiological symptoms by going to the bathroom.
Day Thirteen

Hillary led the students to the computer lab to complete Just the Facts 100 of one of the four operations. Students were given forty minutes to complete the task and record their highest score. Several students stared at the computer screen for five minutes prior to beginning the timed basic facts game. Students were tapping feet up and down, sighing deeply, and placing their hand on their forehead. One student began to chew their fingernails.

Following the computer lab students headed back to the classroom to graph their score. The participants had split gym class today. While students were in the classroom, they worked on a strengths and weaknesses chart. Hillary required every student to fill one out for parent-teacher conferences, which the information will be shared. Participants are to list three strengths and three weaknesses in mathematics. Initially the students were confused about what to write, and Hillary went over topics that have been discussed thus far:

- Homework packets
- Problems of the Day
- Number Talks
- Making Change
- Telling Time
- First in Mathematics
- Graphing
- Addition and Subtraction
- Staying on task
- Taking time on tasks
- Doing your personal best
- Using class time wisely
- Showing all work
Hillary emphasized that she would not accept one-word answers, it must be in complete sentences. Two students showed Hillary their work, and she informed them that they needed to write a different weakness that she feels fits better. All students wrote their weaknesses first before writing one strength.

**End of the day.** Once the second gym class group returned, students got out their Mathematics Journals and answered the following prompt, “I felt _______ because __________.” and circled the number on the Mathematics Thermometer that corresponded to their mathematics anxiety level, see Table 34.

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>I felt really good in mathematics today because I did good work but I made mistakes so I kind of sad, but I am ok now.</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>I felt good because I had fun because it was awesome.</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>I felt (happy face) because games.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>I felt good because was easy and I beat my score in FIM. It was 69% and I got 82%.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>I felt good because of FIM.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>I felt fine because mathematics was simple today.</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>I felt good in mathematics today because I got 78% on Just the Facts 100 multiplication on FIM in the computer lab.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>I felt good because I got 60% on FIM!</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>I felt sick because I was not having a good time.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>I felt happy about mathematics because I was the player of the day.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>I felt good because I was honest on the chart of strengths and weaknesses.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>I felt everything is awesome! Because I had a really good time.</td>
</tr>
</tbody>
</table>
The mathematics journal responses consisted of six positive, one negative, and five about First in Mathematics. The positive themes involved mathematics being simple, doing good work, having fun, and being Player of the Day. The one negative responses referenced not having a good time. All FIM themes were positive with students referencing beating their score or feeling good or happy.

The overall mathematics anxiety level was 1.92 (SD = .75). The researcher perceived zero forms of psychological symptoms and five physiological symptoms when students went to the restroom.

**Day Fourteen**

Mathematics began by dividing students into three groups: Computation Station, Computers, and Lesson. Each station was 25 minutes long. One student left for Speech Therapy and missed Computation Station. A fire drill caused students to miss ten minutes of mathematics.

**Computation station.** Hillary sat at Computation Station grading papers while students worked on the money and change game from the twelfth day of treatment. Students worked with a partner on the money game. One partner would tell the storekeeper the items they wanted to buy. Both computed the total and determined the correct amount of change. Once they finished one round of the game, they played another. Several of the partnerships consisted of one student doing all of the work while the other stared off at the computers. A group required guidance from Hillary throughout the entire activity. While calculating the change, one student pulled their hair and bit their lips.
Computers. Students worked on First in Mathematics Skillsets. Throughout Skillsets, one student played with his left ear with his left hand. Another student began to bite his fingernails while another grabbed their hair and pulled it back. When students got a problem wrong, they would start pulling on their hair and ripping strands out. Two students completed their strengths and weaknesses chart during this time.

Lesson. The partnership student led the lesson and began with Number Talks of 37 + 38 and 66 +28. During Number Talks, students played with their bracelets, laid their head down, flipped through their mathematics journal and played with shoe strings. Students had to be called on to explain methods because no participants raised their hand. Following Number Talks students were instructed to get out their Go Mathematics! books on graphs and go through each problem step by step. Students were to follow along with the partnership student’s pace. Participants showed confusion on how to read the scale on the bar graph. The students struggled with reading the questions and comprehending the question being asked. One student looked at the bar graph and pulled their hair up and back. The partnership student told a student to redo a problem and the participant put their hand on their head and sighed deeply.

End of day. After the timer went off for a final time the students were given the Mathematics Journal prompt, “Draw any picture to describe how you felt and why?” and circled a number on the Mathematics Thermometer that corresponded to their mathematics anxiety level, see Table 35.
Table 35
Mathematics Journal and Mathematics Thermometer Responses for Day 14

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>I drew a train because trains make me happy and I felt happy in mathematics today.</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Stick figure with a half happy and half sad face. I was half happy and half sad because of strengths and weaknesses.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Smiley face. I felt happy because of everything because it was really fun and awesome!</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>I chose an owl because owls are my favorite animal. And because my name starts with A. And it sounds like owl is in my name... And I felt HAPPY!</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Drew a boy playing video games. Happy because I was just happy I guess. Wait because I liked the money game.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Drew a girl smiling with a snake. Happy because I was just happy I guess. Wait because I liked the money game.</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>Drew a spaceship. Felt mad and happy. It was very hard but I got 25 sticks in FIM.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Drew a straight face and a thought bubble with “bored” inside of it. I was okay. But is a little boring. But I understood it good</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>Drew a stick figure saying “yawn”. I felt a little bored today in mathematics because it was just normal with no extra stickers on FIM and nothing exciting.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Drew a shark eating smaller fish and a claw eating $500/5 = 100$. I felt smarter.</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>Drew a dragon breathing fire on a castle. I felt mad because is was just a horrible day.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Drew two suns: one with sunglasses smiling and the other sticking its tongue out smiling and saying “happy”. Mathematics was fun.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Drew a picture of coins and paper money with a key saying coins and money equal happy. I had a great time in mathematics today mostly because in games on FIM I completed division on set-skills. But in lesson I was really, really, very, very, bored.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Drew a pumpkin smiling. I felt like a pumpkin (awesome).</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of eight positive, four negative, two about First in Mathematics, and one uncategorized. One student gave a response with two codes. The positive themes involved two students feeling happy, the money game, feeling good or smarter, and having fun. The four negative responses referenced three students
being bored and one student feeling horrible. The two FIM themes were positive and involved students completing Skillsets and getting more stickers. The uncategorized theme was a student feeling half happy and half sad, which would be both positive and negative.

The overall mathematics anxiety level for the fourteenth day of treatment was 2.29 ($SD = .68$). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. The researcher recorded zero psychological symptoms and two physiological symptoms when two students went to the restroom. Four uncategorized anxiety symptoms were demonstrated through biting fingernails, pulling hair back, playing with left ear with left hand, and pulling on hair.

**Day Fifteen**

Mathematics was taught in a whole-class format. Three students were taken by the Special Education teacher to the Small Group Table during mathematics. Hillary had students get out a graph worksheet previously completed in order to go over the answers. Students did not mark answers wrong but erased their answers to fix them. Participants went around the room to read aloud and share their answers. Students struggled with finding the total number in a graph. Hillary took the time to go over each step of the problem. Participants required great assistance throughout the entire worksheet. One student commented, “I didn’t answer the question because it was tricky.”

After going over the answers, the students took their mathematics notebooks to the carpet area for a read aloud of *Chrysanthemum* (Henkes, 1991). Throughout the read aloud the students were very alert and willing to participate. Once the read aloud was finished, students were instructed to write in their notebook their first name and the
number of letters it contains. Students must then find the difference between their name and Chrysanthemum, e.g., Dave has four letters and Chrysanthemum has 13, 13 - 4 = 9.

When students are dismissed from the carpet, they received a sticky note and wrote their name at the top and number of letters in their first name. Participants placed their sticky notes on the board from least to greatest to form a bar graph. Hillary then instructed students in their small table groups to find the total of all the sticky notes and show their work. In the small groups, one student at each table appeared to dominate the calculations and completed the work while others stared out of the window or doodled on their paper. One student began to pull their hair up and back. The students with the Special Education teacher at the Small Group table completed the same tasks. Hillary checked on these three students and the Special Education teacher reported, “He is doing his own thing so I’m just letting him go”. Students did not have enough time to calculate the grand total of the classroom letters in names.

End of day. For the final ten minutes of mathematics class students responded to the prompt, “Today mathematics was ________ and I felt ________ because ______________.” and circled a number on the Mathematics Thermometer that corresponded to their mathematics anxiety level, see Table 36.
Table 36.
Mathematics Journal and Mathematics Thermometer Responses for Day 15

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Today mathematics was awesome and I felt great because I liked everything we did in mathematics today.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Today mathematics was good and I felt good about everything because everything.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Today mathematics was awesome and I felt good because it was fun!</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Today mathematics was fun and I felt happy because with partners and my partner was (name). And we almost got done with our work but we didn’t get the same answer it was sad. And I had a great day after all.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Today mathematics was good and I felt good because I did not know that was mathematics.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Today mathematics was good and I felt good because it was easy.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Today mathematics was awesome and I felt relaxed because I didn’t do much mathematics today.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Today mathematics was fun and I felt fine because I thought it was easy and fun because of the read aloud.</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Today mathematics was good and I felt good because no hard stuff.</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>Today mathematics was fun and I felt good because it was just a good day.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Drew two suns: one with sunglasses smiling and the other sticking its tongue out smiling and saying “happy”. Mathematics was fun</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
<td>Today mathematics was not bad but not good and I was okay because I LOVED the TWO books we read but my partner didn’t really listen to my ideas but I listened to his! But overall it was pretty much okay.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Today mathematics was great and I felt happy because we had two story times.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of positive themes from all thirteen students. Three students specifically enjoyed the read aloud while others had fun, felt good, thought it was easy, and liked everything.
The overall mathematics anxiety level was 1.15 (SD = .10). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Two psychological symptoms were displayed when students expressed confusion over the graph worksheet. The researcher recorded zero physiological symptoms of mathematics anxiety. One uncategorized symptom of mathematics anxiety was shown through pulling hair up and back.

**Day Sixteen**

Students were divided into three groups and rotated through three stations: Computation Station, Computers, and the Lesson. Each station lasted 18 minutes. The Special Education teacher took four students for forty minutes of the fifty-minute mathematics lesson.

**Computation station.** Participants took a Number Talk Quiz with the following problems: 74 +18, 58 + 28, 113 + 56, 342 + 64, 28 + 47, 90 - 79, 60 - 39, and 40 - 34. Hillary reiterated that students must show their work, and not just the answer. While students worked on the Number Talk quiz, Hillary recorded problems that students missed on previous graph worksheets to review in upcoming lessons. One student sat for five minutes and did not complete any work. Two students clenched their hair while working on the quiz. A student was told they used “messy” handwriting and had to redo his quiz in neater print. Three students were reminded to show their work and they began to stare at the computers. One student was told to explain their thinking and began to cry; the student began to rock back and forth in his chair and did not write out their thinking process.
Computers. Students played Just the Facts Whole Numbers and practiced improving their score. Two students completed their Strengths and Weakness table from day thirteen. Participants either sat on the edge of their seat or stood up to complete the tasks. Many students stared out of the window during the station. Three students utilized egocentric speech to comprehend the problem better. Five students got answers wrong and would slouch their shoulders.

Lesson. The Lesson began with Number Talks of $216 + 137$ and $274 + 57$. Two students had side conversations throughout the Number Talks. Students doodled and stared out the window not paying attention to the problems.

Following Number Talks the students worked on a page from their Go Mathematics! book covering graphs. The partnership student led students through each problem and made sure the answer matched the key. Several students were confused by the wording of the problems, and two struggled with reading the questions. All students but one asked clarifying questions about the worksheet. A student pulled their hair up and back while reading a problem. Two students required one-on-one guidance to attempt the worksheet. One participant stared at the graph worksheet for seven minutes and did not complete one problem. Several students commented, “I don’t get this” and “I don’t even know what this means?” A student answered a question incorrectly and ran their hands down their face; they then ran their hands through their hair and being to hit their head.

End of day. The timer went off, and students were directed back to their seats. The mathematics journal prompt for the sixteenth day of treatment was, “Pick a face and tell why.” Students were given a handout with myriad faces and circled one and explained why, as seen in Figure 23. Participants were instructed to circle a number on
the Mathematics Thermometer to evaluate their mathematics anxiety level for the day, see Table 38 for mathematics journal and Mathematics Thermometer responses.

Figure 23. *Faces for Mathematics Journal Prompt for Day 16*
Table 37
Mathematics Journal and Mathematics Thermometer Responses for Day 16

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Happy. Awesome because mathematics was awesome!!!!!</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>Sad. I did not get to do Games.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Happy. Because it was fun.</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Confused. I felt confused because we did a really hard problem and of course I got it wrong!</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Happy. Because we got to do the money game.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Happy. It was really easy.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Relaxed. Barely any people in my group.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Bored. It was a little boring in the lesson. I was happy in the rest.</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Bored. Felt easy.</td>
</tr>
<tr>
<td>11</td>
<td>5</td>
<td>I felt disgusted.</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>Bored. Because I was bored.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Ecstatic. Today I felt ecstatic in mathematics because I tried subtraction on JTF 100. But I was bored in lesson (like always). But it was okay in computation station.</td>
</tr>
<tr>
<td>14</td>
<td>4</td>
<td>I felt sad because I did not get 100% on JTF 100 addition.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of five positive, six negative, and three about First in Mathematics: one positive and two negative. The positive themes involved students enjoying the money game, having fun and being relaxed. The most prevalent negative theme was feeling bored by four students. The other two students felt disgusted and thought a problem was difficult. The one positive FIM themes was trying a new operation. The two negative FIM responses were not getting to play on the computer and not getting a perfect score.

The overall mathematics anxiety level was 2.65 ($SD = .71$). The researcher perceived psychological, physiological, and uncategorized mathematics anxiety symptoms. Students demonstrated three psychological symptoms with confusion about
the graph worksheet. Two students displayed physiological symptoms by going to the restroom. One uncategorized mathematics anxiety symptom was recorded by clenching their hair.

**Day Seventeen**

At the beginning of mathematics students headed to the Computer Lab to complete First in Mathematics: Just the Facts 100. Students were given forty minutes to complete the task. Once participants finished one round of the game they were instructed to play again. One student hit the keyboard with force that caused it to jump on the table. Another student began to cry and had tears streaming down their face while working on Just the Facts. Several students flapped their arms and hands while flinching their body. Many participants began to rub their eyes. If they got an answer wrong students threw their hands up and ran them over their face. Students were given eight minutes of free time to play a First in Mathematics game of their choice.

When students returned to the classroom they either completed their Number Talk quiz from day sixteen, Problem of the Day, or a worksheet that reviewed material covered thus far. The Problem of the Day was: A basketball player scored 9 points in two games. What might their score be in each game? One student was exempt from mathematics due to an incident in gym class. Throughout the quiz students bit their tongue, stared out the window, rubbed their eyes, and counted down the time left in the period.

While working on Problem of the Day or worksheets, Hillary announced to the class that most students were doing nothing and one participant responded, “If I’m just sitting here that means I’m either reading or thinking”. A student was unable to read any
question on the worksheet and had to ask a classmate to read it aloud to them. One student flicked their pencil and bit their fingernails and did not complete a problem. When a student made a mistake they put their head down, placed their hand on their head, and stared at the paper. Three students commented, “I don’t get this”, “I need help. This doesn’t make sense”, and “I don’t get this. Help”.

**End of day.** When the second group returned from gym class, the students were given the Mathematics Journal prompt, “Draw a face that shows how you feel about Addition, Subtraction, Graphs, Making Change, and Telling Time. How did mathematics go for you today?” Participants were asked to circle a number on the Mathematics Thermometer for their mathematics anxiety level of the day, see Table 38 for mathematics journal and Mathematics Thermometer responses.

**Table 38**

*Mathematics Journal and Mathematics Thermometer Responses for Day 17*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Addition: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtraction: Straight face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graphs: Straight face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Making Change: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telling Time: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good, because I had a great time in mathematics today.</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Addition: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtraction: Sad face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graphs: Half happy and sad face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Making Change: Half happy and sad face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telling Time: Half happy and sad face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hate, hate, hate, hate.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Addition: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtraction: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graphs: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Making Change: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telling Time: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Addition</td>
</tr>
<tr>
<td>----</td>
<td>---</td>
<td>----------</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Smiley face</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Smiley face</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Smiley face</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Smiley face</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Smiley face</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Smiley face</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>Smiley face</td>
</tr>
</tbody>
</table>
Table 38 Continued.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Addition: Smiley face</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1</td>
<td>Subtraction: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graphs: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Making Change: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telling Time: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gooooooooooooooooooooooooooooooooooooooooood.</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
<td>Addition: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subtraction: Smiley face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graphs: Straight face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Making Change: Confused face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Telling Time: A face throwing up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Awesome!</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of five positive, six negative, and three about First in Mathematics: one positive and two negative. The positive themes involved students enjoying the money game, having fun and being relaxed. The most prevalent negative theme was feeling bored by four students. The other two students felt disgusted and thought a problem was difficult. The one positive FIM themes was trying a new operation. The two negative FIM responses were not getting to play on the computer and not getting a perfect score.

The overall mathematics anxiety level for the seventeenth day of treatment was 1.75 (SD = .39). The research perceived three psychological symptoms on students’ confusion of mathematics worksheets; four students displayed physiological symptoms by going to the restroom and rubbing their eyes; and one uncategorized symptom was demonstrated by biting fingernails.

**Day Eighteen**

Today students were split into three groups for stations: Computation Station, Computers, and Lesson. Mathematics was disrupted today by a cooking teacher. Hillary
forgot that there would be an interruption. Mathematics lasted for 22 minutes. The Special Education teacher took one student during mathematics.

**Computation station.** Students had three tasks to complete at Computation Station: a Problem of the Day, a Go Mathematics! worksheet on graphs, and unfinished work. The Problem of the Day was: The Lakeside tour bus traveled 490 miles on Saturday and 225 miles on Sunday. How many miles did it travel in all? Many students for the Problem of the Day do not write their answers or justification and stared out of the window. One student continuously peered at classmate’s work to gauge if they were going faster. Three students commented that, “I don’t even know how to use this data”, “I need help on this”, and “I don’t know how to explain it”.

**Computers.** Students played First in Mathematics Skillsets for the duration of the station. One student sat at the station for seven minutes before beginning the game. Three students discussed their loose teeth and did not complete any work. When an answer was wrong students would fling their head back.

**Lesson.** Hillary began the lesson with Number Talks of 20 - 15 and 20 - 9. Following Number Talks, Hillary posed the question, “Pretend I am going out to eat with three friends at a Japanese restaurant. We will be eating with chopsticks. How many chopsticks are needed?” Students were then asked to solve: How many chopsticks would we need for our whole class? Participants were given time to write down their initial thoughts. The students began to bite their fingernails, lay their head down on the desk, and play with their hair.

**End of day.** After the cooking guests left the students were given the following Mathematics Journal prompt, “Pick a color (any color) to draw you felt about
mathematics today”. The students were encouraged to select any color due to the prompt being used on seventh day of treatment and participants only chose colors that corresponded to the Mathematics Thermometer. Moreover, students were instructed to circle a number on the Mathematics Thermometer that matched their mathematics anxiety level for the day, see Table 39 for mathematics journal and Mathematics Thermometer responses.

Table 39

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Blue makes me feel down and I felt down.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Yellow because I felt happy.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Light green because I got more points on FIM and I had fun.</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Blue. I felt good.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Green. I felt good because I got through everything!!!!</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td><em>with Special Education teacher</em></td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Gray: It was a little boring. Yellow: It was fun with the number of pair thing: sandy beach when (teacher) reminded me of a sea. Green: because I. Blue: I wished I was outside</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>Orange. I picked this color because the day was not horrible but i didn’t get to do my full time for FIM.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Light green. I felt joy.</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>Light green. It was just a good day.</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>Light green because I was tired so I thought I would get facts wrong.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Green. I chose green because it normally means good...so I had a great day. Mostly because we had short mathematics because of Meal Masters. But I also had a good day!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>I picked green because I loved mathematics!</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of eight positive, two negative, and three about First in Mathematics: one positive and two negative. The positive themes
involved students feeling happy, good, joy, and great throughout instruction. The two negative responses referenced a student feeling bored and another feeling down. The one positive FIM theme was getting more stickers. The two negative FIM responses referenced a student not getting their full time on the computer and another being nervous that they would get an answer wrong.

The overall mathematics anxiety level for the eighteenth day of treatment was 1.58 ($SD = .34$). The researcher perceived two psychological symptoms when students expressed confusion about the Chopsticks problem; zero physiological symptoms were recorded; and two uncategorized anxiety symptom was demonstrated through biting their fingernails and playing with hair.

**Day Nineteen**

For mathematics today students were divided into three groups for stations: Computation Station, Computers, and Lesson. Each station lasted 25 minutes each. One student left for 30 minutes for Speech Therapy and missed Computation Station.

**Computation station.** Students worked on the Problem of the Day, Go Mathematics! worksheet, and unfinished work from previous day. All students but two were distracted by the lesson and kept turning around to listen or watch, and one student remained turned around for the entirety of the station. Participants stared blankly at the computers, at the Problem of the Day, and at the clock. Two students rubbed their eyes and one twirled their hair while working on the problem. A student completed the Problem of the Day and was told it was wrong and placed their head on the desk, burying their face. After a second attempt at the problem the student was told it was wrong again and they threw their head on the table, scribbled all over the paper, and stomped their
feet. The student was given one-on-one guidance but said “I don’t know” and threw their hands up in the air. The participant then had to stay behind to finish the problem; the student’s eyes became glossy and they shouted out random numbers. The Problem of the Day was not completed and the student sat in their chair rocking back and forth.

**Computers.** Participants continued their work on First in Mathematics Skillsets. Six students stood up to play the game. Two students sat and stared at the computer without attempting the game. A student stated, “This one is not possible”. One student answered incorrectly, clenched their teeth and grunted.

**Lesson.** The lesson continued from yesterday on the Chopsticks problem. Hillary then asked students to think of objects that come in a group of two. Students responded with socks, eyes, ears, shoes, and arms. Participants were then divided into small groups and created a list of objects that came in groups of 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12. After students completed their list a master list was composed of the group’s ideas. While working in groups students dangled their necklace on their nose, had off-topic conversations, and placed their hands on their head.

When five minutes remained students worked silently on the Problem of the Day from day sixteen. Two students clenched their hair while another doodled on their notebook.

**End of day.** The final timer went off and students headed back to their desks and were given the Mathematics Journal prompt, “Draw a face on the pumpkin for how you felt during mathematics today. Why did you draw this face?” Students were also instructed to circle a number on the Mathematics Thermometer that corresponded to their
mathematics anxiety level, see Table 40 for mathematics journal and Mathematics Thermometer responses.

Table 40
*Mathematics Journal and Mathematics Thermometer Responses for Day 19*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Excited face. I drew this face because I felt great in mathematics today.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Smiling face. Happy.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Smiling face. Because I felt happy because it was fun.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Smiling face with one tooth. I drew this pumpkin because I felt happy.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Worried face. Because I got on game 4 on FIM.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Smiling face with candle in mouth. I felt good.</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>Drew a spaceship. I was feeling chillaxed.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Smiling face. I was happy. I was in my average mood.</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>Straight face. I picked this face because I was excited for cross country but I was struggling on Skill Sets in FIM.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Smiling face. Completed game 4-1.</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>Sad face. My tummy was giving me a hard.</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>Drew a spider web. Because I felt like a web. It was an -ish day. They can be kinda frustrating.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>I drew vampire because I love them (p.s. I had a good time!)</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Smiling face with a thought bubble saying, “ya!” I did this face because mathematics was awesome!</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of nine positive, two negative, and three about First in Mathematics: two positive and one negative. The positive themes involved students feeling happy, good, awesome and great throughout instruction. The two negative responses referenced a student feeling sick and another feeling frustrated. The two positive FIM themes both referenced reaching a higher level on Skillsets. The one negative FIM response referred to a student struggling on the game.
The overall mathematics anxiety level for the day was 1.79 ($SD = .41$). The researcher perceived three psychological symptoms when confusion was expressed during Computation Station; five students had physiological symptoms when using the restroom and two students rubbing their eyes; and two uncategorized mathematics anxiety symptoms of clenching their hair or teeth and twirling hair.

**Day Twenty**

Students learned a new game, Circles and Stars, that was an introductory game to multiplication. The Special Education teacher took one student for the duration of mathematics. The game is played with a partner, two dice, and a booklet containing eight sheets of paper. On the front of the booklet students wrote “Circles and Stars”, their name and score, their partner’s name and score, and the difference between the scores. The game began with a student rolling one die; the number on the die corresponded to the number of circles that would be drawn. The student then rolled the second die and this number represented the amount of stars that were drawn inside of each circle. The students then calculated the amount of stars on the page and wrote the total on the bottom of the paper. Their partner then repeated the steps. The game continued until all pages in the booklet were filled. Throughout the game students had productive chatter and discussed various ways to count the stars on the paper. Students encouraged each other throughout the game. A student clenched their hair while playing the game. A set of partners spent the first five minutes of the game sharpening their pencils. The same set of partners also wrote over pencil in marker.

After playing the game for 20 minutes the students head back to their desks to hear the next steps from Hillary. Participants were told to then write the multiplication
fact that went with each equation. Hillary modeled how to write 5 groups of 2 for the
students in various ways: 5 sets of 2 equals 10; 5 groups of 2 equals 10; 5 times 2 equals
10; and 5 2’s equals 10. Students inquired if 2 groups of 5 would be the same answer.
Hillary furthered their thinking and asked what property demonstrated this rule and a
student responded with commutative property. The teacher then asked what the answer to
a multiplication problem was called and students were unable to give the answer. Hillary
then told students that it was called a product and the numbers being multiplied were
factors. Students then wrote the equations and a word explanation on each of their pages.
The partners go through one page of the booklet a time. Students were confused on the
order of the numbers to write their equations. Several students wrote the equations but
they did not match the pictures. A student ignored their partner’s suggestions and then
began to rub their eyes.

End of day. With ten minutes left in for mathematics the students were given the
Mathematics Journal prompt, Pick a face and tell me why. Participants were given a pre-
made sheet of faces and asked to select one that described how they felt, as seen in Figure
24. Students were also asked to circle a number on the Mathematics Thermometer that
corresponded to their mathematics anxiety level, see Table 41 for mathematics journal
and Mathematics Thermometer responses.
Table 41
Mathematics Journal and Mathematics Thermometer Responses for Day 20

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>Anxious face. I feel anxious because I could get a bad grade.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Happy. It was awesome.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Happy. I felt happy because it was fun because we learned how to play a new game.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Hopeful. I choose this face because I felt thankful about not not having a flu shot at the doctor. And I had a good day in mathematics.</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>Absent</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Serene. I felt good because we played a game only.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Serene. I felt awesome.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Serene. Happy. Sleepy. I had a headache. That made me sad and I was happy</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Happy. I felt happy today because we played a new game and finished.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Serene. Felt good and energized.</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>Terrified and hopeful. I do not know why.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Hopeful. I hope tomorrow I can make two touchdowns in football. Mathematics bad because we didn’t do FIM.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Happy. I chose happy face because well as always happy about mathematics, but that’s not important...I....well....I just love mathematics!!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Ecstatic. I picked this face because of the new game Circles and Stars!</td>
</tr>
</tbody>
</table>
The mathematics journal responses consisted of eleven positive, one negative, and one about First in Mathematics. The positive themes involved students feeling happy, good, and awesome throughout instruction. Four students specifically referred to Circles and Stars as a positive experience. The one negative response was a student feeling terrified with no explanation. The one FIM theme was a student being upset that they didn’t have computer time.

The overall mathematics anxiety level for the twentieth day of treatment was 1.39 ($SD = .27$). The researcher perceived zero psychological symptoms; two physiological symptoms by going to the restroom and rubbing their eyes; and one uncategorized symptom of clenching their hair.

**Day Twenty-One**

Students were divided into three groups for Computation Station, Computers, and Lesson. Each station lasted 20 minutes each. Three students were taken by the Special Education teacher for 30 minutes during Computation Station. One student was taken by the principal and was only in mathematics class for ten minutes.

**Computation Station.** Students completed a multiplication pre-assessment. They have not been formerly taught multiplication and the assessment was meant to gauge prior knowledge. When told they were working on multiplication a student stated, “But I don’t know how to do multiplication”. Students twisted their lips and played with their lips. One student clenched their hair and said, “Ugh”. Two students shook their legs while running their hands through their hair. Several students peered at their classmate’s papers and began to write what they had put down. Many students stared at the computers instead of completing the assessment. A student continuously wrote and then would erase
all work; they completed one problem. Several students doodled on their page instead of
doing mathematics.

**Computers.** Participants completed Just the Facts Whole Numbers. A student
twisted their arms, rubbed their face, and ran their fingers down their face while rocking
back and forth. Three students changed their badge instead of playing the game. If a
student missed an equation they restarted the game.

**Lesson.** The lesson was led by the partnership student and began with Number
Talks of 30 - 19, 50 - 44, and 50 - 29. Throughout the Number Talks students stared out
of the window, laid their head down, and checked the clock.

Students then went over previous graph worksheets and old Problems of the Day.
Participants struggled with the Basketball Problem and Coin Problem. The Basketball
Problem read: A basketball player scored 9 points in 2 games. What are the possible ways
they could have scored? The Coin Problem asked students: A boy has four coins, one two
are the same. What is the lowest value of coins?

While working on the problems students played with their lips, pulled their hair,
bit their nails, and placed their hand on the side of their head. One student working on the
Basketball Problem commented, “This is impossible. Oh gosh, this is so hard”. Another
student completing the Coin Problem stated, “I don’t understand it”.

**End of day.** When ten minutes remained in the mathematics period the students
were given the prompt, Pick an emotion and write it in the heart; draw face in the circle;
thoughts about mathematics in the thought bubble. Students were also prompted to circle
a number on the Mathematics Thermometer, see Table 42 for mathematics journal and
Mathematics Thermometer responses.
### Table 42

*Mathematics Journal and Mathematics Thermometer Responses for Day 21*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Thermometer Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Happy, proud. I loved mathematics today because this was the best mathematics ever!</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Happy. Happy I liked games.</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Happy, chillaxing. I felt happy because it was fun because I got to get on the computer to get on FIM.</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Sad. Today in mathematics I felt sad because we didn’t have FIM. And I missed mathematics.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Smiley face. I just happy because FIM.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Good, happy. I felt good because I just had a good day and felt good!!</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Chillaxing, amazing, awesome, a little lazy. I felt goooooood today.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Sleepy and happy. I had a headache....like usual....that made me really sleepy....but everything else was great!</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Cool, relaxed, still thinking but not overwhelmed. I felt cool today because I was not overwhelmed and I felt completely fine and normal.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Chillaxing. I think happiness when I do good. Got 81% on multiplication.</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>Hopeful. I was not there for mathematics today.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Happy, excited, best day. Happy because I am playing football at recess and mathematics good.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Amazed/awesome. I had a superly awesome time in mathematics because in computation station I got a super hard division problem right! (84/4 = 21) p.s. 21 was my answer, oh, and I don’t know if 84/4 is really 21.</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Happy. I felt happy because I had a really good day.</td>
</tr>
</tbody>
</table>

The mathematics journal responses consisted of eight positive and five about First in Mathematics: four positive and one negative. The positive themes involved students feeling happy, good, fine and great throughout instruction. One student was proud that they answered a hard problem correctly. The four positive FIM themes were three
students liking the games and one student improving their score. The one negative FIM response referenced a student not getting their full time on the computer. One student did not respond because they were not in mathematics.

The overall mathematics anxiety score calculated by averaging the 14 scores was 1.36 ($SD = .25$). The researcher perceived seven psychological symptoms of students not understanding the Basketball or Coin Problem and struggling with the multiplication assessment; two physiological symptoms of going to the restroom; three uncategorized symptoms were categorized with twisting or playing with lip with fingers, clenching hair, and biting lip.

**Day Twenty-two**

On the 22nd day of treatment students were administered the Anxiety Measure and given one last Mathematics Journal prompt. Mathematics was not taught that day due to a holiday party. The Mathematics Journal prompt was, How did you feel about the mathematics journals? Students were instructed to circle a number on the Mathematics Thermometer, see Table 43 for mathematics journal and Mathematics Thermometer responses.
Table 43
*Mathematics Journal and Thermometer Responses for Day 22*

<table>
<thead>
<tr>
<th>Student</th>
<th>Mathematics Level</th>
<th>Students’ Journal Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Great because I liked answering all of the questions!</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Yayyyyy!</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>I felt awesome because it was fun and awesome.</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>I felt happy.</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Good.</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>Good.</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Awesome.</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>It was fine. Most of mine were ones.</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>I felt good writing in our mathematics journal with (researcher) because we were helping (researcher) with her career and that makes me feel good.</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Really good and fun felt.</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>Gooooooood.</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Awesome.</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>I loved writing in my journal. But I always circle the 1 well that’s because I just love mathematics!</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>I felt excited!</td>
</tr>
</tbody>
</table>

All 14 mathematics journal responses were positive and referenced enjoying journaling in an affective method.

The overall mathematics anxiety level for the day was 1.00 ($SD = .00$). The researcher perceived no physiological, psychological, or uncategorized mathematics anxiety symptoms.

**Summary**

Students’ mathematics anxiety levels fluctuated daily individually and as a class. The nine days receiving the most psychological mathematics anxiety symptoms and negative themes were those with assessments, graph worksheets to be completed independently or teacher-led, and Skillsets on First in Mathematics. The eleven days that
garnered low mathematics anxiety levels through mathematics journal responses and observations involved going over previous work, computer lab days, whole class interactive lessons, mathematics games, and students giving their input and thoughts to the lesson. Two of the eleven low mathematics anxiety level days were shortened instruction days.

**Mathematics Thermometer**

The Mathematics Thermometer was developed by the researcher to gauge the daily mathematics anxiety of each participant in the Treatment group. Participants were instructed to circle a number, 1-10, in conjunction with their daily mathematics journal prompt. A 1 represented low mathematics anxiety while a 10 denoted high mathematics anxiety.

Twenty-two school days of Mathematics Thermometer data were collected and analyzed. The first day data point of 2.93 has been disregarded due to students’ difficulty of comprehending the Mathematics Thermometer without the numbers 1-10. After the researcher perceived the participants’ confusion the numbers were added for clarification. Moreover, the twenty-second data point was omitted because of no mathematics instruction for that day due to extracurricular and responding to a mathematics journal prompt about completing mathematics journals for treatment.

The overall mathematics anxiety average mean calculated for the twenty-two days was 2.00 ($SD = .13$); when adjust to disregard two data points the mathematics anxiety average mean was 2.00 ($SD = .12$). The average mean mathematics anxiety levels for each day can be seen in Table 44.
### Table 44
**Daily Mathematics Anxiety Levels Determined by Mathematics Thermometer**

<table>
<thead>
<tr>
<th>Day</th>
<th>Average Mean Level</th>
<th>SD</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.93</td>
<td>.58</td>
<td>HA</td>
</tr>
<tr>
<td>2</td>
<td>1.57</td>
<td>.31</td>
<td>LA</td>
</tr>
<tr>
<td>3</td>
<td>2.23</td>
<td>.72</td>
<td>HA</td>
</tr>
<tr>
<td>4</td>
<td>1.79</td>
<td>.64</td>
<td>LA</td>
</tr>
<tr>
<td>5</td>
<td>2.92</td>
<td>.86</td>
<td>HA</td>
</tr>
<tr>
<td>6</td>
<td>2.54</td>
<td>.82</td>
<td>HA</td>
</tr>
<tr>
<td>7</td>
<td>1.77</td>
<td>.38</td>
<td>LA</td>
</tr>
<tr>
<td>8</td>
<td>1.63</td>
<td>.47</td>
<td>LA</td>
</tr>
<tr>
<td>9</td>
<td>2.31</td>
<td>.72</td>
<td>HA</td>
</tr>
<tr>
<td>10</td>
<td>3.21</td>
<td>.86</td>
<td>HA</td>
</tr>
<tr>
<td>11</td>
<td>2.08</td>
<td>.70</td>
<td>HA</td>
</tr>
<tr>
<td>12</td>
<td>2.08</td>
<td>.70</td>
<td>HA</td>
</tr>
<tr>
<td>13</td>
<td>1.92</td>
<td>.75</td>
<td>LA</td>
</tr>
<tr>
<td>14</td>
<td>2.29</td>
<td>.68</td>
<td>HA</td>
</tr>
<tr>
<td>15</td>
<td>1.15</td>
<td>.10</td>
<td>LA</td>
</tr>
<tr>
<td>16</td>
<td>2.65</td>
<td>.71</td>
<td>HA</td>
</tr>
<tr>
<td>17</td>
<td>1.75</td>
<td>.39</td>
<td>LA</td>
</tr>
<tr>
<td>18</td>
<td>1.58</td>
<td>.34</td>
<td>LA</td>
</tr>
<tr>
<td>19</td>
<td>1.79</td>
<td>.41</td>
<td>LA</td>
</tr>
<tr>
<td>20</td>
<td>1.39</td>
<td>.27</td>
<td>LA</td>
</tr>
<tr>
<td>21</td>
<td>1.36</td>
<td>.25</td>
<td>LA</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>.00</td>
<td>LA</td>
</tr>
</tbody>
</table>

*a Response scale: 1 = low mathematics anxiety to 10 = high mathematics anxiety

*b Interpretive scale: 1 – 2.00 = low anxiety (LA), 2.01 - 10.00 = high anxiety (HA)*

Out of the 22 treatment days nine were categorized as high mathematics anxiety level days, a score between the ranges 1.00 to 2.00; while eleven identified as low mathematics anxiety level days, ranging from 2.01 to 10. The day that scored the highest level of mathematics anxiety for the Treatment group was Day 10 with a score of 3.21. The day’s instruction consisted predominantly of graph worksheets that were completed independently. The day with the lowest mathematics anxiety level was Day 15 with a
mean average of 1.15. Students participated in a whole group activity connecting literacy to mathematics in an activity that involved letters of their names and creating a bar graph.

**High mathematics anxiety days.** The following are characteristics of high mathematics anxiety days:

- **Day 3:** mathematics anxiety level average mean of 2.23 ($SD = .72$). Students took a place value assessment and completed Go Mathematics! worksheets or unfinished work.

- **Day 5:** mathematics anxiety level average mean of 2.92 ($SD = .86$). Students finished a mathematics packet requiring them to show all work, Skillsets on the computer, and a bar graph worksheet that required heavy guidance from the teacher.

- **Day 6:** mathematics anxiety level average mean of 2.54 ($SD = .82$). Students took a measurement assessment, completed a Problem of the Day that was the crux of psychological mathematics anxiety symptoms, and the Phone Number activity, which participants did not fully comprehend.

- **Day 9:** mathematics anxiety level average mean of 2.31 ($SD = .72$). Students had a Number Talk Quiz. Following the quiz, participants were given a worksheet on picture graphs to complete independently.

- **Day 10:** mathematics anxiety level average mean of 3.21 ($SD = .86$). Students completed two worksheets on graphs at Computation Station and the Lesson. Hillary was confused on a graph question at Computation Station and was unable to assist students.
• Day 11: mathematics anxiety level average mean of 2.08 ($SD = .70$). The Pockets activity was not the onset of mathematics anxiety but rather the unfinished worksheets on graphs that students had to complete after the whole group activity.

• Day 12: mathematics anxiety level average mean of 2.08 ($SD = .70$). Students were given directions to the Store game, played new games on First in mathematics, and had eight Number Talks.

• Day 14: mathematics anxiety level average mean of 2.29 ($SD = .68$). Students played Skillsets on the computer, completed a bar graph worksheet that they were prompted through, and had unequal partnerships during the Money Game. The partnership consisted of one student who would complete the work while the other stared out the window or at the computers.

• Day 16: mathematics anxiety level average mean of 2.65 ($SD = .71$). Students took a Number Talk Quiz and were led through a worksheet on graphs.

Four out of the nine high mathematics anxiety days consisted of students completing an assessment or quiz. Graph worksheets were prevalent amongst these days; the main proprietor was students having to complete the graph worksheets independently or teacher-led. Two days required students to play Skillsets on computers, which was often a source of mathematics anxiety demonstrated by students’ reactions and mathematics journal responses. The nine high mathematics anxiety days consisted of minimal to no social interaction throughout mathematics instruction. Students sat quietly and completed their assignments.
**Low mathematics anxiety days.** The following are characteristics of low mathematics anxiety days:

- **Day 2:** mathematics anxiety level average mean of 1.57 ($SD = .31$). Mathematics was shortened to 20 minutes and only involved Number Talks.

- **Day 4:** mathematics anxiety level average mean of 1.79 ($SD = .64$). Students worked on a Dog Problem, Number Talks, and gave their input for prefixes during the Phone Numbers activity.

- **Day 7:** mathematics anxiety level average mean of 1.77 ($SD = .38$). Participants finished their Number Assessment, played Skillsets on the computer, had a Number Talk, and went over previous graph worksheets.

- **Day 8:** mathematics anxiety level average mean of 1.63 ($SD = .47$). Students went to the computer lab for their weekly time Just the Facts Whole Numbers and when completed those who were not finished with the Number Assessment completed the test, while the rest played the game More.

- **Day 13:** mathematics anxiety level average mean of 1.92 ($SD = .75$). Students went to the computer lab to complete their timed Just the Facts Whole Numbers. When they returned participants filled out their strengths and weaknesses in mathematics; this activity caused the mathematics anxiety average mean to be higher. Students filled out their weakness in mathematics first before attempting to identify their strengths.

- **Day 15:** mathematics anxiety level average mean of 1.15 ($SD = .10$). Students participated in a whole group activity connecting literacy to mathematics by
reading *Chrysanthemum* and linking it to bar graphs. The participants connected their names to the data.

- **Day 17:** mathematics anxiety level average mean of 1.75 ($SD = .39$). Students went to the computer lab to complete their Just the Facts Whole Numbers and returned to the room to finish a Problem of the Day: Basketball Problem, a Number Talk quiz for those who did not complete it on Day 16, and a review packet created by Hillary.

- **Day 18:** mathematics anxiety level average mean of 1.58 ($SD = .34$). Mathematics was shortened to 30 minutes. During the shortened time students finished one station of either: Problem of the Day and unfinished work; Skillsets on the computer; or Chopsticks Problem, which involved students calculating the amount of chopsticks for the classroom.

- **Day 19:** mathematics anxiety level average mean of 1.79 ($SD = .41$). Mathematics instruction was a continuation of Day 18’s stations. An extension was added to the Chopsticks Problem involving small groups creating a list of items that come in various sets.

- **Day 20:** mathematics anxiety level average mean of 1.39 ($SD = .27$). Participants learned a new game Circles and Stars and played the game for the entirety of mathematics.

- **Day 21:** mathematics anxiety level average mean of 1.36 ($SD = .25$). Students completed a multiplication pre-assessment and went over previous work.

  For low mathematics anxiety level day’s students went over previous graph worksheets and learned to play new mathematics games: Circles and Stars, Store, and
More. Every Friday was a low mathematics anxiety day due to students going to the computer lab. Two of the eleven days were shortened mathematics periods. Three of the eleven days were whole group interactive lessons where students were part of the data: Chopsticks, Phone Numbers and Chrysanthemum. Students were able to discuss with their peers through social interactions throughout these eleven days.
Chapter 5: Conclusions and Recommendations

Purpose of the Study

The overall purpose of this study was to examine the effects of mathematics journals on third-graders’ mathematics anxiety levels. Specifically, the study addressed the following objectives:

1. Will there be a significant difference between third-grade students using mathematics journals and third-grade students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure?
   - $H_0$: There will be no statistically significant difference between using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.
   - $H_{a1}$: There will be a statistically significant difference between students using mathematics journals and Grade 3 students not using mathematics journals on mathematics anxiety as measured by the Anxiety Measure.

2. Does having students keep mathematics journals decrease the amount of mathematical anxiety in third-grade students as measured through observation and mathematics journals?

Procedures

The Anxiety Measure was administered on the first day of treatment to all third-grade students to determine their mathematics anxiety levels prior to treatment. The questionnaire was given separately to the Control and Treatment groups at their designated mathematics times. The Control group was broken into small groups, per the Control classroom teacher’s request, and was completed in three days. Beth requested
that students be given the questionnaire in three groups of five and one of six over three
days. The researcher went to the Control classroom for three consecutive days
administering the survey to a different group each day. The questionnaire was filled out
by one group each day. The Treatment group was administered as a whole class and
completed in one day. For each group, the research explained the scale of 1 - 5, read
aloud each question, and referenced to students when to refer to the pictures for questions
1, 4, and 5. Anxiety was measured through a smiley-face scale with five faces depicted
upon it, ranging from “not nervous at all (1)” with a smiley face, “a little nervous (2)”
with a slight smile, “somewhat nervous (3)” with a semi-nervous face, “very nervous (4)”
with a sad face, and “very, very nervous (5)” with a nervous face. Prior to administration
children were asked if they understood the term “nervous” and were guided through an
explanation of the smiley-face scale as well as through examples. The researcher did not
give feedback to the child but only general encouragement. Participants selected a face
that had a corresponding value of 1 – 5. Each score was calculated through taking an
average across the 16 items. The researcher read a script to maintain consistency between
groups. Participants wrote the number 1, 2, 3, 4, or 5 to reflect their anxiety level as
opposed to drawing the corresponding face. The number assured that the researcher
interpreted the correct anxiety level from each student.

For the duration of the study, the Treatment group responded to mathematics
journal prompts and Mathematics Thermometer created by the researcher. Students were
allotted at least ten minutes daily to complete their mathematics journals. The researcher
observed the Treatment group for the duration of the study during mathematics.
The post Anxiety Measure was administered 24 school days after the pre-test on the final day to the Treatment group. The process was completed as a whole group with the researcher reading aloud each question and guiding participants through the questionnaire. The Control group was conducted 25 school days after the pre-test; Beth requested that it occur after a class party and class field trip. Students were put into small groups and the researcher guided them through the questionnaire over a two-day period. The Control group took two days to complete in this classroom. The researcher read the same script as the pre Anxiety Measure to ensure consistency. The students were given the opportunity to ask clarifying questions; students only needed clarification for Question 7, How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink? All students answered the 16 questions.

A paired-samples t-test revealed that AM scores for students in the Treatment group decreased more than AM scores in the Control group. The paired-samples t-test for the Treatment group revealed that students in the Treatment group had a decrease in their AM scores from pre AM to post AM.

The questionnaire was administered to thirty third-grade students, 16 in the Control and 14 in the Treatment classroom. The response rate was 100%.

**Interpretation of Findings**

**Quantitative.** The Anxiety Measure questionnaire was used pre and post-test for the Treatment and Control classrooms to compare their responses between groups and within groups pre and post-treatment. One participant in the Treatment groups was removed due to their average mean being three standard deviations outside of the Treatment group mean. Paired sample t-tests were utilized to investigate the effectiveness
of mathematics journals on third-graders’ mathematics anxiety levels. The various paired
sample t-tests analyzed the pre and post for Treatment, pre and post for Control followed
by a separate analyses for the Treatment and Control group. Significance level was
measured at .05 level. The quantitative research question was:

Will there be a significant difference between third-grade students using
mathematics journals and third-grade students not using mathematics journals on
mathematics anxiety as measured by the Anxiety Measure?

- \( H_0 \): There will be no significant difference between using mathematics journals
  and Grade 3 students not using mathematics journals on mathematics anxiety as
  measured by the Anxiety Measure.
- \( H_{a1} \): There will be a significant difference between students using mathematics
  journals and Grade 3 students not using mathematics journals on mathematics
  anxiety as measured by the Anxiety Measure.

The alternative hypothesis of this study was accepted, and it was determined that
third-grade students using mathematics journals did have a statistically significant
decrease in AM scores when compared to third-graders who did not utilize mathematics
journals. Therefore, the alternative hypothesis was accepted.

Harari, Vukovic, and Bailey (2013) found that mathematics anxiety was
detectable at first grade. The current study supported these findings that third-graders do
report mathematics anxiety. The Treatment Group’s participants’ mathematics anxiety
levels reduced from the pre to the post-test, 1.76 (\( SD = .70 \)) to 1.61 (\( SD = .25 \)),
respectively. Students in the Control Group’s mathematics anxiety levels also reduced
from 2.08 (\( SD = .69 \)) to 2.02 (\( SD = .65 \)).
The question receiving the highest level of anxiety from the Control and Treatment pre-test was “How do you feel when taking a big test in your mathematics class?” with a mean 3.50 ($SD = 1.51$) and 2.93 ($SD = 1.44$), respectively. The item receiving the highest mathematics anxiety level for the Control post-test was “How do you feel when taking a big test in your mathematics class?” with a mean 2.87 ($SD = 1.41$). The questions with the highest mathematics anxiety level for the Treatment post-test were “How do you feel when taking a big test in your mathematics class?” and “How do you feel when you are in mathematics class and you don't understand something?” with a mean 2.50 ($SD = 1.45$). The third-graders’ highest mathematics anxiety levels occurred when question pertain to taking a test and not understanding the content. The latter two questions pertained to teacher instruction while the first connected to students receiving a grade for their knowledge.

The question garnering the lowest mathematics anxiety score from the Control and Treatment pre-test was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.13 ($SD = 0.34$) and 1.00 ($SD = 0.00$), respectively. The item receiving the lowest mathematics anxiety score for the Control post-test was “How would you feel if you were given this problem: How much money does Annie have if she has 2 dimes and 4 pennies?” with a mean of 1.19 ($SD = 0.40$). The question garnering the lowest mathematics anxiety score for the Treatment post-test was “How would you feel if your teacher asked you how many cubes are in this picture?” with a mean of 1.00 ($SD = 0.00$). The participants had low anxiety pertaining to questions about place value and coin values.
Questions on the AM required further explanation by the researcher and need to be altered for future research. Question 7, How do you feel when figuring out if you have enough money to buy a candy bar and a soft drink? entailed further clarification. Several students commented that they would use “plastic” or a “card” as opposed to money. Today’s society does not rely as heavily on paper money but instead uses credit or debit cards. Young students today are often more familiar with credit and debit cards and the question must be reworded or changed to reflect the cultural shift. Question 11, How do you feel when getting your mathematics book and seeing all the numbers in it? necessitated rewording by the researcher. The Control classroom did not use the Go Mathematics! booklets but teacher created mathematics packets. When reading this question the researcher had to modify the wording to “mathematics packet” instead of “mathematics book”. Future researchers must be cognizant of materials in the classroom in order for the questionnaire to parallel students’ resources.

Moreover, the 5 item Likert-type scale could cause confusion for elementary students. The scale is not well defined for children to differentiate between “a little nervous (2)” and “somewhat nervous (3)”, as well as, “somewhat nervous (3)” and “very nervous (4)”. It would be easier for participants to distinguish between a 3 item Likert-type scale of “not nervous at all (1)”, “somewhat nervous (3)”, and “very, very nervous (5)”. The proposed changes would ameliorate confusion for children.

**Qualitative.** Daily research observations and mathematics journals were used in the current study. The qualitative research question was:
Does having students keep mathematics journals decrease the amount of mathematical anxiety in third-grade students as measured through observation and mathematics journals?

The researcher created daily mathematics journal prompts for student responses. The allotted time for students to write their responses was ten minutes. Participants also circled their mathematics anxiety level for the day on the Mathematics Thermometer ranging from 1 to 10, with 1 being low mathematics anxiety and 10 being high mathematics anxiety. The data was coded for daily and longitudinal themes. The Mathematics Thermometer levels ranged from 1 to 3.21 with an overall average mean for the 22 treatment days of 2.00 (SD = .13) and an adjusted overall average mean for the 20 treatment days excluding the first and last day of treatment of 2.00 (SD = .12).

Psychological symptoms referred to participants expressing the inability to complete mathematics problems or worksheets. Physiological symptoms were disregarded due to the majority of symptoms involving students going to the bathroom; the physiological symptoms that pertained to crying, watery eyes and rubbing eyes were measured. Uncategorized mathematics anxiety symptoms as perceived by the researcher were included: breathing heavily, pulling on lips, left hand pulling on left ear, playing or pulling on hair, pulling single strands of hair out of scalp, pulling hair up and back, twisting hair, biting or picking at fingernails, fidgeting hands, hitting chest, and clenching teeth. Yet, when compared with general anxiety symptoms the following were categorized as anxiety warning signs: breathing heavily, pulling or twisting hair, and fidgeting hands (Folk & Folk, 2014). Five of the remaining symptoms remained uncategorized: pulling on lips, left hand pulling on left ear, biting or picking at
fingernails, hitting chest, and clenching teeth. More observations need to be conducted in the classroom to create a more inclusive and all-encompassing list of mathematics anxiety symptoms.

Students’ mathematics anxiety levels fluctuated daily, individually and as a class. The nine days receiving the most psychological mathematics anxiety symptoms and negative themes were those with assessments, graph worksheets to be completed independently or teacher-led, and Skillsets on First in Mathematics. The eleven days that garnered low mathematics anxiety levels through mathematics journal responses and researcher observations involved going over previous work, computer lab days, whole class interactive lessons, mathematics games, and students giving their input and thoughts to the lesson. Two of the eleven low mathematics anxiety level days were shortened instruction days.

High mathematics anxiety days were results from instruction that constituted students working independently, taking tests, teacher-direct instruction, or interrelating the four basic operations. Low mathematics anxiety days were composed of student-centered instruction, games, reviewing previous knowledge, and going to the computer lab. The low mathematics anxiety days allotted for student discussion and interaction with their peers; whereas, high mathematics anxiety days ultimately placed students in isolation.

Two out of the twenty-two days of instruction, Hillary referenced her teaching manual as a script. Hillary followed the textbook verbatim without tweaking material to meet students’ needs or interests. The two lessons were teacher-directed that followed a prescribed curriculum that did not allow for student input or interaction. Consequently
these two days had middle to high mathematics anxiety levels of 1.79 ($SD = .64$) for Day 4 and 2.54 ($SD = .82$) for Day 6. Moreover, on two of the other days Hillary referenced the textbook to look up answers to questions that confused students, Days 9 and 10. On Day 9, Hillary said, “This is a tricky question” and proceeded to look up the answer. When giving students the justification Hillary appeared unclear and students were still perplexed by the problem. For Day 10, Hillary referred to the teacher’s manual and gave students the correct answer. The unpreparedness and lack of mathematical knowledge was a contributing factor to the classroom environment. A teacher must be prepared to teach the content competently and not lead students astray with misconstrued answers.

A dichotomy of instruction was presented on the twelfth day of instruction. Students began mathematics instruction with the Pockets activity and then were required to complete unfinished work. The participants were engaged and animated during the Pockets activity before mathematics returned to finishing worksheets. Students were much more on task throughout the interactive activity; they began to stare out the window or be off task during the worksheets. The change of instruction drastically altered students’ motivation and engagement in mathematics. An extension or enrichment activity would have been beneficial, such as, allowing students to offer topics to graph and collecting their own data. The participants needed to have mathematics connect to their lives through interactive activities as opposed to a regurgitation of worksheets with a set answer. The stifling of creativity hinders students’ perception of mathematics allowing them to view the subject as a uniform, product based transaction.

On the 15th day of treatment the students participated in an interdisciplinary lesson of mathematics and literacy. Hillary read the students *Chrysanthemum* and
connected the letters in their first name to creating a bar graph. The lesson had the lowest overall mathematics anxiety level of treatment at 1.15 ($SD = .10$); disregarding day 22 due to no mathematics instruction. The participants enjoyed being read to and comments were made that it didn’t feel as if they were learning mathematics. Instructional approaches that connected to other subjects not only strengthened the association between varying content but showed that mathematics anxiety can be reduced through this process. However, it does not suffice to simply read a picture book and the assign mathematics; students must be active participants in the learning process. Combining literacy and mathematics can assist in bolstering students’ self-efficacy in mathematics, namely struggling students (Whitin & Whitin, 2000). Reading, writing, and speaking are pivotal components to mathematical comprehension (National Council of Teachers in Mathematics, 2000). The literacy process allowed children to practice their oral and written skills for communicating mathematical ideas (Hoover, 2012). The process of mathematizing read-aloud books supported student exploration of ideas, the opportunity to discuss mathematical concepts, and connected content to their lives (Hintz & Smith, 2013; Price & Lennon, 2009; Raymond, 1995).

Graphs were a main source of mathematics anxiety throughout the duration of the study. Six of the nine high mathematics anxiety days required students to complete graph worksheets independently. Participants questioned the material and verbalized their confusion leading to psychological mathematics anxiety symptoms, such as “I don’t get this” or “I’m confused”. However, when students participated in the Pockets and Chrysanthemum activity for graphing their mathematics anxiety levels were lower. One student commented, “I didn’t even know that was mathematics”. The participants were
engaged throughout the activities and were directly involved. The students collected the data and created the bar graphs, essentially, the students were the data. During these two activities, participants were able to discuss with their classmates their mathematical thinking process and collaborate with their peers. Moreover, students went to the computer lab every Friday for First in Mathematics: Just the Facts 100. When returning to the classroom participants graphed their score for the week on their FIM graph paper. Students had no difficulty with creating the bar graph with their weekly score. Thus, students need to be interacting with the material, as opposed to being given material without explanation.

The National Council of Teachers of Mathematics (2006) report advocated for greater attention to graphs due to the rise of STEM. Interpreting and understanding data and graphs is a necessary skill in today’s society. Graph instruction can be implemented across disciplines (National Science Board, 2007); for example connecting to literacy or measurement in science. An interdisciplinary approach supports authentic instruction, as well as, strengthening various contexts. Larson and Whitin (2010) encouraged teachers to conjoin graphs with classroom experiences and routines, students’ interests and experiences, and to make classroom decisions. The utilization of Bruner’s (1987) Discovery Learning Model is crucial for student engagement and involvement in the mathematical process. Students must first begin in the enactive stage by manipulating the materials physically. During the iconic stage, students are able to draw the graphs through visual representations and in the symbolic stage students are able to complete the curriculum worksheets. These steps must be taken to build upon prior knowledge and develop their problem-solving skills through inquiry.
Throughout the duration of the study students’ voice was disregarded. On Day 9, students were given a graph worksheet that required them to measure their feet; however, Hillary believed it would take too much time and gave students the numbers. The interactive portion and students being involved with the material was neglected. The participants had the opportunity to be involved with the lesson but their teacher deemed it unimportant. The 13th day of treatment students were required to write their strengths and weaknesses for mathematics. When students showed Hillary their responses several students were told to rewrite their responses because they did not meet her expectations, for example, Hillary told one student that they needed to work on “taking his time” and was told to erase a weakness and change it to her suggestion. Initially, the students were given a voice but it was taken away. The process perpetuated that their opinions were not as valuable as the teachers. Throughout the Number Talks students were often confined to the teacher’s method and thinking. Students would express their method but ultimately Hillary would lead them to the final product she desired. Participants were also expected to follow a teacher-direct pace that left no room for questions or individuality. An ethic of care, as proposed by Noddings (1993) and Collins (1998), must be implemented in classrooms. The teacher in this study became very frustrated with students causing tension in the learning environment. Moreover, students would express confusion and it would be disregarded; Hillary would often continue with instruction in hopes of the student “catching up” or “figuring it out on their own”. Students need to know their opinions, concerns, and questions are valued in the classroom. The absence of mutual trust and respect only harms the classroom environment.
The Treatment classroom applied “pseudo-differentiated” instruction and ability grouping. Students were grouped into high, middle, and low ability groups based off of their scores and achievement level. The smaller student-teacher ratio was advantageous for the students; it was the instruction that impeded learning. The teacher instruction and activities were not differentiated. Instruction was planned and based off of the middle achieving group, thus hindering the low and high ability groups. Often times, the high ability group would complete work quickly and be given more worksheets, while the low ability groups struggled to finish one problem. Teachers must take into account the varying ability levels and plan accordingly. If students are going to be divided based upon their ability then the instruction and activities must be parallel. When mixed-ability grouping was employed the same results were achieved; the low ability and high ability students were not taken into account. By leaving out two-thirds of the groups in lesson planning, it only inhibited student learning. An all-encompassing view of the classroom ensures that all students are being accounted for and not just one group. When content is not tweaked to better reach individual students it disregards their learning styles and prior knowledge.

Five out of the twenty-two treatment days were assessments that were paper and pencil. Participants were placed under a time limit and expected to finish all problems. One of the assessments was a multiplication pre-assessment to gauge prior knowledge. An alternative means of assessment is needed for students to be able to express their knowledge in a different format. All assessment days garnered high mathematics anxiety and one student was nervous that she would not “pass the third-grade because a grader will say I fail”. Students were already feeling the pressure of achieving high scores for an
external factor and not themselves. Paper and pencil assessments were appropriate for some students but for others an alternative form is necessary. Teachers can require students to complete projects, posters, design books or games, or have a portfolio to give students ownership of material, instead of requiring young children to disseminate knowledge for one correct answer.

**Implications for Practitioners**

Maloney & Beilock (2012) advocated for mathematics anxiety treatment to focus on the affective as opposed to the mathematical skills of a child. The present study furthered this research by implementing affective mathematics journals in the early childhood classroom. Mathematics journals have been utilized in classrooms but for a cognitive purpose as opposed to affective. The emotions of elementary students must be taken into account. Emotions encompass sensory processes but also effect cognition (Immordino-Yang & Damasio, 2007). Cognition and emotion both have effects on “learning, attention, memory, decision making, motivation, and social functioning” (Immordino-Yang & Damasio, 2007, p. 7). The aforementioned aspects of learning are affected by the phenomenon of mathematics anxiety. When students in this study were given the chance to express their emotions towards mathematics it allows the teacher to be cognizant of areas that make children uncomfortable, scared, worried, or sections that students enjoy and create excitement. Student mathematics journal responses can inform instruction; a teacher can continue using methods that children enjoy to ameliorate mathematics anxiety triggers and tweak instruction that causes anxiety in the classroom. Mathematics journals allow for a relationship to build not only between one student and the teacher but the class as a whole. Students’ emotional needs will be taken into account
that will enhance the classroom environment. Teachers have been taught to differentiate instruction based on various learning styles; it needs to be taken a step forward to diversify content around students’ affective needs and reactions to the differentiated instruction.

Participants were familiar with using mathematics journals as a means to express their cognition but not their affective reactions to the material. Students became familiar with the process and as the study progressed the responses became more in-depth. A longer time frame would be beneficial for more extensive and thorough journal entries. These students have learned a strategy that they can utilize in the future for their mathematics anxiety or to express their emotions towards mathematics. The ability to express one’s feelings about mathematics will strengthen the connection between cognition and affective. Students are more self-aware and attentive to their needs. The capacity to monitor one’s reaction to instruction that causes mathematics anxiety will help students to realize that it is the method and not the content that is overwhelming them. Through the mathematics journal responses the low mathematics anxiety days involved interactive group projects and read alouds. It became evident that this group of kids thrived for social interaction and tactile, kinesthetic learning. The classroom teacher must be cognizant of these responses; the teacher must alter instruction to best fit their students’ needs. The present study did not aim to control children’s emotion but rather allow students to express their emotion in a safe, healthy environment. This research project and method can be replicated in other schools using mathematics journals in an affective manner.
Affective mathematics journals are easily implemented in the elementary classroom. Mathematics and emotions are often isolated from each other. Children have strong emotional reactions to mathematics that should be dealt with in order to strengthen their learning of the subject. In the present study, two students began to cry when confronted with a dilemma during mathematics. One participant had tears streaming down their face during the timed Just the Facts100; the student started the subtraction section and was overwhelmed. This strong reaction caused them to not complete the game and instead they hung their head for the remainder of time in the computer lab. Hillary offered little support to the student and they were left to struggle through the remainder of mathematics. A second example is when a different participant began to cry when they were told to show and write their mathematics thinking. The student was able to compute the correct answer but was unable to put the process on paper. Instead of supporting the student and helping children work through their difficulty the student was expected to complete the work on their own despite their crying. Both of these students had strong emotional reactions to mathematics that were not validated but neglected by their classroom teacher. A supportive, caring environment that empowers children and their emotions will assist in strengthening their learning. Students will no longer feel excluded for their emotional responses but bolstered for their unique reaction. By empowering children with methods to understand and validate their emotional responses then it could deter the strong emotional responses, such as crying. Many children from a young age are given methods to cope with sadness but not worry or anxiety (Suveg & Zeman, 2004). The failure to discuss emotional reactions only impedes emotional development, which in turn effects their academic achievement. When a student is
overwhelmed with negative emotion they are no longer able to focus on the task at hand, which deters their learning of mathematics.

Eisner (1982) argued that emotions and cognition cannot be separated, “This case cannot be made because the hard and fast distinction between what is cognitive and what is affective is itself faulty.” (p.20). When emotion was not taken into account instruction loses a pivotal part of child development. Students are essentially treated as emotionless beings whose only task is to absorb mathematical content. However, this is not the case. Children are emotional and social creatures that need opportunities that holistically support them.

Vygotsky theorized that learning would be threatened with the presence of tension and anxiety (Vygotsky, 1987). When mathematics anxiety is present it effects the way children interact with peers and the material. Participants in this study had interactions with their classroom teacher that caused them to shut down for mathematics class. Instances of students alienating themselves from mathematics were when Hillary would disregard students’ answers due to them not fitting her thinking or telling students that if they do not finish their work then they will receive zeroes. The negative environment and discouragement from their own teacher caused students to recoil. They no longer felt supported by their teacher but isolated. Students did not want to complete assignments for a person who would undermine their thinking, dismiss their work, or discourage their ability.

Throughout the treatment participants used private speech to guide their thinking. Private speech is a means to communicate with oneself and learning to self-regulate. When a child is able to guide their own thinking process and actions then they are better
able to critically think about material (Vygotsky, 1986). Early childhood teachers must be cognizant of the benefits of private speech and allow their students to participate in the process. Often times when children are able to talk themselves through a problem it helps in the creation of new synapses to better understand the content. Many children are unable to transfer their knowledge from their brain to paper and the self-talk is a scaffold in the process. A learning environment that allows children to verbally express their thinking is associated with task improvement (Berk & Winsler, 1995).

Moreover, the low mathematics anxiety days involved students being able to talk with their peers and let their opinion be heard, whereas, high mathematics anxiety days constituted independent, silent work. When participants were given the opportunity to discuss their mathematical thinking they were better able to clarify their thoughts, as well as, help their peers. Socialization leads to higher mental functions in children (Vygotsky, 1987). Teachers must allow for social interaction between their students. Children learn through mathematical problem-solving experiences with their peers. The shared experience allows students to verbalize their thinking and discover new processes from their peers. The social experience also allows the classroom to build a strong learning community through collaboration. Students no longer feel that they are isolated in mathematics but have a support system in their teacher and classmates.

Feminist pedagogy is an alternative teaching method that allows for students to feel valued and cared for in the classroom. The present study’s classroom teachers did not use feminist pedagogy, which caused difficult relations with their pupils. Throughout the study several students were not given opportunities to express their opinions or concerns, instead their thoughts were disregarded, which led to frustration. When students became
upset they would stop trying and shut down thus not completing their mathematics assignments, in turn affecting their grade. Teaching must begin with constructing trusting relationships and instruction builds upon the trust foundation (Noddings, 1993). A child begins to care about the teacher’s knowledge once they know they are cared for. Teachers and students can learn from each other in a relational pedagogy that takes into account the relations built within the classroom (Sidorkin, 2002). Children's emotions, relationships, and feelings cannot be ignored in order to solely focus on academic skills (Noddings, 1993).

**Future Research**

Little to no research has been conducted on the variables race and ethnicity. It is pivotal to include this variable to fully understand the phenomenon. Mathematics anxiety research is being extrapolated to other cultures without taking into account their needs, values, and sets of tools. Moreover, research has mainly been conducted in suburban areas with the current study being the first to solely focus in a rural area. More studies need to research mathematics anxiety in various settings to ensure clarity and accuracy.

A longitudinal, year-long study of affective mathematics journals in the classroom is necessary to ensure the treatment is the most effective. The present study used mathematics journals for six weeks and mathematics anxiety levels were reduced; yet with more time these results could decrease more and assist students better in mathematical learning. Smythe (1998) concluded that in order for journal writing to be an effective technique that it must last over time. Students should not write in a journal once and expect gains in academia; the longer the duration, the stronger the effects.
Moreover, a longitudinal study involving participants from second to fifth grade would begin to uncover if keeping affective mathematics journals can assist in alleviating mathematics anxiety and test anxiety. Elementary students begin taking standardized tests in 3rd grade; by beginning the journals in second grade the children are able to familiarize themselves with the process and express their concerns about mathematics. Ramirez and Beilock (2011) concluded that, “one short writing intervention that brings testing pressures to the forefront enhances the likelihood of excelling, rather than failing, under pressure” (p. 15). Pennebaker (1997) found a link between increased academic performance and writing about emotional topics, meaning that students who are able to write about emotional experiences have higher achievement.

In order to better observe physiological mathematics anxiety symptoms heart rate monitors can be utilized to measure a student’s increased heart rate to a particular moment of instruction. In the present study, the researcher observations concluded whether or not a participant showed symptoms of mathematics anxiety. Often times, the researcher was only able to focus on one to three students; heart rate monitors would ensure that all students’ mathematics anxiety level symptoms were being observed at all times. The increased heart rate can inform the researcher of the mathematics anxiety trigger.

The present study concluded that the lowest overall mathematics anxiety day, 1.15 ($SD = .56$) involved an interdisciplinary approach of literacy and mathematics. Researchers need to create a program of mathematics instruction connecting mathematics and literacy and designing student-centered interactive activities to test if mathematics anxiety levels are reduced. A study focusing solely on this process would lead to better
concluding results as to whether a literacy and mathematics joint approach can lead to a reduction of mathematics anxiety in elementary students. The NCTM Connection Standard (2000), called for teachers to connect mathematics to other subjects building a stronger connection through an interdisciplinary approach.

Feminist pedagogy can be incorporated to create a caring, trusting classroom environment. Professional development training can be utilized to train elementary teachers prior to the study. The researcher must be ensured that the teachers being studied are using a feminist pedagogy approach. If it is explicitly stated and expected by the researcher it will help to garner desired results. The present study can be repeated but with professional development prior to the treatment to ensure the Treatment teacher implements feminist pedagogy. Collins (1992) list of Ten Commandments for classroom teachers, as mentioned previously, could easily be implemented in the early childhood classroom. Moreover, Collins (1992). Children's emotions, relationships, and feelings cannot be ignored in order to solely focus on academic skills (Noddings, 1993). A child’s individual uniqueness, emotional responses, and empathy can assist in creating a conducive feminist pedagogy environment.

One study of 17 elementary teachers has been conducted in an urban area that determined that female teachers with high mathematics anxiety permeated their high mathematics anxiety to female students (Beilock, Gunderson, Ramirez & Levine, 2009). More studies in rural and suburban areas need to be conducted. Moreover, female teachers with low mathematics anxiety and male elementary teachers with high or low mathematics anxiety must be researched before conclusions can be made.
Higher education institutes can implement student-centered, constructivist teaching styles for teacher candidates. Pre-service teachers’ exposure to new methods that have been shown to reduce mathematics anxiety will be beneficial to both the future classroom teachers and their students. Peker and Ertekin, (2011) found that there was a link between mathematics anxiety and anxiety about teaching mathematics. Research has discovered that student-centered constructivism techniques in the classroom help to reduce teacher mathematics anxiety and increase their self-efficacy (Shields, 2005; Brown, 2008; Funer and Berman, 2002). When these techniques are utilized in a mathematics classroom there are many advantages for the teachers, as well as the students.

Moreover, higher education institutes can offer more mathematical content classes for teacher candidates. A more in-depth preparation of could lead to more confidence in teaching elementary mathematics. Teacher candidates who are more competent in mathematics content could have a lower mathematics anxiety level, which can reduce the mathematics anxiety levels in the classroom for their students.

Conclusions

The present study provides evidence that mathematics journals in an early childhood classroom statistically significantly decrease mathematics anxiety levels. The collected data demonstrated that employing mathematics journals is an effective teaching strategy in the classroom. The data reported a statistically significant decrease from pre to post-test data for the Treatment group. Moreover, the post-test between Fixed Treatment and Control group mathematics anxiety levels reported a statistically significant decrease in mathematics anxiety levels. The qualitative strand produced data reporting the
fluctuation of mathematics anxiety levels for individual participants and as a whole class. Mathematics journals and observations created a clearer picture of mathematics anxiety in early childhood classrooms than a strictly quantitative study. Mathematics journals can be utilized in an affective manner in early childhood classrooms effectively to eliminate mathematics anxiety.

This research study is the first to use a qualitative strand and mixed-methods approach in mathematics anxiety in young children. The yielded results paint a clearer picture of childhood mathematics anxiety, as opposed to bookend quantitative data points for a pre and post-test. The qualitative portion allows the participants’ stories to be told and enrich the data to support the quantitative. Children are no longer quantified to a single number; the qualitative strand allows for a supporting description of children’s mathematics anxiety. It is through a mixed-methods approach that mathematics anxiety in elementary students can be better understood.
References


Hall, C. S. (1999). A primer of Freudian psychology


National Council of Teachers of Mathematics (NCTM), (2005) “Position Statement on Highly Qualified Teachers”. This statement recommends at least three college mathematics courses for elementary teachers, emphasizing the mathematical structures essential to the elementary grades.


Ramirez, G. (In press). Anxiety measure – adapted from the MARS-E.


Appendix A: Mathematics Thermometer

**Directions:** We want to know how you felt today during mathematics. You will use the thermometer on this page to tell us how you feel. Fill in the thermometer to tell us how you feel like this: If you were not nervous at all, draw a line at the 0-degree position. If you were very nervous, draw a line at the 10-degree position. Use the numbers in between for your other choices.
Appendix B: Control Group Classroom Setup
Appendix C: Treatment Group Classroom Setup
Appendix D: IRB Approval Letter

A determination has been made that the following research study is exempt from IRB review because it involves:

Category 1: research conducted in established or commonly accepted educational settings, involving normal educational practices

Project Title: Examining the Effects of Math Journals on Elementary Students' Math Anxiety Levels

Primary Investigator: Trisken N. Emmert

Co-Investigator(s):

Advisor: Krisanna Machmues

Department: Teacher Education

Robin Stack, CIP, Human Subjects Research Coordinator
Office of Research Compliance

Aug. 21, 2014

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved (as an amendment) prior to implementation.
Appendix E: Mathematics Journal Prompts

1. Today in mathematics I felt ______ because ________.
2. I felt _____ because ____.
3. How did you feel about the mathematics assessment?
4. How did Mathematics go for you today? Why?
5. What was the best part about mathematics today? Why? What was the most challenging part about mathematics today? Why?
6. Pick a face that describes how you felt about Mathematics today? Why? See Figure 21.
7. Pick a color that tells how you felt about mathematics today. Why?
8. Draw a face for how you felt in mathematics today. Why?
9. Pick an emotion, draw a face, and write thoughts about mathematics.
10. How did you feel about mathematics today?
11. Pick a face and explain why. See Figure 22.
12. Drawing four faces to describe FIM (computers), Lesson, Computation Station and Overall. How did mathematics go for you today?
13. I felt ______ because ________.
14. Draw any picture to describe how you felt and why?
15. Today mathematics was ________ and I felt ________ because ______________.
16. Pick a face and tell why. See Figure 23.
17. Draw a face that shows how you feel about Addition, Subtraction, Graphs, Making Change, and Telling Time. How did mathematics go for you today?
18. Pick a color (any color) to draw you felt about mathematics today.
19. Draw a face on the pumpkin for how you felt during mathematics today. Why did you draw this face?
20. Pick a face and tell me why. See Figure 24.
21. Pick an emotion and write it in the heart; draw face in the circle; thoughts about mathematics in the thought bubble.
22. How did you feel about the mathematics journals?