Establishing Growth Mindset Teaching Practices as Part of the Third Grade Math Curriculum to Increase Math Self-Efficacy, Math Mindset and Student Achievement

by

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ABSTRACT

This mixed methods action research dissertation examines the effects of implementing growth mindset teaching practices in third grade math as a means to improve student math self-efficacy, math mindset and student achievement. Since the transition to the Pennsylvania Core Standards, students across the state including those in this district have been experiencing a decrease in math achievement in grades three through eight according to the Pennsylvania System of School Assessment (PSSA) the standardized achievement test all public school students take. Locally, traditional interventions such as worksheets, boxed programs, computer-based programs and extra practice have not yielded gains so this intervention focused on developing growth mindset teaching practices in math to answer four research questions. Framed in Dweck's Implicit Theories of Personal Attributes (1995), Bandura's description of self-efficacy (1997) and Hall and Hords' work with teachers in bridging research into practice (2011), this study used Jo Boaler's, *Mathematical Mindset* (2015) in a book study with the third-grade teachers. The dissertation study analyzed pre and post survey data from the third-grade class (n=57) on both mindset and self-efficacy. The study also analyzed pre and post survey data from the teachers (n=2) on mindset along with pre and post intervention interviews with the teachers. Qualitative and quantitative data analysis revealed the intervention had a positive effect on teacher mindsets and practices, a positive effect on student mindsets and a positive effect on student math self-efficacy. While the study did not reveal the intervention to have a positive impact on student achievement at this time, previous research included in the literature review cites improvement in student achievement through developing growth mindset thinking. This gives reason to predict

that with more time, these students will experience improved achievement in math. Implications from this study include that we should train all math teachers in incorporating growth mindset practices, and that administrators should build the bridge between research and practice for teachers as they implement new teaching practices in effort to positively affect student performance.

DEDICATION

My dissertation is dedicated to my Anthony, my Madison and my Owen.

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CHAPTER 1

INTRODUCTION

> "Proficiency in mathematics is a strong predictor of positive outcomes for young adults, influencing their ability to participate in post-secondary education and their expected future earnings" (PISA 2012).

Larger Context

Today's educational conversations often include discussion about how the United States performs academically in reading and math from a global perspective. In the 2012 Program for International Student Assessment (PISA) results, the United States ranked 36th of the 65 participating countries in Math Performance. Included in the PISA sample were all 34 Organization for Economic Co-operation and Development (OECD) countries and 31 additional countries that combined represent 80% of the world economy (Organization for Economic Cooperation and Development. 2012). PISA assesses the math skills of fifteen-year-old students and the most recent results show a disconnect between what is being taught to United States (US) students and their ability to perform higher level tasks such as problem solving.

Within the US, the National Association of Educational Progress (NAEP) randomly assesses fourth and eighth grade students across the country. While the 2015 NAEP shows math scores have been increasing since 1990, the 2015 results were a few points lower than the previous year. In fact, since the nationwide switch to the more rigorous Common Core Standards, there has been very little improvement observed in math or reading (The Nation's Report Card n.d.).

One contributing factor to the years of repeated underperformance in math are reports of students' negative feelings about math. As Boaler (2008) states, "Far too many students in America *hate* math and for many it is a source of anxiety and fear" (p. 3). Ramirez, et al (2015) found that, "Math anxiety is a negative predictor of the use of advanced problem-solving strategies" (p. 96). I believe these negative feelings about math and math anxiety is the mindset many students have towards the subject.

Dweck's (2006) work shows that when students see intelligence as a skill that can be worked on and grown, they tend to show motivation and persist on tasks that present challenges. Consequently, Dweck's (2006) research also shows that when students see intellectual ability as a "gift" or mindset, they tend to show less motivation towards tasks, lack persistence when facing a challenge, and question their overall ability.

Dr. Joan Boaler's (2015) work takes Dweck's assertions about mindset and focuses it on mindsets specifically in math. Students with a fixed mindset believe they have a limited amount of knowledge regarding math and see failure as the end; however, students with a growth mindset believe that math knowledge can be built and mistakes are pathways to new learning opportunities. Students with a growth mindset in math will fare better when faced with the real-world problem-solving demands of the Common Core State Standards () in math.

Too often, this negative self-talk about math and the overall negative feelings about math as a subject area stem from adults, most often parents (Seeley, 2016; Boaler, 2009, Wills, 2010, Yeager & Dweck, 2012, Romberg & Kaput, 1999). Parents often project their own negative feelings, experiences, and misconceptions about math onto students including low expectations. Wills (2010) lists three myths and misconceptions

seen time and time again, “You have to be very intelligent to be good at math. It is acceptable to be bad at math because most people are. Math isn’t really used much outside of special occupations” (p.6). Furthermore, Wills notes the consequences of student negativity towards math, “Stress, low motivation, decreased levels of participation, boredom, low tolerance for challenge, failure to keep pace with class lessons, behavior problems and avoidance of the advanced math classes necessary for subsequent professional success” (p. 6-7). Combating negative math perceptions is critical to improving student math performance.

In an acknowledgment of this ever-growing issue of fixed mindset and underperformance in math, the National Council of Teachers of Math, ASCD, Amazon Education and multiple other professional agencies recently endorsed a nationwide campaign entitled *With Math I Can* to tackle the growing epidemic of students who believe the negative self-talk that, “I’m not good at Math.” Teachers, parents, and students have access to materials aimed at reversing the negativity and developing a growth mindset in math. This collaboration among so many professional organizations brings legitimacy to the need for mindset education in the math curriculum.

In Pennsylvania

In 2010, the Pennsylvania Board of Education (PDE) committed to adopting the Common Core State Standards. The Common Core State Standards call for a focus on “developing the critical-thinking, problem-solving, and analytical skills students will need to be successful” (“What parents should know”, n.d.). The nationwide shift to The Common Core State Standards was a wake-up call for teachers, administrators, and all educational stakeholders that our students need to be able to go beyond the basics in

English Language Arts (ELA) and math and to be ready for college and careers. The current generation of students will have jobs and careers that will demand critical thinking skills, collaboration among peers, and creative problem solving.

Subsequently, Pennsylvania (PA) adopted its own version of the Common Core State Standards known as the PA Core Standards. The PA Core Standards are described as, "robust and relevant to the real world and reflect the knowledge and skills our young people need to succeed in life after high school, in both post-secondary education and a globally competitive workforce" (Pennsylvania Department of Education 2016, para 2). In math, the new standards are divided into Standards for Mathematical Content and Standards for Mathematical Practice (Pennsylvania Department of Education, 2014).

Despite this shift to the more rigorous PA Common Core Standards that allows for more mastery of number sense in the primary grades, students in Pennsylvania are continuing to struggle in math especially as the material becomes more demanding as Table 1 indicates. Across the Commonwealth of Pennsylvania and in most grades, barely 50% of students at each tested grade level are performing in the Proficient or Advanced performance categories since the transition to the PA Core Standards in 2015 (See Table 1). There is a clear need for swift intervention.

Table 1

Percent of Pennsylvania Students Proficient/Advanced on Math PSSA

Year	third-	4th	5th	6th	7th	8th
2002			53			51
2003			56			51
2004			61			57
2005	81		69			63
2006	83	77	67	68	67	62
2007	79	78	71	70	67	68
2008	81	80	73	72	71	70
2009	82	82	74	76	75	71
2010	85	85	74	78	78	75
2011	84	85	76	79	79	77
2012	80	83	73	77	80	76
2013	82	80	70	86	83	79
2014	93	76	67	72	76	74
2015*	**49**	**44**	**43**	**40**	**33**	**30**
2016	54	47	44	41	37	31
2017	54	47	44	40	38	32
2018	54	44	45.	40	39	31

*Revised Test to reflect switch to PA Core Standards

At this time, the educational marketplace is inundated with academic interventions aimed at improving math skills. Countless companies claim to be selling the

'answer' to academic underachievement either through computer programs, targeted intervention programs, manipulatives, teaching techniques, etc. In my experience as an educational leader, I have seen little evidence to show that these styles of interventions have any lasting impact past the initial treatment period. I believe this to be the case because these interventions are not addressing the underlying issue of mindset as reflected by the nearly stagnant growth in performance across time on the national and state level assessments. Students need to shift from thinking, "I'm not good at math." to "I can get better." They also need to experience improvement in their work by trying again and correcting mistakes. When the self-talk takes this shift, we will begin to see students willing to try again, learn from their mistakes and ultimately see long-term academic improvements and also see improved math self-efficacy.

Local Context

My School District (SD) sits in the west central region of PA. (Names of the school district, school building and teacher names are pseudonyms.) The district is approximately 22 square miles comprised of five attendance areas that feed the district. Enrollment for the 2018-19 school year is 889 students in two buildings. There are two buildings: the junior/senior high and the elementary school. I have worked in various capacities in the district since the 2005-2006 school year.

Since July 1, 2014, I have been principal at The Elementary School (ES) that houses students PreK4-6th grade with a 2018-19 enrollment of 520 students. The Free/Reduced Lunch Percentage fluctuates between 60%-65% annually. The 2017-18 school year was the first year of the district's participation in the Community Eligibility Program. This program allows the district to provide free breakfast and lunch to every

student in both buildings. Determination for participation in CEP is based on the number of students who are already eligible for public entitlement programs. About 15% of the students are classified special education, with less than 1% classified as gifted. There is little ethnic diversity within the district with 78% enrolled students identified as white/Caucasian, 2% African American and 20% identified as Mixed Race.

Since 2002, the Pennsylvania System of School Assessment (PSSA) has been administered. Students in the district have performed well as determined by the number of overall students achieving a Proficient or Advanced rating on the PSSA (See Table 2). Over time, there were dips in performance that could be attributed to teacher turnover, overall dynamics of a particular student group, or curriculum change. However, there has been a noticeable decline in student performance since the implementation of the PA Core Standards.

In the 2011-12 school year, teachers were informed of the upcoming switch to the Common Core Standards and encouraged to begin the transition. By 2013-14, all schools in PA were to be fully transitioned to the PA Core Standards. As mentioned previously, the new math standards are divided into two strands: math practice and math content (See Figure 1)

PA Core Standards

Mathematical Content and Mathematical Practice

Standards for Mathematical Content	Standards for Mathematical Practice
2.1 Numbers and Operations A) Counting and Cardinality B) Numbers and Operations in Base Ten C) Numbers and Operations – Fractions D) Ratios and Proportional Relationships E) The Number System F) Number and Quantity	-Make sense of problems and persevere in solving them. -Reason abstractly and quantitatively -Construct viable arguments and critique the reasoning of others. - Model with Mathematics - Use appropriate tools strategically. -Attend to precision - Look for and make use of structure - Look for and make sense of regularity in repeated reasoning.
2.2 Algebraic Concepts A) Operations and Algebraic Thinking B) Expressions & Equations C) Functions D) Algebra	
2.3 Geometry A) Geometry	
2.4 Measurement, Data, and Probability A) Measurement and Data B) Statistics and Probability	

Figure 1 Chart from page 2 of Academic Standards for Mathematics from PDE

PDE further clustered the standards for mathematical practice into four categories, "Habits of Mind of a Productive Mathematical Thinker, Reasoning and Explaining, Modeling and Using Tools, Seeing Structure and Generalizing" (Pennsylvania Department of Education, n.d. p. 1). The standards for math practice relate directly to incorporating growth mindset into the math classroom particularly in the category Habits of Mind of a Productive Mathematical Thinker that calls for students to persevere in problem solving which is at the core of a growth mindset.

For the 2013-2014 school year, ES adopted the PA Core Standards-aligned *My Math* as the K-6 core curriculum. Until 2013, ES math teachers had the autonomy to create their own curriculum. The district had a 1998 math series available to all teachers as a tool, along with copies of the PA Standards for Mathematics Instruction. An unfortunate trend occurred in that teachers may have become too autonomous in their math instruction. They relied on a PSSA Coach Book, PSSA Released Items and Studyisland.com© as the math curriculum materials. In essence, students spent the year

practicing taking the state assessment and ultimately scored well as a whole through 2014 as shown in Table 2.

Table 2

Percent of ES Students Proficient/Advanced on Math PSSA

Year	third-	4th	5th	6th**	7th**	8th**
2002			85			60
2003			68			40
2004			71			64
2005	81		90			80
2006	100	74	68	90	86	66
2007	90	74	76	76	90	82
2008	84	82	84	88	80	93
2009	78	77	81	95	78	77
2010	83	71	57*** 95	89	86	
2011	85	80	68	94	85	83
2012	88***	82	75	96	89	86
2013	82	80	70	86	83	79
2014****	93	72	71	90	69	80
2015*	**50**	**41*****	**54**	**45**	**22**	**18**
2016	64	39	49*** 52	30	18	
2017	75	46	38	63	24	18
2018	66	48	24	39	45	32

*Revised test to reflect switch to PA Core Standards
**The same teacher has taught this course since testing began

*** New Teacher for the course
******First year for implementation of Pearson's My Math Curriculum K-6 and first year of my tenure as building administrator**

As Table 2 details, the 2014-15 school year, my first year as Principal at CVES, was also the first year of the new PSSA test that aligned with the PA Core Standards. Table 2 also displays the continued decline and relatively poor student performance on these high demand critical thinking tasks as assessed by the PSSA. Prior to the PA Core Standards, the third-grade standard for fractions called for students to use a visual to identify parts of a whole. Now, the third-grade standards for fractions call for students to compare fractions without using visual representations, find equivalent fractions, order fractions by value, and also identify fractions on a number line (M. LaRose, personal communication, March 27, 2018).

As a result of the dramatic drop in math performance at all grade levels in 2015, teachers tried a host of interventions to improve math performance included in Table 3:

Table 3

Interventions Implemented at ES

CDT Testing three times per year	Standards-based Classroom Diagnostic Test; one-to-one conference between student and teacher after the winter CDT Benchmark- together students and teachers identify areas of strength and areas for improvement and create a plan.
Additional practice worksheets,	Teacher selected or created for practice of targeted skills
Studyisland.com	Standards-based computer program that asks similar questions as PSSA
PSSA Coach Books	Standards-based workbook with PSSA practice problems

Professional Development	Collins Writing in Math: program for teachers to provide them strategies on how to help students respond to math problems in written form.
Professional development in CRA Math	Program for teachers to move students from a concrete, to representational, to abstract understanding of math concepts.
Multiplication charts	Support learning support population experiencing difficulty mastering basic math facts
Practice timed tests	Supporting mastery of basic math facts
Curriculum vertical/horizontal alignment	Teacher in-service time under direction of Tri-State Study Council Consultant that included creating course overviews, curriculum maps, unit plans and assessment schedules

None of these interventions outlined in Table 3 truly addressed the universal need for deeper-level thinking about math as shown in the PSSA scores in 2015 the first test aligned to the PA Core Standards (See Table 2). Also of note, none of the interventions addressed student math mindsets.

Clearly, math performance at SD has experienced a drop-off since the shift to the PA Core Standards as has math performance across the state as shown in Table1. As Table 2 indicates, SD students are on a trajectory for even poorer math performance as determined by the PSSA as they progress to seventh and eighth grade. Math attitudes in both teachers and students are at an all-time low and indicated in my Cycle 0 research and my interaction with teachers. At the beginning of each school year, I meet with each teacher to discuss the previous year. I use the PSSA scores and the PVAAS growth scores and ask them to bring additional materials such as teacher-created resources, lesson plans or classroom data to engage in discussion regarding strengths and areas for improvement. Several math teachers have expressed their frustrations with lack of student motivation

and student performance. I also observed this lack of perseverance and motivation during Cycle 1 of my research. All indictors point towards the need for a new approach to academic intervention and innovation.

Yeager & Dweck (2012) cite several studies (e.g., Garet et al., 2010; Glazerman et al., 2010; James-Burdumy et al., 2010; Somers et al., 2010) that demonstrate traditional interventions have little effect on achievement past the treatment phase. At ES, all interventions have focused on the student performance in math through excessive drill and practice. As Dr. Joan Boaler (2016) states, "The fixed mindsets that many people hold about mathematics often combine with other negative beliefs about mathematics, to a devastating effect" (p. iv). I believe we are experiencing this devastating effect because overall math performance seems to be at a stand-still and stagnant at ES. Despite teachers' best intentions, teachers are growing frustrated and in desperate need of a new intervention. I see the teachers in need of an intervention that will challenge their own beliefs about teaching and learning math along with students' thinking about math. ES teachers and students are in need of a mindset shift.

Part of the vertical and horizontal PreK-12 curriculum alignment (See Table 3) is to answer the question, "What do I do when students come to my class without the required skills?" Based on the results of my Cycle 0 research, it is now time for teachers to answer another question, "How do I respond when students display a negative attitude towards math, a negative self-concept of ability towards math, math anxiety and give up easily when presented with a math challenge?

Cycle 0 of my action research attempted to establish the baseline for designing an intervention aimed at providing teachers with the skills and knowledge necessary to

address math mindset, math self-efficacy and math anxiety. The results from Cycle 0 of my action research project teacher open-ended survey indicated an overwhelming trend of a fixed mindset with the math students at ES. I asked all math teachers third--6th grade including learning support teachers to respond to the survey questions about what they see and hear coming from the students during math class. Teachers reported that when faced with challenging math tasks, most students would say something like, "I don't understand", "I can't do this" or, "I need help." Teachers also reported that when students were faced with a challenging math task, they immediately asked for help, skipped the problem, or just shut down and sat there.

Overwhelmingly, I believe these themes as reported by the teachers indicate that the majority of our math students are not displaying traits of a growth mindset. They lack self-efficacy in math as well as perseverance.

Purpose of the Study

The purpose of this study is to address the need for a change in teaching approaches to math at ES. Drill and practice alone is a practice of the past. Addressing the whole student including student-mindset is the way of the future. The first step towards the change in student mindset is a change in teacher mindset. It is important for teachers to provide opportunities for students to develop positive outlooks, deeper thinking and mathematical reasoning and processing. Through teacher responses to surveys and my own observations as the educational leader of the school, I identified a distinct need for teachers and students to develop new thinking when it comes to math including teaching students how to examine and change their mindsets and improve student self-efficacy in the math classroom. I also identified the need for specific

professional development for the teachers in teaching with a growth mindset approach. This shift began with me working with teachers and then gradually releasing the teachers to teach their students with an emphasis on growth mindset in the math classroom. Dr. Joan Boaler (2016) notes, "Math teachers have the potential to deeply impact students' learning in a sustained way over time" (p. ix). My study examined the effects of conducting a book study with the math teachers in order to provide classroom-based changes to math language and instruction focused on developing a growth mindset and building math self-efficacy.

I used Dr. Joan Boaler's book *Mathematical Mindsets: Unleashing Students' Potential Through Creative Math, Inspiring Messages and Innovative Teaching* as a book study with the two third grade teachers. Together, we read, planed and then they tried out the specific strategies Boaler describes in Chapters 2-8 that brought growth mindset into the math classroom. I observed and recorded field notes from the classroom as to the effects on both teacher and student mindsets. Pre/Post assessments allowed me to analyze for effectiveness with both the students and the teachers.

In addition, I used the *With Math I Can* resources to teach about mindset in general using the lessons and the example videos. The *With Math I Can* program is designed for students, teachers, and parents to help every student succeed in math by achieving a growth mindset in math. Part of the program includes turning the negative self-talk into positive statements and dispelling myths and misconceptions by providing resources for classroom teachers, school districts, and families to use. There are pre-made lesson plans to introduce the concept of growth mindset along with videos that model the processes. There are links to specific teacher professional development, as well as videos

to use with the students as they move through the process of reshaping their thinking. This collaboration among so many professional organizations brings attention to need for mindset education in the math curriculum.

Research Questions

RQ 1: How and to what extent does implementing the growth mindset program affect the self-perceptions of third-grade teachers' mindset?

RQ 2: How and to what extent does implementing growth mindset as part of the third-grade math curriculum affect students' math self-efficacy?

RQ 3: How and to what extent does implementing a growth mindset program as part of the third-grade math curriculum affect students' mindset?

RQ 4: How and to what extent does implementing a growth mindset program as part of the third-grade math curriculum affect students' mathematics performance?

Summary of Introduction

The widespread belief that math ability is fixed could be a contributing factor to the lack of math performance across the United States, in Pennsylvania and at Elementary School (ES). An intervention focused on improving students' mindset towards math and subsequently their math self-efficacy, and resilience has never been implemented at ES. With a focus on growth mindset and self-efficacy, the potential exists for ES students to rise up out of the math slump and develop the mindset to persevere not only in math but in other content areas as well as life events. Learning to persevere and having an 'I Can' mindset will serve the students over the course of their lifetimes!

CHAPTER 2

THEORETICAL PERSPECTIVES AND LITERATURE

"What any person in the world can learn, almost all persons can learn if provided the appropriate prior and current conditions of learning*"* (Bloom, 1985, p.4)

Introduction

Starting very early in life, people's beliefs about their own abilities fall somewhere in the range of being born with the ability to ability being developed and refined over time (Blackwell, et al, 2007). Environment and experience both factor into shaping one's beliefs regarding math ability (Boaler, 2008, Boaler, 2016). These beliefs often follow a student and shape his/her performance over the course of school and beyond.

I begin with the main theoretical perspective guiding my work, Dweck's (1995) thinking about implicit theories of human attributes such as personality and ability. This is followed by existing research that supports my project of developing and fostering a growth mindset in math class as a means to improve academic performance including a focus on implicit theories of intelligence and mindset. This is followed by the second theoretical perspective guiding my research: Bandura's (1997) self-efficacy. Finally, I will conclude with the literature review that includes growth mindset, self-efficacy and supporting teachers as they move from research to practice to positively affect change.

Theoretical Perspective

Implicit Theories of Personal Attributions

Dweck et al. (1995) define implicit theories as the "two different assumptions people may make about the malleability of personal attributes" (p. 267). In other words,

people assume that attributes such as ability, trait, skill or emotion are either fixed and unchangeable or shaped, developed or formed by the individual. Intelligence is an attribute that people often believe is either fixed or flexible. Entity theory supposes that attributes are not malleable and therefore, fixed. Alternately, incremental theory reasons that attributes are in fact malleable and able to be changed. Furthermore, the same person can have differing theories based on the trait or personal attribute. The authors also note that neither theory "is the correct one" (p. 268), but rather two alternative ways to "construct reality" (p. 268) and have, "potentially important consequences for people" (p. 269). Ultimately, a person's beliefs shape his/her decision making and judgement across multiple contexts.

Implicit Theory of Intelligence

In her 2006 book *Mindset*, Carol Dweck applies the incremental and entity implicit theories to the personal attribute of intelligence related to mindset. The idea of two different mindsets was born from Dweck and her doctoral student attempting to understand why some students were focused on proving ability where other students just seemed to "let go and learn" (p. 15). Dweck (2006) describes entering a mindset as entering a world. In other words, in a mindset of fixed traits, success is found by proving ability, by demonstrating ability, and by seeking validation for being smart or talented. In this fixed world, failure is a sign that one is not smart. Failure represents one's lack of fulfilling potential (p. 15-16). Also in this fixed world, putting forth effort represents lack of intelligence or talent because if one had the talent and ability, effort would not be needed (p. 16). This fixed mindset affects achievement by limiting it and limiting effort (p. 67). Students possessing this fixed mindset about math, might be highly discouraged

and put forth little effort when presented with a challenging math task. They might lack self-efficacy or self-belief that they can complete the math task and therefore, give up easily. These same students might have very little perseverance and believe the negative self-talk regarding their fixed ability in math. For these students, this mindset likely does not just apply to math, but rather other school subjects and interests.

In the world of the growth mindset, ability is malleable and success is found not by proving ability, but rather by demonstrating the ability to persevere through a challenging task rather than be stopped by it. Furthermore, in this growth mindset world failure represents the opportunity for growth and extended learning. Effort is paramount to this world because it is the gateway to problem-solving. Students possessing a growth mindset about math are not discouraged by mistakes and set-backs, but rather see them as opportunities to try again. Where the fixed mindset limits achievement, the growth mindset enables it.

Self-Efficacy

When discussing implicit theories of intelligence, a natural extension of this topic is self-efficacy. Social learning theorist Alfred Bandura (1997) defines self-efficacy as the belief in one's abilities to accomplish his/her desired outcomes, belief in ability to powerfully affect people's behavior, motivation, and ultimately, their success or failure. He contends that without self-efficacy, people would not exert effort on tasks because they perceive their effort will be unproductive. Furthermore, those who possess a strong sense of self-efficacy are not fearful of challenging tasks, rather, they see these types of challenges as an opportunity for growth. Additionally, those with strong sense of self-

efficacy maintain their efforts in the face of failure as they quickly recover from a set-back rather than quit (Bandura, 1994, 2).

As described, a strong sense of self-efficacy is truly an extension of the growth mindset. Students with this strong sense of self-efficacy are also students with a growth mindsets. In the math classroom, too often students give up on a challenging task because they think they can't do it or they aren't good at math. Improving self-efficacy goes hand-in-hand with fostering a growth mindset.

Literature Review

Research Related to Growth Mindset

Implicit theories of intelligence impact how students face challenging tasks and their subsequent achievement on these tasks (Yeager & Dweck, 2012). The authors also link the concept of resilience to implicit theories. They define resilience as "good outcomes in spite of serious threats to adaptation or development" (p. 303).

Yeager and Dweck's (2012) research revealed that students with a fixed mindset or entity theory of intelligence believe that intelligence is unchangeable and tend to view their struggle with challenging tasks as a sign that the student lacks intelligence. Whereas students with a growth mindset or incremental theory of intelligence believe intelligence is malleable or able to be changed. These students tend to view their struggles with challenging tasks as an opportunity to apply learned skills and problem solve and continue working to find the correct answer and ultimately building resilience.

Yeager and Dweck's (2012) research suggests that changes in mindset can promote resilience, that in turn, can also have a positive effect on student achievement. While their data is from the college level, it is still intervention evidence that changes to

implicit theories of intelligence can affect academic performance over time. This supports the goals of my action research project to improve students' growth mindset towards math and subsequently their math self-efficacy as a means to improve academic performance in elementary math classrooms.

Moorman and Pomerantz (2010) explained that effects of how mindset treatments influence the quality of mothers' involvement with their children's learning and influenced mothers' responses to children's helplessness? After exposing two groups of mothers to either a fixed or growth mindset treatment, researchers observed the parents interact with their children on challenging tasks. The authors describe the quality of parent involvement with their child as either constructive (mastery focused) and unconstructive (performance focused and controlling). What they found is that the mothers who were exposed to the entity or fixed treatment were more likely to grow frustrated and focus on task performance, exhibited more control over the situation and were overall more negative compared to mothers who were exposed to the incremental or growth mindset treatment.

Moorman and Pomerantz's (2010) research demonstrated a relationship between how a mother thinks and how she interacts with her child on challenging tasks. It also demonstrates how the mom acts when her child is displaying helplessness which is associated with fixed thinking (p. 1354). The implications from this research highlight an area where schools might consider providing training in parent/child time during homework and begin during the early years. Furthermore, these results support the importance of teacher mindset on student outcome as teachers spend the most time with students and learning concepts.

Blackwell, Trzensniewski, & Dweck (2007) applied implicit theories of intelligence to predict academic performance as students transitioned to junior high school. Differences in core beliefs about intelligence was a mitigating factor in how students perform academically. If students believe that their intelligence is uncontrollable and they believe they have very little, they are more likely to give up and put forth little effort. Alternately, those students with the belief that intelligence is directly affected by their own effort, put forth the effort to persist. Students can be at either end of the spectrum of mindset belief with the same intellectual ability, but it is this mindset belief that accounts for how they respond to challenging tasks. Their findings support that all students benefit from growth mindset exposure and practice.

Where students of the entity or fixed mindset focus on performance goals and demonstrating ability, students with the incremental or growth mindset focus on learning goals and increasing their ability. They found students displaying this entity mindset make little effort and do not view effort as a tool for learning. This scenario often leads to learned helplessness (Blackwell et al. 2007). Ultimately, this research supports the idea that students who possess the incremental theory of intelligence also support stronger learning goals and are more motivated to face challenges. There are fewer instances of learned helplessness; instead, there are students using effort-based approaches when facing failure and ultimately these students experienced an increase in academic achievement in math.

Self-Efficacy and Growth Mindset Related Research

In their 2014 work, Stankov, Morony, and Ping Lee, discussed self-conscious constructs such as self-efficacy, self-concept and anxiety as non-cognitive predictors of

academic achievement in mathematics. Within their research, the authors defined self-concept as, "one's perception of self in relationship to a particular area of competence" and defined self-efficacy as referring to "one's belief in one's capability to produce outcomes" (p. 10). In other words, self-efficacy refers to one's belief in him/herself to successfully complete a task such as a math word problem or confidence. Their findings concluded that confidence has the highest correlation with mathematics accuracy (.68), followed by past math performance (.49) and self-efficacy (.48) (p. 18).

The self-efficacy along with self-concept are predictors of long-term academic achievement (Parker et al. 2014). Parker et al. present self-efficacy and self-concept as two distinctly different processes that impact long-term achievement. Specifically, Parker et al. established a clear distinction between self-efficacy and self-concept in mathematics outcomes. Self-efficacy measures "self-perceptions of capabilities" (p. 31) and refers to one's perceptions about their own capability to successfully complete a task such as completing a specific math calculation. Thus, self-concept refers to, "evaluating, relating to judgements about whether one's behavior math self-set standards of worth and competence" (p. 31) such as making a general statement about ability of good or bad in math.

Their research concludes that both self-beliefs of self-efficacy and self-concept are positively associated with achievement in math. This positive association supports the importance of establishing a growth mindset as part of a math program that also addresses self-efficacy.

Research Related to Teacher Book Study in Supporting Change Effort

Incorporating new teaching practices and approaches requires a great deal of work on both the teacher and initiator of the change. Too often, teacher professional development has resembled the one and done model where a teacher attends a training and then returns to the classroom with no support and no follow up. In my educational experience, this type of professional development is not effective and certainly has little impact on affecting positive change in the classroom.

In their 2011 work, Hall and Hord used the visual of a bridge to stress the need for and the importance of supporting teachers as they work to implement change by putting research into practice. Hall and Hord focused on what changes need to take place within the professional development framework in order for the implementation process of new approaches and practices to be effective and produce the desired outcomes of new skills and understandings. These new understandings and skills not only take time but also support from educational leaders. Hall and Hord use the symbolism of change as the Grand Canyon and teachers' attempts at implementation as a leap across this canyon. Obviously, taking a running leap across the vast chasm will likely result in injury, failure, or worse which is exactly the point the authors are trying to make. What is needed is a bridge to cross the wide-open space between research and practice.

Hord and Hall use the term "implementation bridge" (p. 53) to represent the support that teachers need to make the connection between research to practice. The bridge provides support across the entire journey through change. So, too, professional development should be ongoing and support a change process from beginning to end.

Supporting the teachers throughout the implementation of the growth mindset intervention is an essential key to its success or failure.

Sustainability of initiatives as well as teachers, is a topic among educators and researchers in the age of change efforts. Coburn et al., (2012) conducted research through a longitudinal study on how teachers' social network support their work in change initiatives. Their research demonstrates that teachers' social networks with peer teachers through the first two years of a change initiative plays a role in supporting the initiative in its first two years of implementation. Teacher social networks are just one example of an implementation bridge as described by Hord and Hall. Social networks when implementing a growth mindset intervention in the math classroom may be a way to support teachers as they develop and implement growth mindsets for math in their classrooms.

Riveros, Newton and Burgess (2012) propose a "practice-based focus for professional learning communities in schools" (p. 202). Their works supports the idea that teachers working with their fellow teachers in professional development initiatives have a higher likely hood of, "transforming teacher practices in ways that will bring about high rates of student achievement" (p. 204). These peer relationships working through professional development together is a second example of the implementation bridge described by Hord and Hall. Two teachers working in the same classroom while working on implementing the growth mindset intervention embedded in their practice in the math classroom carries a high likelihood of increased student achievement, improved math self-efficacy and math growth mindset.

Rationale for Growth Mindset Intervention in Math Curriculum

Assumptions people make about the ability of personal traits such as intelligence and personality frame how they think and how they act. This includes young students and their ability to perform in certain subject areas including math. These mindsets are developed early and influenced by parents and other adults.

In her 2006 book *Mindset*, Dweck details at length the differences between a fixed (entity) mindset and a growth (incremental) mindset. When students, parents and teachers alike embrace a growth mindset, they persevere through challenging tasks and view failure as a means to improve rather than an indicator of lack of ability. Furthermore, a growth mindset goes hand-in-hand with a strong sense of self-efficacy and grit. Incorporating these traits into an elementary math program by working directly with the teachers through a book study should ultimately develop students who believe in their abilities, possess a strong sense of determination and identify failure as an opportunity to grow. Developing these traits with the teachers as part of the math curriculum should also lead to increased student self-efficacy in math and overall improved student performance in math.

In order to develop the growth mindset, improve students' self-efficacy and ultimately improve student achievement, the math teachers need meaningful and sustained professional development and support in digesting and adopting these practices. As Hall and Hord (2011) note, without the support between research to practice, change efforts will likely fail. Thus, establishing this strong support system for teachers through a weekly book study (See Chapter 3) where we review, plan, try out and then reflect is

critical to successful implementation of growth mindset teaching practices in the elementary math classroom.

Summary

In Chapter 2, I presented the theoretical perspectives and subsequent research in support of my intervention of developing growth mindset teaching practices in the elementary math curriculum as a means to improve math self-efficacy, math mindset, and improve math performance through sustained teacher professional development. Chapter 3 outlines the methodology of my action research.

CHAPTER 3

METHODS

"In the way we can build a community that highlights being smart or one that values effort and flexibility, a teacher can direct the way a community works in the intentional celebration of specific actions and words of its members"

(Mraz & Hertz, 2015, p3).

Introduction

Chapter 3 discusses the methodology for my action research project examining the effects of implementing growth mindset practices as part of the elementary math curriculum to improve student math achievement, develop a growth mindset and self-efficacy. In addition, the project also examined how sustained teacher professional development through a collaborative book study and in-class support affected teacher belief and teacher practice.

As Herr and Anderson (2015) describe, action research is, "Inquiry that is done *by* or *with* insiders to an organization or community, but never *to* or *on* them. It is a reflective process, but is different from isolated spontaneous reflection in that it is deliberately and systematically undertaken and generally requires that some form of evidence be presented to support assertions" (p. 3-4). Mertler (2014) refers to action research as, "Truly a systematic inquiry into one's own practice" (p. 4). The purpose of my action research mixed methods study was to support the assertion that working with teachers through on-going professional development to systematically implement growth mindset focused teaching practices in the third- grade elementary math curriculum will improve student math self-efficacy, student mindset and student achievement at the

elementary school where I am the educational leader. Since this is a mixed methods study, I examined both qualitative and quantitative data for evidence in support of my research questions. I selected the mixed methods design because I felt that neither qualitative nor quantitative data alone would be thorough enough to answer my research questions. Rather, together, the quantitative data followed up by qualitative data would as Plano Clark & Cresswell (2015) describe, "Develop an enhanced understanding of how the experimental intervention actually worked" (p. 387). Furthermore, the dual data collection will assist in triangulating the data to, "Ensure themes found in a study are credible representations of people's experiences and perspectives because the information draws on multiple sources of information or individuals" (p. 364). I collected both data sources at the same time throughout the course of the study.

ES students have experienced a decline in math scores on the state standardized tests across all grade levels since the implementation of the PA Core Standards that have been assessed since 2014. This decline has been felt from third through eighth grade where a traditional approach to math instruction has been practiced. In my previous cycles of research, teachers identified students giving up easily, not willing to try, and accepting failure. These are all indicators of a fixed math mindset. Couple this with the economic distress this region faces and many parents who are uneducated and/or not working, we do not know what student hear about school before they get to us each day.

This growth mindset intervention was aimed at transforming teaching practices to support the notion that failure is not the end but rather a means to try again and students can grow skills they once thought fixed or predetermined. Furthermore, this intervention was aimed at eliminating the idea that a student is not good at math, but rather build self-

efficacy as he/she experiences the rewards of trying again, persevering, and understanding math concepts. With this in mind, my research questions were:

RQ 1: How and to what extent does implementing the growth mindset program affect the self-perceptions of third-grade teachers' mindset?

RQ 2: How and to what extent does implementing growth mindset as part of the third-grade math curriculum affect students' math self-efficacy?

RQ 3: How and to what extent does implementing a growth mindset program as part of the third-grade math curriculum affect students' mindset?

RQ 4: How and to what extent does implementing a growth mindset program as part of the third-grade math curriculum affect students' mathematics performance?

Setting

The setting for my action research examining the effects of implementing a growth mindset intervention in the math curriculum was my current elementary building and the 2018/2019 third-grade class (n=57). There were three third-grade homerooms that changed classes for the four main content area classes of Math, ELA, Science and Social Studies. There was one math classroom and teacher team. Third-grade is the first year students are not taught in a self-contained setting. In addition, all third-grade students participate in the special classes of art, music, library, physical education and technology education on a five-day rotation. Students attend Monday through Thursday 8:15 a.m. until 3:15 p.m. and Friday 8:15 a.m. until 1:15 p.m. This building is four years old and includes a Smartboard and projector in every classroom. We are one-to-one with Chromebooks for students in grades first and beyond. In addition, we have additional carts of laptops, Chromebooks or iPads available for use in special classes.

Participants

I conducted my action research project in my work place and as part of our on-going math curriculum work. I asked the third-grade math teacher, Mrs. Jones, and the third-grade learning support teacher, Mrs. Dill, to participate. I selected third grade because it is a transition year at our school. Students move from a self-contained classroom to changing classes for the core subjects. Third-grade is the first year in their educational career that the same teacher teaches all students in the grade one subject. Third grade is also the first year of the state assessment PSSA. In addition, they preliminarily agreed to participate as part of their professional goals to improve math instruction and student math achievement. Both teachers were aware that they could withdraw at any time without it impacting their positions as indicated in the Consent to Participate Letter (See Appendix H).

Mrs. Jones teaches three sections of students grouped heterogeneously. Mrs. Dill, the third-grade learning support teacher, co-teaches the section with the identified students in it. These two teachers have been co-teaching for five years using multiple co-teaching frameworks during each of the 93-minute class. Mrs. Jones and Mrs. Dill used a combination of teaching methodologies such as whole group instruction, math centers, and independent practice with the core curriculum *My Math*© published by Houghton Mifflin Harcourt that included a daily Smartboard component for each lesson. Students sat in table groups of four to five but also had access to the math work stations throughout the classroom.

These two teachers were part of my Cycle 0 that established a need for this math intervention. Mrs. Jones has been teaching third-grade math for six years with her prior

experience in the kindergarten classroom. The Mrs. Dill has been co-teaching in elementary classrooms for her entire twenty-year teaching career. Each teacher had at least twenty years teaching experience.

All enrolled third-grade students were invited to participate as part of their classroom curriculum work. Third-grade is the first year students take the computer-based Classroom Diagnostic Test (CDT) three times per year to inform teachers where students are performing in terms of the PA Core Standards. Third-grade is also the first year students participate in the Pennsylvania System of School Assessment (PSSA) each spring. This is what is referred to as purposeful sampling because I intentionally selected the third-grade to study this phenomenon of the growth mindset intervention for the reasons stated above (Plano Clark & Cresswell, 2015). The 2018-19 enrollment for third-grade is 59. According to our student information system: *Powerschool*©, the male/female and ethnic breakdown is displayed in Table 4 below.

Table 4

Demographic Breakdown of Participant Students

Grade Level	Male /Female	Asian M/F	African American M/F	Hispanic M/F	American Indian/ Alaskan Native M/F	Multi-Racial M/F	Native Hawaiian/Pacific Island M/F	White M/F	IEP/special educated
3	32/27	0	0/0	0	0	5/2	0	27/25	12

Table 4 displays the data from *Powerschool*© which reveals a very clear picture of our participants. We had nearly equal number of female students to male students; no African American, Asian population, a slightly larger Multi-Racial population (11%); and

a predominantly white population (89%). In addition, there are eleven students identified for Special Education and no students identified as Gifted.

A few years into my tenure as building principal and just prior to the start of the 2016-17 school term, my administrative team comprised of the district superintendent, high school principal, high school assistant principal, director of special education and myself selected math as an area of focus for improvement as all tested grade levels were experiencing low performance percentages of Advanced or Proficient on the PSSA. This is the standardized assessment used in teacher, school, and district, state and federal level report cards shared with the public. This assessment is aligned to the PA Core Standards and is the opportunity for the students to demonstrate their mastery of the grade level standards, assessment anchors and eligible content.

Role of the Researcher

My position as principal at ES already placed me as in insider for my action research; it also means that I am the immediate supervisor directly responsible for the evaluation of the two teachers participating. As Herr and Anderson (2015) note, the insider is one who, "either alone or in collaboration with other insiders, are researching their own practice or practice setting" (p. 41). According to this description, I researched in my practice setting where I was the educational leader of the school; not only was I an insider, I was also what Clark and Creswell (2015) defined as participant observer. In other words, not only did I do the observing in the classroom where the intervention was taking place, I was also be participating in some of activities that went on in the classroom.

Positionality of the researcher is a component of action research that has garnished much discussion (Mertler, 2014; Clark & Cresswell, 2015, Herr and Anderson,

2015). Since the action research takes place in the researcher's context and the goal is to affect positive change in the context, the door to bias is open. However, in order to keep this in check and conduct a valid study, I selected to use multiple data sources in attempt to triangulate my findings. I remained objective throughout because my goal is positive change, not change for the sake of change. The teachers I worked with conducted themselves as professionals and remained open to the suggested growth mindset changes throughout the course of the study as they made permanent changes to their daily teaching practices.

Growth Mindset Intervention

While traditional math interventions have their place within the classroom context to improve academic achievement, so too, does developing teachers' and students' mindset to embrace a growth mindset in mathematics. This shift in intervention approach goes beyond identifying a math skill deficit and providing specific intervention related to that deficit; rather it focuses on developing mind skills that empower students to persevere in the face of a challenge rather than quit, or worse, thinking he/she just is not smart enough.

After co-teaching the introductory lesson to the students, the first component of the intervention with the teachers was participation in reading and discussing Dr. Joan Boaler's book Mathematical *Mindsets: Unleashing Student's Potential Through Creative Math, Inspiring Messages, and Innovative Teaching*. Dr. Boaler's book introduced teachers to the importance of a growth mindset in the math classroom and the impact on the brain. The book then provides seven specific practices/approaches to making the happen in the classroom as outlined in Table 5 below. Our book study included four 40-

minute sessions discussing materials, content and ideas in person. It also included five hybrid discussions where I presented specific questions and asked for thoughts and input on specific chapter content through the use of a shared Google Document among the three of us.

Table 5

Description of Dr. Boaler's Seven Strategies for Incorporating Growth Mindset in math

Chapter 2: The power of mistakes and struggle – value mistakes and teach students they are learning tools.

Chapter 3: The Creativity and Beauty in Mathematics – teach math as a broad, visual and creative subject

Chapter 4: Creating Mathematical Mindsets: The Importance of Flexibility with Numbers "Conceptual, investigative math teaching and mindset encouragement" (p. 55)

Chapter 5: Rich Mathematical Tasks – Modify math tasks for "different ways of seeing, different methods and pathways and different representations" (p. 90)

Chapter 6: Mathematics and the Path to Equity – Provide high level content for all, change ideas about who can do well in math, encourage students to thinking deeply about math, teach students how to work together, provide additional encouragement for girls and students of color to learn about math and science, eliminate or change idea of homework,

Chapter 7: From Tracking to Growth Mindset Grouping – Teach broad, open, multidimensional math, teach student to be responsible for each other and communicate growth mindset in the classroom

Chapter 8: Assessment for Growth Mindset – assess to provide information about student learning rather than student achievement (p. 168)

Data Sources

Data sources included pre/post surveys, teacher interviews, reflective notes, the spiral review assessment as the student work samples and a comparison of cohort student performance on the CDT from Beginning of Year to Mid-Year for both the 2017/2018 third- grade students and the current study group of third- grade students 2018/2019.

Pre/post surveys. I prepared and administered pre/post treatment surveys related to math mindset (See Appendix A) and math self-efficacy (See Appendix B). I followed the example of using both growth and fixed mindset statements from the Teacher Mindset Quiz. I designed five statements framed in growth mindset language and five statements framed in a fixed mindset language all statements were designed for third-grade independent readability.

I designed the student self-efficacy survey titled *I Believe I Can Try* as an assignment in TEL 701 Advanced Quantitative Analysis. I used Bandura's (2006) *Self-Efficacy Beliefs of Adolescents* to guide the development of this survey. I selected the three constructs of self-efficacy in setting goals in math, self-efficacy and math tasks and self-efficacy and challenges in math. I framed all statements using "I can" as self-efficacy is one's perception of his/her own ability.

On September 9, 2018, I administered both surveys to each of the three sections of third grade. On January 8, 2019, I again administered both surveys to each of the three sections of students. For analysis purposes, I only used the surveys from the students who were present for both pre and post survey administration.

With the teachers, I distributed the pre/post treatment mindset quiz (see Appendix D) designed by Emily Diehl (2008) (See Appendix D). The teachers completed these on their own and returned them to me.

Teacher interviews. I conducted pre/post semi-structured interviews with the two teachers regarding mindset, student self-efficacy and best practices (See Appendix C). I recorded the interviews using the Voice Memos application on my phone. I also used the Transcribe Me! Application on my phone to transcribe the interviews at a cost of $1.25

per audio minute. After receiving the documents back, I printed them and returned the interviews to the teachers to review and approve for use. I followed this same protocol for recording and transcribing the book discussion topics.

Reflective notes. I recorded reflective notes throughout the course of the entire study. I attempted to use one notebook, but would often jot my thoughts, predictions or reflections on paper as I would have them and transfer them to the reflection notebook. I did not follow a specific timeline for reflections, I recorded my reflections as I had them.

Student spiral review. I collected and examined the teacher-created spiral reviews of the five students from each homeroom and charted their achievement progress over the course of the study. This is a teacher-created formative assessment piece that is a short cumulative review of materials taught to date and completed by students on a weekly basis for a grade as shown in Figure 2.

Student CDT results BOY to MOY comparison. I examined the difference in cohort student performance between the beginning of the year (BOY) Classroom Diagnostic Test (CDT) and the middle of year (MOY) assessment in both the 2017/18 and the 2018/19 cohorts. Using descriptive statistics through SPSS, I compared these two cohort performances in order to determine if there was a difference in performance between the 2017/18 students who were not exposed to the growth mindset intervention and the 2018-2019 students who were.

Table 6 provides an overview of the data sources I used to answer each of my research questions.

Table 6

Research Questions and Data Sources

Research Questions	Data Source
How and to what extent does implementing a growth mindset program affect self-perceptions of third-grade teachers' mindsets?	*Pre/Post mindset survey *Pre/Post interview *Observations *Reflective Field Notes *Book Study Discussion
How and to what extent does implementing a growth mindset program in third-grade math affect students' math self-efficacy?	*Pre/Post self-efficacy survey *Observations
How and to what extent does implementing a growth mindset program in third-grade affect students' mindset?	*Pre/Post mindset survey *Observations
How and to what extent does implementing a growth mindset program in third-grade math affect students' math performance?	*Student Spiral Reviews *Observations, CDT Performance Review

Procedure

Implementation of the intervention was two-fold: intervention with the participating teachers and intervention with the students. I began with the teachers prior to the start of the school year with the pre-interview (See Appendix C) and pre-assessment (See Appendix D). On August 20. 2018, I delivered the Consent to Participate Letter to both teachers (See Appendix H). On August 21, 2018, I received both letters signed indicating their consent to participate. Once they each handed me the consent to participate, I handed them the pre-mindset quiz (See Appendix D) that same day. Each teacher returned the pre-mindset quiz by August 24, 2018. I then completed the pre-interviews with both teachers on September 5, 2018 in my office at ES.

I completed all pre-work with the teachers prior to surveying the students. I then distributed the book, Dr. Jo Boaler's Mathematical *Mindsets: Unleashing Students Potential Through Creative Math, Inspiring Messages, and Innovative Teaching* and introduced them to the introductory lesson found at the online site *With Math I Can*.

Together, we reviewed the introductory lesson from *With Math I Can* that we co-taught to all three sections. Together we created the anchor chart (Appendix K) that we distributed to the students and displayed in the room to reflect the language associated with growth versus fixed mindset thoughts after teaching the introductory lesson. We created a calendar for the nine-session book study with deadlines and dates for discussions but quickly learned that the real-life demands of being teachers, being the principal and all of the responsibilities outside of the school realm demanded we be very flexible with due dates and deadlines.

I began the student part of the intervention on August 20, 2018 during meet-the-teacher night when all students were invited to be part of the study. I met with parents in three groups to explain the study. I also explained to them that if they did not wish for their student's data to be collected, they would still reap any benefit as the study was taking place in the context of third-grade math. I provided each parent with a Parental Consent Letter (Appendix I) by which their signing indicated their approval for their student to participate. There were four students who did not attend the meet-the-teacher night event; therefore, I telephoned them individually, explained the study and sent the consent form home with the student. By September 18, 2018, I collected 100% of the parental consent forms for all students to participate. On September 9, 2019, I visited each section of the third-grade math to review the Child Assent Form (Appendix J).

I then collected the pre- intervention survey data from the students on math mindset and also math self-efficacy (Appendices A and B). I collected the data for the pre-survey on September 13, 2018 from each of the three sections of students. I visited the classroom and conducted the surveys.

After I distributed the surveys, I read the directions and conducted the practice items. I then read the statements from each survey and provided time for selection of response. The other two teachers circulated the room and re-read the statements when requested and also helped students stay on the right number. On January 8, 2019, I followed the same procedures and conducted the post-survey with the students.

On September 18, 2018, I co-taught the introductory lesson from the *With Math I Can* website (https://www.amazon.com/gp/withmathican) to all three sections of third-grade math with the two participating teachers. This was an already independently established lesson introducing the concept of mindset.

Over the course of the intervention, I collected student achievement samples from the weekly spiral review assessment already in place in the third- grade curriculum. I gathered this data from five randomly selected students from each class for a total of fifteen students. I randomly selected five students from each homeroom to follow by pulling numbered sticks from a can. Each number corresponded to a student number. I selected the five numbered sticks for the first class, Mrs. Jones selected the five numbered sticks for the second class and Mrs. Dill selected the numbered sticks for the third class. I then matched the numbers to the corresponding students and collected the scores from the grading program Powerschool©.

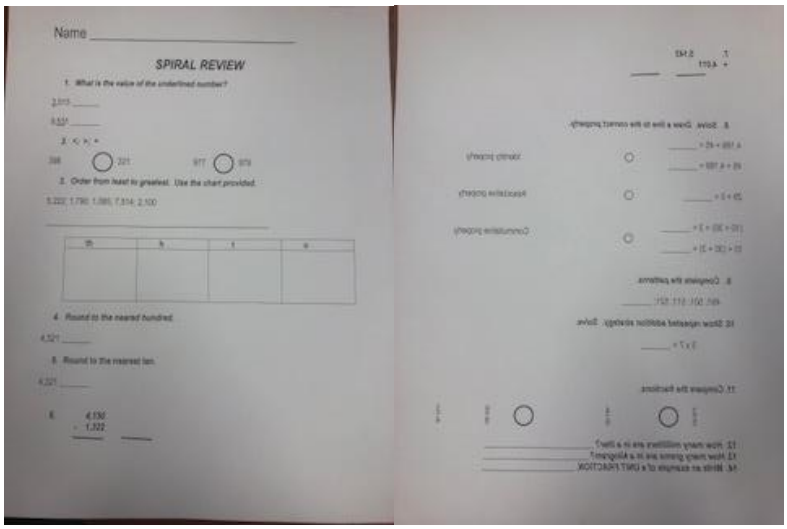

Figure 2: Example of teacher-created spiral review

I also collected the Beginning of the Year (BOY) and Middle of Year (MOY) Classroom Diagnostic Test (CDT) assessment results from the entire grade level. I collected the same data from last year's third grade who did not participate in the intervention in an effort to compare results with and without the mindset intervention. I received permission to use this blind data from the superintendent via a letter dated October 18, 2017 and approved through the IRB process.

I originally proposed collecting qualitative data from two self-designed observation protocols: one related to what students were saying and doing and a second to use in the classroom after completing each chapter of the book discussion. I followed Observation Protocol 1 two times. Both times were with the co-taught students; I quickly discovered my presence in the classroom was a distraction to the students as they wanted to interact with me. They were getting out of their seats for 'things', waving, trying to show me items unrelated to class. As this section was the neediest group of students in terms of achievement and growth, I made the decision to end my observations.

I designed the second observation protocol to record data from the teachers and students after the teachers and I completed each of the chapters in the book study. While preparing for our discussion of Boaler's Chapter Two, I noted in my reflection journal,

> This is already beginning to feel too much like an official teacher observation on my part; therefore, how is it going to feel from the teachers' perspective? While I don't believe the teachers would intentionally not be authentic, I still might 'see the show' so to speak. Should I release these try-outs to them?

A second factor that influenced my decision to exclude the second observation protocol from the study was the fact that due to a variety of reasons including teacher absences, my absence or my position as elementary principal, we had to reschedule the first observation. I finally told the teachers to go ahead with their planned lesson as it was now into October. A few days later, I bumped into Mrs. Dill in the hallway, she was elated as she related to me how well the lesson that focused on the power of mistakes went. It then became clear to me that the autonomy they experienced in the lesson was very valuable to the process. My presence in the classroom in that evaluative role could stifle the process they were working through together to make changes in their teaching. I weighed the decision heavily and ultimately decided to release that part of my original plan to observe each try-out lesson. I placed all responsibility of the try-out strategies into the hands of the teachers.

Timeline for Intervention

The Growth Mindset Intervention took place during the first semester of the 2018-2019 school year. The timeline for implementation is presented in Table 7.

Table 7

Timeline, Procedures and Data Collection of the Growth Mindset Intervention Study

Time Frame	Actions	Procedures and Data Collection
August parents	Meet the Teacher Night	Secure consent/assent from third- grade
August	Pre-Interview	Complete pre-interviews with teachers
August	Pre-assessment	Complete pre-assessments with teachers & students
September	Intervention Begins	Book study, observations, reflective field notes, Examining student spiral reviews, Introductory lesson.
October - November	Intervention Continues	Book study, observations, reflective field notes, Examining student spiral reviews
December	Intervention Continues	
January	Collect MOY Data	
February	Teacher Interviews	Complete post-interview with teachers

Quantitative Data

With the pre/post survey data from the students and the teachers, I used SPSS (23) to calculate the descriptive statistics to present the mean scores and the standard deviation for both administrations of both surveys. I calculated Cronbach's Alpha to discuss the reliability of the surveys. I also ran dependent two tailed t-tests on the pre and post scores in order to examine the mean differences between administrations to determine the likelihood that the intervention caused difference in scores. I created a chart of the percent scores of the spiral reviews from the fifteen students I followed over the course of the study to identify any achievement trends--positive or negative.

Additionally, I collected and compared overall cohort student performance from the Beginning of the Year (BOY) CDT to the Middle of the Year (MOY) CDT for the 2017/2018 group and the 2018/2019 group. This provided further data as to the effect of implementing the growth mindset intervention by comparing one group who did not receive the intervention to the group participating in the study.

Qualitative Data

To analyze the qualitative data from the semi-structured interviews and the data/notes from the book study discussions, I followed Srivastava and Thomson's (2009) framework analysis to identify themes using their five steps: familiarization, identifying a thematic framework, indexing, charting and mapping and interpretation.

The first step in this process was familiarization; therefore, I began the process as soon as I obtained approved transcripts. This allowed for analysis throughout the research process. I read and reread the transcripts and also wrote reflective notes throughout the course of the study. After familiarization, I identified themes and trends in the data in conjunction with identifying the data points that supported the themes and trends known as step three: indexing. I completed these two steps right on the pages of the transcripts. From the identification of themes and the indexing, I then charted the data according to the themes by creating self-made graphic organizers using paper and pencil. These charts were the beginning to the actual charts I used in Chapter four to display the results. Lastly, I used the charts to draft my interpretations of the data and answer my research questions.

Summary

In attempt to answer my four research questions, I conducted a mixed methods action research study establishing growth mindset teaching practices with the third- grade math teachers as part of curriculum during the first semester of the 2018-19 school year. I collected both qualitative and quantitative data from the teachers through a pre/post survey on teacher mindset, pre/post interviews, a book study, and researcher reflective notes. I collected quantitative data from the students' pre/post surveys on mindset and self-efficacy. Chapter 4 presents the data and the analysis of the data I collected along with my findings related to the four research questions.

CHAPTER 4

DATA ANALYSIS AND RESULTS

"Children don't hate math. What they hate is being confused, intimidated, and embarrassed by math. With understanding comes passion, and with passion comes growth – a treasure is unlocked" Larry Martineck

The purpose of my action research was to examine the impact of incorporating growth mindset teaching practices in the third-grade math classroom to improve on both the teachers' and the students' mindset along with improving student math self-efficacy and student achievement. Chapter 4 presents the results of all the data collection measures I employed over the course of the study followed by my data analysis. The results and analysis are presented in response to each of my research questions.

Implementing the Growth Mindset Intervention Affected Teachers' Mindset

Through the combination of a pre/post teacher mindset quiz, pre/post interviews and regular discussions over the course of the book study, I collected data in attempt to describe how and the extent to the growth mindset intervention affected the teachers' mindsets. I present the quantitative results first followed by the qualitative findings and an overall interpretation of my analysis.

Teacher Mindset Survey

Reliability On the Teacher Mindset Survey, a total score of between 60 and 45 translated into a Strong Growth Mindset; a total score of between 44 and 34 points equals a Growth Mindset with some Fixed Ideas; a total score of between 33-21 points equaled a Fixed Mindset with some Growth Ideas; and a total score of 20-0 points translated into a Strong Fixed Mindset. The author did not include any information on reliability of the

measurement item; therefore, I used Statistical Package for the Social Science software (SPSS) Version 23 to calculate the Cronbach's alpha test of reliability. Table 8 presents the alpha results for both administrations of the Teacher Mindset Survey to both teacher-participants.

Table 8

Teacher Mindset Quiz Pre and Post Cronbach's Alpha
n=2

Pre Score	$\alpha = 0.758$
Post Score	$\alpha = 0.822$

An alpha score of 0.70 is widely accepted in the research community as an acceptable reliability threshold (Fraenkel & Wallen, 2005). As Table 8 indicates, both administrations yielded an alpha score of greater than 0.70; therefore, The Teacher Mindset Survey is a reliable measure in that it is measuring the construct of growth mindset to an acceptable degree.

Dependent paired t-test and analysis. In order to determine if the change in the mean scores between the pre-assessment and the post-assessment of the Teacher Mindset Survey could be attributed the Growth Mindset intervention, I used SPSS Version 23 and conducted a dependent paired sample t-test to compare the mean scores.

Table 9

Paired Sample T-Test for Pre and Post Teacher Mindset Survey
(n=2)

Administration	Mean	SD	t	df	p
Pre Score	35.5	10.6			
Post Score	52.5	4.9			
			-4.75	1	0.132

As displayed in Table 9, the results show the mean score on the post survey (M=52.5, SD = 4.9) nearly thirty points higher than the mean score on the pre intervention survey (M = 35.5, SD = 10.6). The increase in the mean of the post scores

and the decrease in the SD shows not only did the two teachers select responses more in line with growth mindset thinking, but that there was a substantially smaller distribution of scores on the post administration. This smaller distribution of scores on the post survey indicate that the teachers' responses were more similar than they were on the pre survey. However, the t-test found this difference not be significant, $t(1) = -4.75$, $p > 0.050$ ($p=0.132$). So while there was an increase in the mean score and a decrease in SD, the $p = 0.132$ is outside the accepted p value of 0.050 and therefore I cannot attribute the mean differences to the intervention. I should also note that with n=2, the low number of participants plays a role in the p score.

Descriptive statistics and analysis. Both Mrs. Jones and Mrs. Dill completed the Mindset Surveys independently and returned them to me for scoring. They completed the surveys prior to meeting with me for the pre interviews and again prior to meeting for the post interview. Table 10 presents the scores from both administrations of the Teacher Growth Mindset Survey over the course of this study.

Table 10

Pre and Post Score on Teacher Mindset Survey

(n=2)	Score	Descriptor	Correlation	p
Teacher 1				
Pre Score	41	44-34 points= growth mindset with some fixed ideas		
Post Score	56	60-45 points = strong growth mindset		
Teacher 2				
Pre Score	36	44-34 points = growth mindset with some fixed ideas		
Post Score	49	60-45 points = strong growth mindset		
Pre-Post			1.00	0.000

Based on the Teacher Mindset Survey scoring system, Mrs. Jones entered the study with a slightly higher growth mindset than Mrs. Dill; however, both teachers brought with them elements of a fixed mindset according to the scoring guide. Both teachers scored higher on the post-administration of the survey and both scored into the next reporting category of Strong Growth Mindset. The pre/post test correlation is a perfect 1.00 with $p = 0.00$ indicating that the change is statistically significant or that their participation in the intervention improved their own mindsets. The quantitative results indicate that the intervention had a positive effect on both teachers' mindsets as they scored into the 'Strong Growth Mindset' reporting category on the post-survey.

Pre-Post Interviews

In addition to collecting the quantitative data, I also collected qualitative data for this research question including a pre- and post-interview (See Appendix C) with each of the participating teachers along with regular discussions of the book's content either in person or through a Google document. I followed Srivastava and Thomason's (2009) framework for qualitative data analysis. This framework for analysis is very user-friendly and allows the researcher to begin the process a soon as she begins collecting the data. The steps include: familiarization, identifying thematic framework, indexing, charting, and mapping and interpretation as explained in detail in Chapter 3.

I will present three sections of qualitative data and analysis. In the first section, I begin with the data and analysis from Mrs. Jones' pre/post interview followed by section the data and analysis from Mrs. Dill's two interviews. The last section presents the data and analysis from the book study discussions.

Mrs. Jones pre/post interview. Mrs. Jones and I agreed to the date of September 18, 2019 for our pre-interview my office. She asked me the day prior if she could review the questions before the interview and I did allow that as she indicated it would make her more comfortable. Before we got started, I showed her the app on my phone that I would be using to record our interview. I pushed record and did a test recording of only my voice and played it back for her so she could hear how it would turn out. I then pushed record again and asked her on record if she was ok with me recording our conversation; she said yes.

The semi-structured interview consisted of eight questions (See Appendix C) all related to growth versus fixed mindset of teacher/student, self-efficacy, what teachers

see/hear in their classrooms, motivation techniques, best instructional practices and thoughts on need for the intervention. I used Srivastava and Thompson's (2009) guide for analysis of the qualitative data and began familiarizing myself with the data as soon as it was transcribed and approved by the teacher for use in the study. I spent hours reading and rereading the questions and responses in order to identify themes. I looked very closely at the semantic structure of their responses including subjects, verbs and adjectives to identify themes. I completed Step 3, Indexing, while I was identifying the themes. Indexing refers to identifying the corresponding text to support the themes. From these two steps, I moved to charting the themes according to the questions asked during the interview in order to identify the key characteristics by question from the pre interview to the post interview.

There were distinct shifts in Mrs. Jones' thinking as reported through her pre/post interviews over the course of the intervention. During the pre-interview, she expressed a very basic understanding of mindset stating that is was something that needed to be there at birth. She had no understanding of self-efficacy and then after I provided a basic description she responded that this was something again based on home life. She structured part of one her responses around the teacher to allowing growth mindset in students. Mrs. Jones also repeatedly weaved student home life, home situation, lack of home support into her response to several of the questions. For example Mrs. Jones stated:

> So as far as what I see in my third-grade students in terms of this (self-efficacy), I think it's a combination of both (home and school).

> I see depending on the child's environment and how they're raised, I see a lot of that. I also feel that it's sort of something that is there at birth. If the parents believe and they are confident and they push these issues at home then the kids tend to exude that, whereas when a student come from a home that even the parents lack that, they don't
>
> believe that they're good at something or they are not highly motivated. It definitely ripples off into their children and that comes through then in the classroom and sports. Because it goes back to again the home environment.

Mrs. Jones projected a good bit of the ownership of student thinking and performance onto their upbringing and parent motivation. There was little-to-no teacher ownership expressed on her part. Analysis of her pre-interview responses revealed her having a more literal definition of growth mindset in that she always believes her students can grow in knowledge over the course of the year but so much of that is dependent on what they have at home. In response to the question about motivating students about learning math, she described in detail how she feels building relationships with her students and allowing them to see her investment in them are key factor in motivating them in her class. This response along with her response of "modeling, modeling, modeling" to the question about her best instructional practices reflected as Mrs. Jones' responses on to the pre-survey questions aligned with her score 41 on the Teacher Mindset Pre-Assessment which placed her into the category of a growth mindset with some fixed traits.

There was a distinct increase in post-survey score 56 that is also seen in the post interview question responses. Instead of bringing the students' home situation into nearly

every response, Mrs. Jones weaves herself and the students into the responses and acknowledges a shared ownership between teacher and student:

> I can either be huge instrumentally as an educator with growth mindset, or how I could also play an instrumental part in having a fixed mindset within my classroom. I didn't realize the impact, as a teacher, that I can either have a fixed mindset within my room or a growth mindset. I think it was a belief that I initially though students believed it themselves, either believed one way or the other. But now, I feel it's a combination of teacher and students creating the mindsets. I t is the individual's belief in their ability to achieve goals.

Mrs. Jones did not mention the students' home life, lack of home support, one time in the course of the post-interview. All statements were teacher and student related with many "I" and "we" pronoun use. From this, I assert that by her own reporting, over the course of the study, she embraced the ownership she has in affecting student self-efficacy and mindset regardless of what happens in the students' upbringing. The post-interview data analysis confirms the increase Mrs. Jones experienced on the post Teacher Mindset Survey where she scored into the Strong Growth Mindset category.

Mrs. Dill pre/post interview. Teacher 2 and I agreed to complete the pre-survey on September 5, 2018 in my office at ES. The day prior this teacher also asked me for a copy questions. I did allow that as she indicated it would make her more comfortable and I had provided a copy to Mrs. Jones. Before we got started, she expressed nervousness about being recorded. I showed her the app that I would be using to record our interview; I then did a practice run where I recorded a test sentence and played it back to her. She still appeared nervous so I assured her we did not have to continue, however, she

indicated she wanted to. I proceeded to push record and asked her on record if she was ok with me recording our conversation; she said yes. I placed the phone out of her view in attempt to ease her anxiety about being recorded. Upon her approval of the transcribed interview, I followed the same process as I did in analyzing Mrs. Jones' interview data.

As I discovered in the analysis of Mrs. Jones' pre and post interviews, there was another distinct shift in thinking and responses to all interview questions as reported by Mrs. Dill from pre to post interview. The pre interview responses were short and to the point despite mild prompts and encouragement to expand or add to a response; I believe nerves played a role in the short responses. Despite the length of answers, Mrs. Dill's pre interview was in line with her pre Teacher Mindset Survey where she scored into the category of Growth Mindset with some Fixed Ideas. Mrs. Dill's responses to the pre-interview questions were student focused with only one reference to parent influence.

Mrs. Dill Pre-Interview:

> I do hear students saying that "my mom or dad was bad at math, so I'm going to be bad at math." Or this Common Core – a lot of parents and then the student repeat it, but the Common Core is a big, "Oh, we can't do that math. It's new math." So I do hear a lot of that. Whenever something is a little bit challenging or difficult, a lot of the student will just shut down and not even try. And getting them to even try at first is an issue that we have. I feel all students have the ability to learn. Some learn quicker. Some learn slower. Some need a different method of learning whether it the hands-on or visual or auditory, but all students can learn.

Mrs. Dill blossomed with excitement in the post-interview responses. Her body language and voice tone all indicated a definite change in thinking and even a more relaxed

demeanor. Where her pre-interview questions were student focused, many of her post-interview responses highlighted student and teacher ownership.

Mrs. Dill Post-Interview:

> I have seen some change in some students. I'd say a medium change. They're actually believing that they can do it. They more positive. Willing to make mistakes because we've been stressing that you learn from your mistakes and it's okay. Overall, I mean, I do see a lot of the students believing in themselves. Believing that they can do it. They're willing to try it before they're raising their hand asking for help. They feel like they can do it.

Perhaps one of the most telling example of a mindset shift is the following revelation from Mrs. Dill:

> I always thought that intelligence, you can't change it- it is what it is. And reading that book and discussing that through practice and perseverance, through all that, I think you can change, but you have to have the inner drive, I think, to do that. And I've sort of seen that firsthand with one of my students. She was diagnosed with a 72 IQ and immediately I thought, 'Okay, she's not going to be able to go this far.' And she totally outshined what we were doing in third grade. She tried that math chamber about ten times until she accomplished it. And she worked and she studied so hard. She did it. And I would have thought she was never going to be able to. I'm not going to put that expectation on them just by IQ alone anymore because they can do it.

Mrs. Dill's positive change in the Teacher Mindset Survey along with the dramatic shifts she reported from pre to post interview confirm that the Growth Mindset intervention

positively affected her thinking and practice that she plans to make permanent part of her teaching practice. As an experienced learning support teacher, this change in thinking has abundant potential to impact students in a way she experienced with the student she referenced. While I am certain Mrs. Dill is aware that students are much more than their IQ number, she needed this first-hand experience to accept that there are additional modifications and accommodations to student mindset that can dramatically impact student thinking and achievement. She will no longer look at IQ as a limiting factor in teacher expectations for this student's math performance.

Interpretation of pre/post interview analysis. Both Mrs. Jones and Mrs. Dill revealed in the post-interviews the impact that the teacher and her beliefs and practices can have on students on their performance or lack thereof in class. It is understandable that after twenty years of teaching, they could become caught up in placing too much ownership of the students' classroom performance on outside factors such as home life. With shows they are open to growth in their practice.

Book Study Discussions

For the discussion of Chapter 1 "The Brain and Mathematics Learning", the three of us met in my school office. I did not provide any prior framework for this discussion; we each entered the discussion with points self-selected bring up in discussion. For the remainder of the chapters, I provided some guiding questions or requested feedback on specific passages along with having teachers highlight what they felt was relative to the discussion.

I recorded discussions and transcribed it immediately following the discussion. I returned all text to the teachers for validation and permission to use. For the online

document discussion of chapters, I created a Google document with guiding questions and pointed out quotations and concepts for their response. Each teacher responded in a different color type text. Once we completed the book study discussions, I again followed the Srivastava & Thompson (2009) Framework for Qualitative data analysis: familiarization, identifying a thematic framework, indexing, charting and interpretation. I began familiarization as each of the chapter discussions were transcribed and approved for use by the teachers, but I waited until the completion of the book study for the other steps. Much like the process I followed with the interview data, I proceeded through steps two, three and four with the outcome of Table 11 which highlights the themes or major take-aways that the teachers had about each chapter of the book from which I based my analysis upon.

Table 11

Themes by Chapter of Teacher Book Discussion

Chapter	Themes: Major Take-Away
1: The Brain and Mathematics Learning	Teachers unintentionally decide who can and can't do math; we unknowingly self-sabotage; let backgrounds (students') influence of teaching; teacher mindset will influence classroom; positive praise works with correct phrasing.
2. The Power of Mistakes and Struggle	Move away from training our teacher brains to value correct work less and mistakes more; years of students erasing work could indicate fixed mindset-don't want teacher to see mistakes; change the way we award points;
3. Creativity and the Beauty of Mathematics	Students more interested in process when they can relate; math not dead subject at elementary; many opportunities to share beauty of everyday use; too much focus on always being correct; Misconception: fast in math is good and slow is not smart.
4. Creating Mathematical	Use discovery as an approach for students to explore mathematical relationships; student need to take risks, explore, ask questions and

Mindsets; The Importance Of Flexibility with Numbers	make sense of; students need to see connections between concepts To gain number sense; number sense lacking. gain number sense; number sense lacking
5. Rich Mathematical Tasks	Need as many opportunities for real-world math experiences; all classroom need to create more real-world experiences.
6. Mathematics and the Path to Equity	Homework does cause inequity; releasing traditional beliefs regarding homework
7. From Tracking to Growth Mindset Grouping	De-tracking removes limits for all students; heterogeneous grouping supports growth mindset
8. Assessment for a Growth Mindset	Goal setting with students builds self-awareness; already implementing many suggested strategies
9. Teaching Mathematics for a Growth Mindset	Free students from notion that failure and messing up prevents them from being good at math; using many of suggestions already

The themes from the book study discussions were all confirmations of or general agreement with the content the author presented. There was wide-spread agreement by the teachers that they were already implementing many of the suggested strategies to some degree and this was confirmed when I matched the actual text to the themes I identified through the process of the indexing step of analysis.

My overarching interpretation of the chapter discussions is that the two teachers were open to the content presented in the chapter and they were generally in agreement with at least trying out the suggestions made by the author. Analysis of the book discussion text alone did not reveal any change in teacher thinking; the changes were revealed through the post-interviews and side conversations we had in passing.

At this point, it is crucial to share from my own personal field notes in order to see the true transformation particularly relating to the two teachers. Prior to book discussion and based on my knowledge of the content and the teachers whom I have known for 10 years, I wrote reflections about each teacher:

> Mrs. Jones has been a long-time proponent of homogenous grouping; she advocates yearly for this grouping: she not only assigns daily homework, but also daily opportunities for extra-practice worksheets for "tickets" the class currency; long-time proponent of timed tests; promotes timed "Multiplication Chamber' where every student is encouraged to take chances at answering 120 multiplication problems in under twenty minutes with 100% accuracy-she is going to be extremely reluctant to give this up as speed and mastery are important to her; she prides herself in her push to promote master of multiplication.
>
> Mrs. Dill is a learning support teacher who is dedicated to her students experiencing some sort of success; she is not a proponent of timed tests, strong advocate for her students; respectful of her place as co-teacher.

At the completion of the study, I revisited my reflections and predictions and noted several important changes. Mrs. Jones has not only embraced heterogeneous grouping, but she is now a voice advocating for it among other grade levels. In addition, she has let go of the need to have daily homework and released the push for students to take the extra-practice worksheets in exchange for tickets from her classroom currency as she recognizes the inequities they create. Perhaps the most significant change to Mrs. Jones' classroom practice is the changes she incorporated into her Multiplication Chamber. She eliminated the timed component of the Multiplication Chamber and now more students

are taking chances at “beating the chamber”. In a personal communication she granted me permission to share, she revealed:

> After more study of growth mindset, I realized that the loved Math Chamber was actually doing more harm than good for my students. My Math Chamber was really just reminding those students who had a fixed mindset that once again it would be an impossible goal for them to accomplish with time requirements and a large number of problems, this just spelled failure for my already defeated students. It was glaring after reading the research what I needed to do in order to create that growth mindset within my classroom. Change!!!! I needed Change! With a few simple modifications the Math Chamber was reborn. After those were made to the Math Chamber” time restraints removed and fewer problems, I am proud to say that to date 53 OF 59, third- grade students have attempted the “CHAMBER” and are getting closer everyday and 26 of 59 BEAT the “CHAMBER”. The remaining 6 students are very ready they just said they need a little more time.
>
> I feel very confident that this year I will have the largest number of students in third- Grade that have either attempted or BEAT the “CHAMBER” . I feel having a “GROWTH MINDSET” in my classroom and impressing that upon my students has made a huge difference this year. Many students have had their moment and some are still …… “NOT YET” but…. I believe that we as educators have a GIFT to make a huge impact on every single student we come in contact with. Something as simple as the POWER of YET / NOT YET.

As for my reflection/predictions related to Mrs. Dill, I was a bit surprised by her revelation about her expectations tied to the students IQ and highly encouraged by her releasing that notion.

Interpretation

Through both quantitative and qualitative data collection and analysis, I explored how and to what extent the growth mindset intervention affected the teachers' mindsets. The change in both teachers' mindset and their approaches to teaching of math as reported by them in their interviews reflect a self-reported transformation, a paradigm shift. Long held beliefs, like homework is a mush and practices such as ability grouping were released by experienced teachers in exchange for the opportunity to transform student beliefs and practices. Both teachers improved their overall scores on the Teacher Growth Mindset Survey indicating a stronger growth mindset. While the statistical analysis did not support making the assertion that the intervention caused the change in thinking and practice, I believe the qualitative data supports the assertion that the intervention did, in fact, start the beginnings of a paradigm shift both teachers experienced as recorded by their own descriptions in the interviews. Their deeply personal revelations are the strongest testament to their new ways of thinking. Even though both Mrs. Jones and Mrs. Dill were experienced and dedicated teachers, they were open to the possibilities of putting research into practice in their classroom. In the matter of a semester of personalized study of math teaching practices, they demonstrated the power of retraining their thinking about math mindset in order to affect change in students' mindsets. Their new growth mindset thinking has empowered them take risks

by releasing long-held beliefs simply because it would be the easiest path because it is what we have always done.

Implementing a Growth Mindset Intervention in third- grade math Affected Students' Math Self-Efficacy

To address the research question, How and to what extent does implementing the growth mindset intervention affect students' math self-efficacy? I collected quantitative data. I administered the *I Believe I Can Try* math-self efficacy pre/post survey (See Appendix A). I present the results from the quantitative data beginning with the presentation of results followed by the data analyses.

The *I Believe I Can Try* self-efficacy survey presented students with fifteen statements related to self-efficacy and the three sub-constructs of setting goals, tasks and challenges. I designed this survey and therefore needed to examine its reliability. Reliability refers to the, "Consistency of the scores obtained-how consistent they are for each individual from one administration of an instrument to another and from one set of items to another" (Fraenkel & Wallen, 2005, p. 160). I used SPSS Version 23 to calculate Cronbach's alpha as represented by (α) because the survey was a matched pre- and post-test survey: the same students took both administrations of the survey. Table 12 displays the reliability results.

Table 12

*Chronbach's Alpha (*α*) for Self-efficacy Sub-construct Pre and Post Survey Administration* (n=53)

Construct	Item #s	Pre α	Post α
Self-efficacy and goals	1-5	0.565	0.78
Self-efficacy and tasks	6-10	0.456	0.563

Self-efficacy and challenges	11-15	0.565	0.646

An alpha score of 0.70 is generally known as the acceptable level of reliability when considering an instrument for use in collecting data (Fraenkel & Wallen, 2005). However, Dr. Sloat (2017) stated that reliability is dependent on context, construct and consequence of the data for example, no high-stakes or life-altering decisions were being considered as a result of the data collected from this self-efficacy survey; therefore the researcher can use a tool with less than the .70 alpha. One way to improve reliability of in instrument is to increase the number of items (Tavakol & Dennick, 2011). With this in mind, I heavily considered the age of the respondents which was nine and ten years and their ability to attend to tasks. The alpha score improved from pre-survey to post-survey, a factor that could be contributed to the age of the students and their understanding of the concepts in two different time periods: pre/post survey. These students had little exposure to the concept of growth mindset so the teachers were tasked with building that knowledge which started during our co-taught introductory lesson at the beginning of the study. The higher post-survey alpha score indicates a better understanding of the concepts presented.

In order to determine if the difference in mean scores between the pre and post intervention survey scores could be contributed to the Growth Mindset intervention, I conduced a paired sample t-test (see Table 13).

Table 13

Paired Sample T-Test for Pre and Post Self-efficacy Survey

Administration	Mean	SD	t	df	p
Pre Score	61.5	6.6			
Post Score	69.1	5.8			
			-9.40	52	0.000

As displayed in Table 13, the results show the mean score on the post survey (M=69.1, SD = 5.8) is higher than the mean score on the pre intervention survey (M = 61.5, SD = 6.6). The similar SD scores show that there was a relatively close distribution of scores on pre and post administrations. The t-test found this difference to be significant, t (52) = -9.40, $p < 0.000$. The increase in the mean score together with $p < 0.000$, suggests that the growth mindset intervention had a positive impact on the students.

I framed all fifteen statements in the positive self-efficacy context framed in an 'I can' statement reflecting the respondent's self-belief related to each sub-construct (See Table 15). I converted the responses to the numerical values for the purpose of data analysis. I assigned numbers to the values on a scale of 1-5 with 5 being strongly agree and 1 being strong disagree. Therefore, a total score of 75 indicated high self-efficacy in each of the three constructs. The lower the overall score, the less self-efficacy reported by the student. I used the program Statistical Package for the Social Science (SPSS) software to run all statistical analysis on the data. Table 14 presents the descriptive statistics for the 52 students who completed both the pre and post survey including the mean, standard deviation, correlation and p value.

Table 14

Descriptive Statistics for Pre and Post Self-efficacy Survey

n=52

Administration	Mean	Standard Deviation	Correlation	p
Pre Score	61.60	6.62		
Post Score	69.00	5.86		
Pre-Post			.56	0.000

As Table 14 indicates, the overall Pre-Score Mean was 61.60 out of 75 points. This indicates that the third-grade students responded with fairly strong self-efficacy in math and the three sub-constructs of setting goals, tasks and challenges. The SD of 6.62 indicates the overall mean scores were slightly spread out from the mean so there were a variety of response by the student. The post-score mean of 69 shows an increase in student reported self-efficacy and the same three sub-constructs. The SD decreased from a 6.62 to a 5.86 showing the post scores were a slightly closer to the overall mean score. The correlation of 0.56 indicates a strong correlation between the pre and post scores.

In order to examine this pre and post survey data further, I used the SPSS software to calculate the mean and standard deviation of each of items from the three sub-constructs within the survey. As I stated earlier, I converted the Likert items to numeric values in order to use the SPSS software: Strongly Agree equaled five points, Agree equaled four points, Sometimes equaled three points, Disagree equaled two points, and Strongly Disagree equaled one point. Table 15 presents those results.

Table 15

n=53

Descriptive Statistics for Student Self-efficacy Survey by Sub-Construct

	Pre Score		Post Score	
	M	SD	M	SD
Sub-Construct: Self -efficacy and Setting Goals				
1. Planning new way to solve math problem	4.17	.86	4.77	.70
2. Try a new way to solve math problem	4.28	.71	4.83	.43
3. I can set goals for myself	4.72	.56	4.85	.36
4. Set a goal to do better when not doing best	4.23	.82	4.66	.65
5. I can work toward goal I set in math	4.43	.84	4.81	.56
Sub-Construct: Self-efficacy and Tasks				

6. Recognize when math problem is difficult	4.21	.90	4.54	.75
7. Stick with hard math problem	4.06	.84	4.30	.97
8. Complete math homework by myself	3.58	.91	4.32	.94
9. Complete math test by myself	4.21	.93	4.64	.71
10. Solve math review problem with little help	4.09	.71	4.45	.88
Sub-Construct: Self-efficacy and Challenges				
11. Keep trying when frustrated	4.36	.81	4.66	.55
12. Use strategies to solve hard math	4.38	.79	4.74	.62
13. Complete hard math homework by myself	3.43	.91	4.35	.79
14. Complete hard math test by myself	3.68	1.17	4.54	.72
15. Try challenge question in math	4.42	.63	4.72	.69

Student mean scores for all fifteen statement responses increased from pre to post intervention and all post scores were greater than four indicating strong self-efficacy. Statement two "I can try a new way to solve a math problem when my first try does not work." and statement three "I can set goals for myself." had highest mean scores in post results. While no pre survey mean score was below 3.43, the increase in scores and the overall decrease in standard deviation indicates a high sense of self-efficacy among the 53 students with little variance in their responses.

These next three tables present the survey response frequencies for each of the self-efficacy sub-constructs. Table 16 presents the self-efficacy and setting goals frequencies based on a five-point Likert scale.

Table 16

(n=53)

Response Frequencies for Self-efficacy Survey Setting Goals Sub-Constructs by Percent

Item	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
Self-efficacy and Setting Goals					

1.	Pre Score	43%	34%		19%	4%	n/a
		n=23	n=18		n=10	n=2	
	Post Score	87%	8%	4%	n/a	2%	
		n=46	n=4	n=2		n=1	
2.	Pre Score	43%	42%		15%	n/a	n/a
		n=23	n=22		n=8		
	Post Score	85%	13%		2%	n/a	n/a
		n=45	n=7		n=1		
3.	Pre Score	77%	17%		6%	n/a	n/a
		n=41	n=9		n=3		
	Post Score	85%	15%		n/a	n/a	n/a
		n=45	n=8				
4.	Pre Score	45%	34%		19%	2%	n/a
		n=24	n=18		n=10	n=1	
Post Score		76%	15%		10%	n/a	n/a
		n=40	n=8		n=5		
5.	Pre Score	60%	26%		11%	2%	n/a
		n=32	n=14		n=6	n=1	
	Post Score	87%	9%		2%	2%	n/a
		n=46	n=5		n=1	n=1	

The post survey results show that at least 75% of all students responded with Strongly Agree to each of the five statements regarding self-efficacy and setting goals. The number of Sometimes responses from pre to post survey decreased by at least 50%, and there was no increase in the Disagree or Strongly Disagree. These results also indicate a trend of the Sometimes responses changing to either Agree or Strongly Agree. Initially, students reported a high sense of self-efficacy and setting goals. By the end of the intervention, the students reported an even strong sense of self-efficacy and goal setting.

Table 17 displays the results of the self-efficacy and tasks sub-construct frequency of responses based on the same five-point Likert scale.

Table 17

n=53

Response Frequencies for Self-efficacy Survey Tasks Sub-Constructs by Percent

Item		Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
Self-efficacy and Tasks						
6.	Pre Score	45%	36%	15%	2%	2%
		n=24	n=19	n=8	n=1	n=1
	Post Score	67%	21%	9%	2%	n/a
		n=36	n=11	n=5	n=1	
7.	Pre Score	36%	36%	26%	2%	n/a
		n=19	n=19	n=14	n=1	
	Post Score	56%	25%	13%	4%	2%
		n=30	n=13	n=7	n=2	n=1
8.	Pre Score	21%	23%	53%	2%	2%
		n=11	n=12	n=28	n=1	n=1
	Post Score	56%	19%	21%	n/a	2%
		n=31	n=10	n=11		n=1
9.	Pre Score	49%	26%	23%	n/a	2%
		n=26	n=14	n=12		n=1
	Post Score	76%	15%	8%	2%	n/a
		n=40	n=8	n=4	n=1	
10.	Pre Score	30%	49%	21%	n/a	n/a
		n=16	n=26	n=11		
	Post Score	64%	21%	13%	n/a	2%
		n=34	n=11	n=7		n=1

The most dramatic change in this sub-construct occurred with statement eight, *I can complete math homework by myself.* Initially, 30 of the 53 student participants responded

with sometimes disagree or agree with 28 in the sometimes category. Post intervention, that total number of students responding with sometimes or strongly disagree decreased to 11 with only one student response in the strongly disagree category. In the post survey responses, 31 students responded with strongly agree and ten responded with agree. This change from pre to post survey responses shows that students developed a stronger sense of self-efficacy in their ability to complete homework independently which is exactly what homework is meant to be: independent practice.

Finally, Table 18 displays the frequency results of the self-efficacy and challenges sub-construct using the same five-point Likert Scale.

Table 18

n=53

Response Frequencies for Self-Efficacy Survey Challenges Sub-Constructs by Percent

Item	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
Self-efficacy and Challenges					
11. Pre Score	57%	22%	21%	n/a	n/a
	n=30	n=12	n=11		
Post Score	70%	26%	4%	n/a	n/a
	n=37	n=14	n=2		
12. Pre Score	55%	30%	13%	2%	n/a
	n=29	n=16	n=7	n=1	
Post Score	83%	7%	9%	n/a	n/a
	n=44	n=4	n=5		
13. Pre Score	11%	34%	45%	6%	4%
	n=6	n=18	n=24	n=3	n=2
Post Score	55%	26%	19%	n/a	n/a
	n=29	n=14	n=10		

14. Pre Score	26%	36%	26%	2%	9%
	n=14	n=19	n=14	n=1	n=5
Post Score	68%	19%	13%	n/a	n/a
	n=36	n=10	n=7		
15. Pre Score	49%	43%	8%	n/a	n/a
	n=26	n=23	n=4		
Post Score	79%	17%	2%	n/a	2%
	n=42	n=9	n=1		n=1

Overall, frequencies for strongly agree and agree were consistently on the high end of the pre survey with each seeing even higher frequencies in the post survey. The frequency of the sometimes response decreased from pre to post survey with nearly all changes going in the positive direction; however, there were still ten students who responded sometimes to statement thirteen, *I can complete my math homework by myself even if I think it is hard.* As with statement eight from the previous table, the frequency of responses to statement 13 saw an increase in positive responses. The trends to the positive responses to both statements related to homework indicates that students' self-belief in completing homework has improved.

Interpretation

In response to the question, how and to what extent does the intervention affect student self-efficacy, the data analysis supports the assertion that the intervention had a positive impact on student math self-efficacy. The pre survey results indicated a fairly strong sense of self-efficacy amongst the third- grade students; however, there was an increase in mean scores from pre to post intervention survey administration. The paired sample t-test found the mean difference to be significant with p =0.000; I can assert that the Growth Mindset intervention positively affected students' self-efficacy for math.

The Growth Mindset Intervention Affected third- Grade Math Students' Mindsets.

To answer the research question about how and to what extent does implementing the growth mindset intervention affect students' mindset, I administered a pre and post growth mindset survey to the students. (See Appendix B)

The student mindset survey presented the students with ten statements related to growth mindset thinking. I framed five of the statements in the fixed mindset context and I framed five of the statements in the growth mindset context. An overall score of 50 was the maximum score which indicates the strongest growth mindset beliefs. Table 19 presents the reliability results calculated using SPSS Version 23 for Cronbach's Alpha. Included are the alpha scores for both the pre and post administration.

Table 19

Student Mindset Survey Pre and Post Cronbach's Alpha

n=56	
Pre Score	$\alpha = 0.530$
Post Score	$\alpha = 0.700$

Similar to the self-efficacy survey, I weighed the decisions I would make based on the results and none were life-altering; therefore, given that and the age of the respondents, I accepted the pre score of 0.530 as acceptable for this process. The post score of 0.700 is the generally accepted reliable alpha score. I also believe that given the age of the students, they likely had little-to-no experience in third grade yet and no prior knowledge related to mindset. I think the stronger alpha score on the post survey results supports the assertion that students' mindsets changed over time with exposure to the teaching practices and maturing in a new grade level.

All ten of the survey statements were aimed at measuring the construct of growth mindset. However, in order to increase the construct validity, I framed the statements in two different contexts: growth and fixed. I framed statements one, two, six, seven and ten on the Growth Mindset Student Survey in a fixed mindset context. For these statements, I converted the Likert Scale responses to numbers in order to run statistical analysis. I converted the responses to the numerical values for the purpose of data analysis. I assigned numbers to the values on a scale of 1-5 with 5 being strongly disagree and 1 being strongly disagree. The lower the score on these five statements indicates strong growth mindset because the are stated in a fixed mindset belief. Twenty-five was the maximum score.

I framed statements three, four, five, eight and nine on the Growth Mindset Survey in a growth mindset context. Again, I converted the Likert Scale responses to numerical values in order to run statistical analysis. I assigned numbers to the values on a scale of 1-5 with 5 being strongly agree and 1 being strong disagree. For these statements, the higher score indicated strong growth mindset beliefs with a score of 25 being the maximum. Table 20 presents the descriptive statistics for the Student Mindset Survey pre and post administration.

Table 20

n=56

Descriptive Statistics for Pre and Post Growth Mindset Survey

Administration	Mean	Standard Deviation	Correlation	p
Pre-survey	36	5.3		
Post-survey	41	5.4		
			0.540	0.00

Table 20 conveys the overall Pre-test Score Mean was 36 out of 50 points. This indicates that the third-grade students responded with an idea of growth mindset but not what could be considered strong growth mindset in math. The post score mean of 41 shows a five point increase in student reported math growth mindset thinking. The SD increased to a 5.4 showing a very similar distribution of scores as the pre survey with SD 5.3. The correlation of 0.54 is relatively strong and p at 0.00 indicates statistically significant change from pre to post score results.

Table 21 displays the frequency of responses for the five statements framed in the fixed mindset context.

Table 21

n=56

Survey Response Frequencies for Fixed Mindset Statements (Q1, 2, 6, 7 and 10)

Item	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
S1 I possess a certain amount of math ability, and I can't do much to change it.					
Pre Score	16% n=9	23% n=13	20% n=11	14% n=8	27% n=15
Post Score	13% n=7	16% n=9	11% n=6	5% n=3	55% n=31
S2: Some students are just good at math.					
Pre Score	48% n=27	29% n=16	18% n=10	2% n=1	4% n=2
Post Score	30% n=17	27% n=15	27% n=15	11% n=6	5% n=3
S6: In math, it is important to avoid making mistakes.					
Pre Score	18% n=10	27% n=15	23% n=13	26% n=15	5% n=3
Post Score	7% n=4	9% n=5	5% n=3	25% n=14	54% n=30

S7: I like math work I can do without too much thought.						
Pre Score	29% n=16	27% n=15	11% n=6	11% n=6	23% n=13	
Post Score	13% n=7	13% n=7	23% n=13	27% n=15	25% n=14	
S10: There is only one way to solve a math problem.						
Pre Score	12% n=7	7% n=4	11% n=6	20% n=11	50% n=28	
Post Score	n/a	5% n=3	4% n=2	11% n=6	80% n=45	

High frequencies of student responses in the Strongly Disagree and Disagree categories indicates growth mindset thinking since these statements were framed as fixed mindset statements. More specifically, the change in frequency from pre to post survey administration on statement one, *I possess a certain amount of math ability*, and *I can't do much to change it,* supports one of the main tenants of growth mindset thinking: intelligence is not fixed. Consequently, the lack of change in frequency in statement two, *Some students are just good at math* could indicate the fixed mindset context may be too confusing for students in this age group.

Table 22 displays the frequency of responses for the five statements frame in the growth mindset context.

Table 22

n=56

Survey Response Frequencies for Growth Mindset Statements (S 3, 4, 5, 8 and 9)

Item	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
S3: I think I am good at math.					
Pre Score	2% n=1	39% n=22	41% n=23	14% n=8	4% n=2
Post Score	42% n=23	43% n=24	11% n=6	n/a	5% n=3
S4: I can be good at math if I work hard at it.					
Pre Score	68% n=38	27% n=15	5% n=3	n/a	n/a
Post Score	86% n=48	11% n=6	2% n=1	2% n=1	n/a
S5: Mistakes in math help me learn.					
Pre Score	38% n=21	38% n=21	13% n=7	4% n=2	9% n=5
Post Score	71%	20% n=40	5% n=11	2% n=3	2% n=1
S8: When a math problem is hard, it makes me want to work harder.					
Pre Score	57% n=32	29% n=16	11% n=6	2% n=1	2% n=1
Post Score	50% n=28	30% n=17	16% n=9	2% n=1	2% n=1
S9: If I work hard, I will do well in math.					
Pre Score	71% n=40	25% n=14	2% n=1	2% n=1	n/a
Post Score	86% n=48	13% n=7	n/a	n/a	2% n=1

Student response frequencies were noticeably higher for the statements presented in the growth context. In the pre survey, only one student responded Strongly Agree to the statement *I think I am good at math*. This increased to twenty-three students in the

post survey. Additionally, in response to statement seven, *I like math work I can do without too much thought*, the increase of students responding with either Disagree or Strongly disagree from pre-survey (n=19) to post-survey (n=29) shows students are more accepting of a challenge which could possibly be attributed to strong growth mindset thinking.

Table 23 represents the paired sample t-test I conducted to compare the mean Scores of the growth mindset survey before and after the growth mindset intervention.

Table # 23

Paired Sample T-Test for Pre and Post Growth Mindset Survey Score

Administration	Mean	SD	t	df	p
Pre Score	36	5.3			
Post Score	41	5.4			
			-6.90	55	0.000

Results showed the scores on the post survey (M=41, SD = 5.43) higher than those on the pre intervention survey (M = 36, SD = 5.30). The similar SD scores show that there was a relatively close distribution of scores on pre and post administrations. The t-test found this difference to be significant, $t(55) = -6.90$, $p < 0.000$. The increase in the mean score together with $p < 0.000$, suggest that the growth mindset intervention had a positive impact on the students.

Interpretation

In response to the research question, How and to what extent does the growth mindset intervention have on student mindset?, the data analysis indicates that the intervention had a positive impact on student mindset thinking. The pre survey results indicated some sense of growth mindset already in existence in the third- grade students. The post survey responses show a small increase in mean scores from pre to post

administration. The paired sample t-test found the mean difference to be significant with p =0.000; based on this, I can again assert that the Growth Mindset intervention had a positive impact on student mindset.

Implementing a Growth Mindset Intervention in third- Grade Math Did Not Improve Students' Academic Performance.

To answer the research question, how and to what extent does implementing the growth mindset intervention improve students' academic achievement, I collected two sources of student achievement data. Over the course of my study, I collected student scores on the spiral reviews given by the teacher roughly every two weeks. Prior to beginning this data collection, I randomly selected five students from each homeroom to follow. I randomly selected the students by pulling numbered sticks from a can. Each number corresponded to a student number. I selected the five numbered sticks for the first class, Mrs. Jones selected the five numbered sticks for the second class and Mrs. Dill selected the numbered sticks for the third class. I then matched the numbers to the corresponding students and collected the scores from the grading program Powerschool©. Table 24 presents the percent scores for the spiral reviews over the course of the study.

Table 24

Student Performance on Spiral Reviews by Percent (%)

Student#	Gender	#1	#2	#3	#4	#5	#6	#7
Section 1								
312	M	100	93	100	100	100	100	100
316	M	86	80	100	75	40	69	50
319	F	92	73	100	75	80	74	70
3111	F	100	93	100	95	100	100	93
3117	M	100	93	100	90	100	100	93
*Section 2**								
322	F	76	45	96	85	50	66	67
325	F	97	45	92	95	90	97	87
3212	F	97	93	100	100	100	100	90
3215	M	97	73	100	100	100	91	87
3219	F	95	93	100	90	80	100	90
Section 3								
335	M	97	93	100	90	90	100	97
338	M	79	100	100	90	40	80	80
339	F	89	80	100	80	40	100	77
3315	F	92	80	100	90	50	100	77
3317	F	86	100	100	80	70	77	80

* Co-taught Classroom

The spiral review data do not show any consistent trends in improvement over the course of the intervention. Students who scored well, did so throughout the entire intervention with a few exceptions on Spiral Review #5. Upon further investigation, this spiral review was on addition and subtraction because the teacher noticed some students were becoming lazy with addition and subtraction facts and missing more of these problems as the semester continued. This spiral review did not follow the pattern of typically planned reviews. Regardless, this achievement data does not support that the Growth Mindset intervention had any impact on student achievement over the course of the study as there were not significant improvement trends among these fifteen students. The trends were students either did very well throughout or did ok throughout. Since this was only one piece of classroom performance data, I collected a second source.

The second data source I collected to examine the effect of the growth mindset intervention on student academic performance was the scores from the 2018-19 Beginning-of-Year (BOY) and Middle-of-Year (MOY) Classroom Diagnostic Test (CDT) administrations (n=52). I also collected the same data set from the 2017-18 CDT administrations (n=50). The 2017-18 students had the same two teachers for instruction using the same core curriculum of My Math©. However, the 2017-18 students did not receive the growth mindset intervention.

Table 25 presents the 2018-19 overall student mean scores as well as the mean scores for each of the four math reporting categories (RC), #1 Numbers and Operations, #2 Algebraic Concepts, #3 Geometry and #4 Measurement, Data and Probability for the BOY and the MOY administrations of the CDT.

Table 25

n=52

Mean Scores for 2018-19 BOY and MOY CDT Test Administrations

	Over All Mean	RC#1 Mean	RC#2 Mean	RC#3 Mean	RC#4 Mean
BOY	665	661	701	628	660
MOY	770	762	792	733	783

The 2018-19 CDT results show growth in the overall score as well as the four reporting categories.

Table 26 displays the student performance results from the 2017-18 CDT administration including the overall mean scores as well as the mean scores for each of the four math reporting categories (RC), #1 Numbers and Operations, #2 Algebraic Concepts, #3 Geometry and #4 Measurement, Data and Probability for the BOY and the MOY administrations of the CDT.

Table 26

n=50

Mean Scores for 2017-18 BOY and MOY CDT Test Administrations

Administration 2017-18	Over All Mean	RC#1 Mean	RC#2 Mean	RC#3 Mean	RC#4 Mean
BOY	641	631	662	596	668
MOY	784	787	789	735	809

As with the 2018-19 CDT scores, the 2017-18 CDT scores show growth from the BOY to the MOY administration. However, the 2017-18 show greater growth from BOY to MOY and these students did not receive the Growth Mindset intervention. I cannot use SPSS to analyze this data as no two students take the same CDT test. It is a predictive test in that the answer to one question generates the next question. Therefore, according to this cohort comparison of student achievement by scaled scores, I cannot say that the Growth Mindset intervention had any impact on improving student achievement over the course of the study.

Interpretation

To answer the research question, How and to what extent does implementing the growth mindset intervention affect student achievement?, I collected two sources of student achievement data. Based on analysis of the student achievement on the spiral review, no trends in improvement were discovered. Furthermore, the cohort comparison data of the CDT data between the group of students who participated in the intervention and the group who did not showed no increase in achievement by the students who participated in the intervention. Therefore, I can assert that the Growth Mindset intervention did not have an effect on student academic achievement over the course of the study.

Summary

Over the course of my study examining the effects of a growth mindset intervention on teachers' mindset, students' math self-efficacy, students' mindset, and student academic performance, I collected a variety of qualitative and quantitative data. While I originally designed the study to collect both data types for RQ#1, 2 and 3, I was only able to collect usable qualitative data for RQ#1. Based on my data analysis results, the growth mindset intervention had a positive and statistically significant impact on teachers' mindset, students' math self-efficacy, and students' mindset. The student achievement data I collected did not demonstrate the intervention had any impact on achievement at this time. I discuss my findings and the implications from them in greater detail in Chapter 5.

CHAPTER 5

DISCUSSION

"Mathematics is a performance, a living act, a way of interpreting the world…those who use mathematics engage in mathematical performances. They use language in all its forms, in the subtle and precise ways that have been described, in order to do something with mathematics" (Boaler, 2008 p. 29)

The purpose of this mixed methods action research study was to address the need for a fresh intervention to improve student achievement in math at ES. The intervention was aimed at incorporating growth mindset geared teaching approaches to math at ES in order to improve math self-efficacy, growth mindset and improve student math achievement. I focused my intervention around a professional and sustained book study with the two third- grade math teachers using Dr. Joan Boaler's book *Mathematical Mindset Unleashing Student's Potential Through Creative Math, Inspiring Messages and Innovative Teaching.* Together, we read, discussed and worked towards incorporating growth mindset practices their daily classroom instruction in order to improve math self-efficacy, math mindset and ultimately improve student math achievement. Four research questions guided me throughout my study:

RQ 1: How and to what extent does implementing the growth mindset program affect the self-perceptions of third-grade teachers' mindset?

RQ 2: How and to what extent does implementing growth mindset as part of the third-grade math curriculum affect students' math self-efficacy?

RQ 3: How and to what extent does implementing a growth mindset program as part of the third-grade math curriculum affect students' mindset?

RQ 4: How and to what extent does implementing a growth mindset program as part of the third-grade math curriculum affect students' mathematics performance?

This final chapter includes a discussion of my findings related to each of the research questions. Also included is discussion on the connections to the existing research on growth mindset, self-efficacy and professional development for teachers. I conclude the chapter with a discussion of the implications for future research on this topic based on my findings, limitations of this study and a conclusion. However, before I begin those discussion, I feel it necessary to discuss something that happened along the way of the study that I should have anticipated, but did not because I was so focused on the student achievement aspect of the study.

As educators, we place students at the center of our decisions and practices each and every day. Fittingly, I designed this intervention with the students at the core of the process. Specifically, I saw ES students' performance in math on a steady decline according to the standardized PSSA that all schools and teachers of third grade and beyond are measured by to some degree. Across the district, students were not responding to the various interventions aimed at improving math achievement presented to them. Over time, it became obvious there was a distinct need to think outside of the box in order to turn this achievement trend upwards. Through a combination of listening to the teachers, listening to the students and immersing myself in literature about transforming math instruction and learning, I identified the need for my students to develop math self-efficacy and develop a growth mindset in math. If students would develop math self-efficacy and develop math growth mindset practices, then naturally, these same students would experience improved academic achievement. Therefore, I

anticipated seeing positive changes in the students, hence the reason for three research questions related to the students' self-efficacy, mindset and academic achievement. Yet that academic achievement goal kept calling out to me. Given ES's lack of performance on the PSSA state assessment over the last five years, my problem of practice was extremely personal to me as it was the math performance of the students in the building where I am the instruction leader.

As I began collecting the student achievement data to address research question four about the intervention impacting student achievement, it became apparent that I was not seeing what I wanted to see in terms of improved academic achievement for the students. In addition to the lack of improved student achievement, I had to come to terms with the fact that my presence in the classroom became a distraction for the young students. I chose to discontinue those observations after two cycles and no relevant data. There I was in my own study not collecting firsthand qualitative data from my students. I asked myself repeatedly, how will I witness and record the changes in students in terms of mindset, self-efficacy and academic achievement that I so desperately wanted as results of implementing the growth mindset intervention.

After collecting the MOY CDT in January and comparing it with last year's student data from the same time period, I was nothing short of deflated. I even had thoughts that my entire study was a bust. In comparing the two cohort groups, there were no gains in academic achievement of the current group over the previous group. The 2017-18 students who did not receive the intervention had higher overall scores and higher scores in each of the four reporting categories.

After two straight days on the proverbial bridge of wanting to throw my hands in the air and declare failure, it all became clear. The bridge was the answer, the implementation bridge! I became so focused on the student achievement aspect of it all, that I was not seeing what was right in front of me: the teacher - the number one factor in student achievement (DuFour & Mattos, 2013). My study always included the teachers; I presented framework in Chapter 2 about the need for school administrators to create bridges between research and practice for the teachers to truly affect change. By the end of the study, it became clear, the teachers and the community of practice we developed together was the impact of the study. I should never have anticipated seeing the improvements in student achievement at the same time I was working with the teachers in our community of practice in only a semester. In fact, I should have eliminated the research question related to student achievement altogether and replaced it with a question asking how and to what extent does implementing a community of practice impact my role as the instructional leader of the building?

The teachers needed time to make their way across the implementation bridge between research and practice. They needed time to digest all of the information, try out and hone strategies over time in order to support the students in improving achievement. Just as I was working with the teachers on their mindsets, they, in turn needed time to work with the students and their mindsets. So, it is here where I take the lesson I taught the students about the power of the word "yet." The intervention was not a bust, I simply did not collect the data that shows improved student achievement in math, at least not yet.

Connections to Theoretical Framework and Existing Research

Growth Mindset When reflecting on the previous research completed related to Dweck's Implicit Theory of Personal Attributions and self-efficacy, the field was lacking in research with respect to elementary age students; however, I identified many connections between the results of the literature I presented in chapter two and the results from my study. As for the power of intentional long-term professional development for teachers as they implement research into practice, my study adds to that body or work.

With regard to both teacher and student mindset, direct instruction and practice of growth mindset strategies holds the power to change mindsets at any age. Yeager and Dweck (2012) suggest that changes in mindset can promote resilience that will have a positive effect on student achievement. Similarly, Mrs. Jones regrowth mindset strategies especially in the context of the third- Grade Math Chamber:

> I feel very confident that this year I will have the largest number of student in third- grade that have either attempted or beat the chamber.

And Mrs. Dill reported:

> In the past, my learning support students have not been eager to attempt the chamber; this year, all have attempted the chamber at least a few times and a few have beat the chamber which in third- grade equals success.

Both teacher statements support Yeager and Dweck's (2010) assertion about growth mindset positively affecting student resilience achievement as this year, the Math Chamber has seen its most contestants.

In addition, the student responses to the post surveys on both mindset and self-efficacy contribute to the already existing body of literature detailing student

improvement when these two constructs become a focus of instruction along with the content. There was a distinct increase in student responses disagreeing with the statement about preferring easy math problems. This shows that they have learned about the power of mistakes and are at the minimum recognizing them as opportunities to learn instead of barriers to learning.

Teacher Professional Learning Hall and Hord (2011) discuss teacher-need for a bridge between research and practice and as they attempt to affect positive change within their classrooms. "As with real bridges, different change efforts require varying lengths, degrees of stability, and combinations of supports" (p.53). This support structure they reference truly became the heart of my study. In Chapter 2, I described a few options for bridging that gap including Riveros, Newton and Burgess' (2012) "practice-based focus for professional learning communities" (p. 202) and Coburn et al., (2012) teacher social networks. The personalized book study between myself and the two teachers fit into both proposed examples of creating that bridge from research to practice described by Hall and Hord (2011). The teachers felt supported throughout the entire process. Rather than being provided the materials and let go to implement, we spent time examining their existing beliefs, studying the proposed changes, identifying ways to incorporate changes without completely revamping their lesson, and lastly, they had the autonomy to practice the suggestions in the classroom without the threat of evaluation.

DuFour and Mattos (2013) outline how educators in schools who have embraced learning communities are more likely to:

- Take collective responsibility for student learning, help students achieve at higher levels and express higher levels of professional satisfaction.

- Share teaching practices, make results transparent, engage in critical conversations about improving instructions, and institutionalize continual improvement.
- Improve student achievement and their professional practice at the same time that they promote shared leadership.
- Experience the most powerful and beneficial professional development.
- Remain in the profession

(p. 37).

With the exception of seeing that improved student achievement in this cycle of research, the two teachers have embraced all of the listed practices. Mrs. Jones has completely redesigned the third- grade Math Chamber by removing the time constraint and the volume of problems she asks students to complete. She is also incorporating more mixed-ability group work within her classroom. Not only is she practicing these within her classroom, she has become a voice promoting these same approaches in all classrooms. Mrs. Dill who revealed she always believed all students could learn, let go of the restraints of an IQ number because she watched a student overcome the expectations she had set for her based on that number. These are very powerful changes that are supported by the existing research and provide additional examples of how changes in growth mindset impacts both students and teachers learning.

Implications for Practice

Teacher professional practice. Both Mrs. Jones and Mrs. Dill remain adamant about sharing this book with all of the math teachers in the building. In fact, in a side conversation with Mrs. Dill, she revealed she is already discussing ideas and suggestions

with another grade level she works with and those teachers are very interested. Furthermore, Mrs. Jones also happens to be the Math Department Chair and is planning to replicate our community of practice with the math department. The district has already purchased *Mathematical Mindsets* for every math teacher at ES. They will begin working with the text in the month of April.

Because the study had us engrossed in the work of Jo Boaler, this lead us to another one of her works. So in addition to purchasing the first book, the district has purchased a second title for all math teachers third to sixth grade *Visualizing and investigating bid ideas: Mindset mathematics* (2018) specific to each of those grade levels. The books in this series present teachers with the big ideas in math at each grade level along with suggestions and approaches to engage the students in visualizing math, playing with math and investigating math. "Mathematics is not a set of methods; it is a set of connected ideas that need to be understood. When students understand the big ideas in mathematics, the methods and rules fall into place" (Boaler, Munson & Williams, 2018, p. 9). I believe this book will be a critical resource for the teachers as they work towards connecting those big mathematical ideas through their respective grade levels and then across all grade levels. They will have the summer to become familiar with both of the texts, then, when school begins next year, myself, Mrs. Jones and Mrs. Dill will work with the staff in book discussions much like our own during this study. All teachers will have access to Mrs. Jones and Mrs. Dill for questions, to run ideas by, etc. just as we did throughout the study.

Each year, the district provides a menu of on-line professional learning opportunities for teachers to engage in during in-service time. The district works in

conjunction with the Intermediate Unit to provide these online courses through what we call The Valley Network. Because of the improvement of teacher mindset and their acceptance of growth mindset teaching practices, I am researching online courses available through USC Online designed by Dr. Joan Boaler and colleagues as an option for all district math teachers to complete as part of their on-going professional learning through The Valley Network.

Student practice. The implications for students learning about the power of growth mindset in the context of the specific content areas has the potential to transform student self-efficacy and mindset across all content areas each year during their enrollment at ES. These connections to personal improvement through self-belief have implications for life-long changes in attitude and performance across time. For example, if students can embrace the power of self-efficacy and growth mindset in math, they may be more open to accepting the possibility of the same power in another subject area. Experiencing desired results through perseverance through challenges is applicable to most anything they may face in life.

My administrative practice Conducting this study took me back to my time spent as an instructional coach; something I have let slip in the busy life of an administrator running a building. My training as an instructional coach, made clear to me that the collaboration between coaches, teachers and their practice is the most effective method for impacting student outcomes. When I transitioned into building administration, this collaboration took on a different look due to the demands of the teacher evaluation system; in Pennsylvania, this tool is known as the 82-1. I have always felt uneasy about the effectiveness of this piece of paper in improving teacher practice and positively

impacting student achievement. The positive changes that I witnessed and recorded as part of this study solidifies the impact sustained coaching and support has on improving teacher practice. By supporting teachers as they worked through the new teaching strategies while still affording them the classroom autonomy to try out the strategies and discuss the outcomes with a peer proved an effective framework for implementing change. This showed I respected their professionalism and did not need to micro-manage or evaluate every move they made. It also created ownership on their part while also providing a backdrop of support and a safe place to discuss and discover.

I am encouraged to replicate the professional learning community we created during our journey through *Mathematical Practices*. As DuFour & Mattos, 2013) assert, "Teacher quality is one of the most significant factors in student learning" (p.34). Quality teachers are not created by the current system of teacher evaluation, but rather, they are created through sustained support of putting research into practice. It is my job to provide that support through a strong professional learning community (PLC) as it is the method by which we can all positively impact student achievement. As mentioned above, DuFour and Mattos (2013) cite that one of the benefits to teachers who have, "Embraced PLCs are more likely to improve student achievement and their professional practice at the same time that they promote shared leadership" (p. 37). Improving student achievement is at the heart of educators and education administrators, my study truly supports the need for education administrators to bring the instructional leadership to the forefront of building leadership and not allow it to get lost in day to day operation of the building.

Implications for Research

With the two teachers ready to share their experiences with the rest of the math faculty, future iterations of research related to this topic are not only prevalent but readily accessible. I see the next logical research being the collection of the 2019 PSSA results. After all, this is the measure of data driving the assertion that ES students are not performing where could be performing in relation to the state testing. Furthermore, examining their 2020 PSSA scores compared to their baseline 2019 scores would provide some indication as to their growth in achievement or lack thereof. If those results show little improvement, I believe it would be time to identify another source of student achievement data relative to the research classrooms in order to address the achievement question. Additionally, I believe that collecting data from future cohorts of Mrs. Jones' and Mrs. Dill's math students would prove beneficial to their instructional practice as they work to fully implement the changes related to growth mind set and math instruction and learning.

A second implication from the findings of my study is to have all math teachers across the district complete the book study. However, the teachers should be aware that they may not see improvement in student achievement right away. They must allow time for themselves as the teachers to refine their practices and allow students the time to accept the practices as they form their mindsets. Additionally, they should be aware that the older the students are, the more resistant to change in math mindset they may be. Rather, this set up lends itself to a longitudinal study to follow the current third grade cohort through the completion of Algebra 1 and the Keystone Exam with those teachers having completed the book study prior to having those students in those classes.

With so many reports of students bringing their parents thoughts and experiences into the math classroom, I also see potential for a parent component to the intervention. Perhaps bringing parents in three times over the course of the study to survey and/or interview while also presenting them non-threatening material about creating positive math language in the homes.

Limitations of My Study

One of the first limitations of my study is the age of the student participants. While, one way to increase the reliability of surveys is to increase the number of items presented, the age of the students factored into my decision to include a limited number of items on the surveys. I took the chance that fewer, focused statements would keep the students engaged, on task and interested. Had I increased the number of responses, I believed that students would lose interest and choose an answer just to get finished. I cannot guarantee that did not happen, but the number of statements on both student surveys were manageable for the age group.

A second limitation of my study is not being able to triangulate the data for the students and self-efficacy and growth mindset. Triangulation of qualitative and quantitative data strengthens the results. However, the observation protocol I designed to collect observational data of students and teachers participating in math class, did not work out. In retrospect, it would have been more beneficial to have the two teachers take turns periodically completing the observation protocols while the other was teaching. Those observations would have generated authentic data as the two teachers were a natural part of the classroom culture and worked with the students on a daily basis. A once-every-two-week drop-in by an authority figure, regardless of how hard I tried to

shed that role, was never going to reveal to me what the teachers revealed through the discussions and the post-interviews.

Additionally, the transformation that occurred with the teachers was self-reported through the process of the pre and post interviews. I did not observe those changes first-hand, but rather relied on their reports both through the interviews and the conversations through-out the study. A series of random observations over the course of the study would have supported the assertions.

Another limitation of my study is the lack of student achievement. One contributing factor to this is the fact that the 2019 results of the PSSA will not be available until at least June of 2019. The PSSA is the measure by which I have asserted ES students are not achieving in math. The results of the third- grade 2019 PSSA should be included in a final report of the research in order to truly examine the effects of the Growth Mindset Intervention on student achievement. The assertion that the intervention did not lead to improved student achievement leads to a few important questions to consider: Should I have anticipated an increase in student achievement in such a short amount of time? Did I select the right assessments to include given the 2019 PSSA results will not be available until summer 2019? Should I have used a different definition of student achievement from the onset of the study? I still believe that growth mindset teaching practices will improve student achievement; however, my timeframe was not conducive to answering this question.

Conclusion about My Intervention

In a collection of writings presented in ASCD's *Educational Leadership: Poverty and Learning* (2008), James Comer (1995) asserted, "No significant learning occurs

without a significant relationship." I think this sentiment encompasses the story of my action research. While I entered the process focused on what the students needed to learn in order to improve student achievement, it evolved into building stronger relationships with my teachers and the power that holds. That then transferred into the teachers building stronger relationships with each other as they worked together through the long-held beliefs in attempt to improve practice. The cycle of significant relationships continued as they solidified relationships with their students incorporating their new beliefs and practices.

The community of practice that the two teachers and I established around the book contributed to a transformation of teaching beliefs and practices for both teachers. Long-held beliefs by experienced teachers were released in favor of new ways of thinking. This could not have happened without the open-mindedness of the teachers to place the students at the heart of all decision making. The transformation in teacher beliefs and practices led to both improved student math self-efficacy and improved math growth mindset.

Ultimately, the purpose of my Growth Mindset Intervention was to improve student achievement, achievement that has been lacking at SD as demonstrated by the steady decline in PSSA scores since 2015. It was the 2015 PSSA that began assessing the PA Core Standards, Pennsylvania's version of the Common Core Standards. With a focus on developing specific growth mindset practices in the math classroom with both the teachers and the students, math self-efficacy would improve, and thus, student academic achievement would improve. While both students and teachers demonstrated growth according to my data collection and analysis, the student achievement data I collected for

the study did not indicate the growth mindset intervention had a positive impact on student achievement yet. I stress the word yet because time is the commodity needed to refine practices and solidify shifts in thinking.

What my study confirmed for me was the effect of sustained, highly personal professional development for teachers to bridge the gap between research and practice in order to affect true change within the classroom. Whether through peer work groups, professional learning communities, communities of practice, or one-to-one work between professionals, as the instructional leaders of the building, I must facilitate continued access to that implementation bridge for all teachers in order to improve instructional practice and ultimately improve student achievement.

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APPENDIX A

MATH MINDSETS IN THIRD- GRADE

Homeroom Number: _____ **Class Number**: _____ Please circle: I am a **boy girl**

Directions: After each statement is read out loud by Mrs. Castiglione, please decide what answer best represents how you feel about that statement. Remember, there are no right or wrong answers. Your answer should be how you feel about the statement.

Practice Items that will not be scored:

I like coming to school at CVES.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree

Math is my favorite subject at CVES.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree

Math Mindsets in third- Grade

I possess a certain amount of math ability and I can't do much to change it.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Some students are just good at Math.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
I think I am good at Math.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
I can be good at Math if I work hard at it.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Mistakes in math help me learn.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
In math, it is important to avoid making mistakes.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
I like math work that I can do without too much thought.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
When a math problem is hard, it makes me want to work harder.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
If I work hard, I will do well in math.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
There is only one way to solve a math problem.	Strongly agree	Agree	Undecided	Disagree	Strongly disagree

APPENDIX B

I BELIEVE I CAN TRY-MEASURING MATH SELF-EFFICACY

Homeroom Number: _____ Class Number: _____

Please circle: I am a: Boy Girl

Directions: After the statement is read out loud by Mrs. Castiglione, please decide if you agree with the statement, the statement is true sometimes or you disagree with the statement. Remember, there are no "right" answers. Your answer should be how you feel about the statement.

Practice items that will not be scored:

I like coming to school at CVES.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
Math is my favorite subject at CVES.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree

Self-efficacy and setting goals:

1. When one way I use to solve a math problem does not work, I can plan a new way to solve the problem.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
2. I can try a new way to solve a math problem when my first try does not work.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
3. I can set goals for myself.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
4. I can recognize when I am not doing my best in math class and I can set a goal to do better.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
5. If I set a goal to do better in math, I can work on that goal.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree

Self-efficacy and tasks:

6. I can recognize when a math problem is hard for me.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
7. I can stick with a math problem when it is hard for me to answers.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
8. I can complete my math homework by myself.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
9. I can complete a math test by myself.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
10. I can solve math review problems from a different lesson with little help from the teacher.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree

Self-efficacy and Challenges:

11. If I become frustrated when solving a math problem, I can keep trying.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
12. I can use strategies to solve hard math problems.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
13. I can complete my math homework by myself even if I think it is hard.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
14. I can complete a math test by myself even if I think it is hard.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree
15. If the teachers gives a challenge question in math I will try it.	Strongly Agree	Agree	Sometimes	Disagree	Strongly Disagree

APPENDIX C

SEMI-STRUCTURED TEACHER INTERVEIW QUESTIONS

1. Explain your concept of growth and fixed mindset.
2. Explain your understanding of self-efficacy.
3. What do you see in your third- grade students in terms of mindset and self-efficacy? What do you see? What do you hear from the students?
4. How would you describe your own mindset when it comes to student learning?
5. Where do you see your students struggle in math and what barriers prevent the students from experiencing success?
6. What have you done to try and motivate your math students to get excited about learning math?
7. What are some of your best practices for teaching math?

APPENDIX D

TEACHER MINDSET SURVEY

To what extent do you agree or disagree with these statements:

1.Your intelligence is something very basic about you that you can't change very much.
Strongly Agree Agree Disagree Strongly Disagree

2.No matter how much intelligence you have, you can always change it quite a bit.
Strongly Agree Agree Disagree Strongly Disagree

3.You can always substantially change how intelligent you are.
Strongly Agree Agree Disagree Strongly Disagree

4.You are a certain kind of person, and there is not much that can be done to really change that.
Strongly Agree Agree Disagree Strongly Disagree

5.You can always change basic things about the kind of person you are.
Strongly Agree Agree Disagree Strongly Disagree

6.Music talent can be learned by anyone.
Strongly Agree Agree Disagree Strongly Disagree

7.Only a few people will be truly good at sports – you have to be "born with it."
Strongly Agree Agree Disagree Strongly Disagree

8.Math is much easier to learn if you are male or maybe come from a culture who values math.
Strongly Agree Agree Disagree Strongly Disagree

9.The harder you work at something, the better you will be at it.
Strongly Agree Agree Disagree Strongly Disagree

10.No matter what kind of person you are, you can always change substantially.
Strongly Agree Agree Disagree Strongly Disagree

11.Trying new things is stressful for me and I avoid it.
Strongly Agree Agree Disagree Strongly Disagree

12.Some people are good and kind, and some are not – it's not often that people change.
Strongly Agree Agree Disagree Strongly Disagree

13.I appreciate when people, parents, coaches, teachers give me feedback about my performance.
Strongly Agree Agree Disagree Strongly Disagree

14.I often get angry when I get feedback about my performance.
Strongly Agree Agree Disagree Strongly Disagree

15.All human beings without a brain injury or birth defect are capable of the same amount of learning.
Strongly Agree Agree Disagree Strongly Disagree

16.You can learn new things, but you can't really change how intelligent you are.
Strongly Agree Agree Disagree Strongly Disagree

17.You can do things differently, but the important parts of who you are can't really be changed.
Strongly Agree Agree Disagree Strongly Disagree

18. Human beings are basically good, but sometimes make terrible decisions.
Strongly Agree Agree Disagree Strongly Disagree

19. An important reason why I do my school work is that I like to learn new things.
Strongly Agree Agree Disagree Strongly Disagree

20.Truly smart people do not need to try hard.
Strongly Agree Agree Disagree Strongly Disagree

**Survey designed by Emily Diehl
Key

1. ability mindset – fixed
2. ability mindset –growth
3. ability mindset – growth
4. *personality/character mindset - fixed*
5. *personality/character mindset – growth*
6. ability mindset – growth
7. ability mindset – fixed
8. ability mindset – fixed
9. ability mindset – growth
10. *personality/character mindset - growth*
11. ability mindset – fixed
12. *personality/character mindset – fixed*
13. ability mindset –growth
14. ability mindset – fixed
15. ability mindset – growth
16. ability mindset – fixed
17. *personality/character mindset – fixed*
18. *personality/character mindset –growth*
19. ability mindset – growth
20. ability mindset - fixed

Scoring

Growth Questions

1. Strongly agree – 3 points
2. Agree – 2 points
3. Disagree – 1 points
4. Strongly disagree – 0 point

Fixed Questions

1. Strongly agree – 0 point
2. Agree – 1 points
3. Disagree – 2 points
4. Strongly disagree – 3 points

Strong Growth Mindset = 60-45 points
Growth Mindset with some Fixed ideas = 44-34 points
Fixed Mindset with some Growth ideas= 33-21 points
Strong Fixed Mindset= 20-0 points

APPENDIX E

STUDENT ANCHOR CHART

G r o w t h

Mistakes help me learn.
I will try again.
Never give up.
Doing my best, always.
Success will come, if I try.
Effort helps me achieve!
Training my brain to grow!

APPENDIX F

OBSERVATION PROTOCOL 1

Location: third- Grade Math Classroom Date: Time in: Time out:

Observation Objective: What are students doing and saying growth v. fixed mindset

Observer: R. Castiglione

What students are saying.	Growth	Fixed	What students are doing.	Growth	Fixed

APPENDIX G

OBSERVATION PROTOCOL 2

Location: third- Grade Math Classroom Date: Time in: Time out:

Observation Objective: Lesson Implementation Chapter:

Observing: Teacher(s) Students Teachers & Students

Observer: R. Castiglione

Component	**Description**	**Reflective Notes**
Communicating with students.		
Communicating with teacher.		
Questioning/Discussion Techniques (Teacher)		
Questioning/Discussion Techniques (Students)		
Engaging students in learning.		
Using Assessment in Instruction. (Teacher)		
Using Assessment in Instruction (Students)		
Demonstrating flexibility and responsiveness (Teacher)		
Demonstrating flexibility and responsiveness (Students)		
Creating an environment of respect.		
Establishing a culture for learning.		
Managing classroom procedures.		
Managing student behavior.		

APPENDIX H

TEACHER CONSENT

Dear Potential Participant:

I am a doctoral candidate under the direction of Dr. Josephine Marsh in The Mary Lou Fulton Teachers College at Arizona State University. I am conducting a research study to examine the effects of implementing growth mindset practices as part of our elementary math curriculum as a means to improve student performance and students' belief that they can do math.

I am inviting you to participate in this study, which will involve a pre/post study semi-structured interview, pre/post study survey, participation in a nine-session book study (each session will be no longer than 40 minutes) and seven debriefing sessions lasting no more than 15 minutes from August 23 until November 30, 2018. You will be asked to try out seven new classroom practices and I will observe these try out session and record observation data according to predesigned protocols. You have the right not to answer any question, and to stop participation at any time.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. Your participation is in no way related to your job evaluation or continuous employment at CVSD.

There are potential benefits to both you and your students by participating in this study. You will be able to try out some new teaching strategies that support a growth mindset and students have the potential to improve their beliefs about their own abilities and improve their academic performance. There are no foreseeable risks or discomforts to your participation.

Your participation and responses will be confidential. I am the only person who will know your identity, but I will not use your names or any other identifying information in any presentations or my dissertation. I will also be the only person who stores any data I collect. I will keep it in my home office or in my Google Drive supplied by ASU and only accessible through my own username and password. The results of this study may be used in reports, presentations, or publications but your name will not be used.

I would like to audio record the pre and post interviews. The interview will not be recorded without your permission. Please let me know if you do not want the interview to be recorded; you also can change your mind after the interview starts, just let me know. . All recorded content will be done so on a portable tape recorder and kept by me. I will transcribe the contents of the recordings and keep all documents in my home office.

If you have any questions concerning the research study, please contact the research team Dr. Josephine Marsh at 480-727-4453 or me at 814-270-2582. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

By signing below you are agreeing to be part of the study.

Name:

Signature: Date:

APPENDIX I

PARENT CONSENT

Dear Parent:

I am a doctoral candidate under the direction of Associate Professor Josephine Marsh in the Mary Lou Fulton Teachers College at Arizona State University. I am conducting a research study to examine the effects of implementing growth mindset practices as part of our elementary math curriculum as a means to improve student performance and students' belief that they can do math.

I am inviting your child's participation which will involve participating in pre/post research surveys. The student will not be asked to reveal any identifying information on the surveys, only gender and class section. Additionally, your child may be selected to have his/her progress on the classroom weekly assessment tracked over the course of the study. Again, no identifying information will be collected. Should your child be selected, he/she will be assigned a number that only I will know the identity of. His/her name will be removed from the item sample and replaced with his/her number. I will store all materials and no one will have access to the information. The length of the research study is from August to December of 2018. All students will participate in the innovation; however, your child's participation in data collection is voluntary. If you choose not to have your child participate or to withdraw your child from the study at any time, there will be no penalty and it will not affect your child's grade. Likewise, if your child chooses not to participate or to withdraw from the study at any time, there will be no penalty. The results of the research study may be published, but your child's name will not be used.

The possible benefit of your child's participation is creating a growth mindset and helping him/her realize that he/she can be good at math. There are no foreseeable risks or discomforts to your child's participation.

All data collected from the surveys will be kept confidential as I am not collecting any identifying information on the surveys thus the responses will be anonymous. If your child is selected to have his/her performance on the weekly assessment tracked over the course of the study, his/her name will be removed from assignment and replaced with a corresponding number. Only I will know the identity of the number and will store that information in a locked drawer in my office to which I am the only one with a key. The information will later be destroyed upon the three year mark of university approval of my dissertation. The results of this study may be used in reports, presentations, or publications but your child's name will not be known/used.

If you have any questions concerning the research study or your child's participation in this study, please call me at 535-6187 or Dr. Marsh at 480-727-4453.

Sincerely,
Rebecca A. Castiglione

By signing below, you are giving consent for your child _____ (Child's name) to participate in the above study.

_____ _____ _____
Signature Printed Name Date

If you have any questions about you or your child's rights as a subject/participant in this research, or if you feel you or your child have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the Office of Research Integrity and Assurance, at (480) 965-6788.

APPENDIX J

CHILD ASSENT FORM

I have been told that my mom, dad, or caretaker said it is okay for me to take part in a project about trying to feel better about doing math and get better at math.

I will be asked to answer questions about how I think about math and how I feel about math two times: one time in August and another time in November. I know that there are no right answers, just my own thoughts.

I am taking part because I want to. I know that I can stop at any time if I want to and it will be ok if I want to stop.

_____

Sign or Print Your Name Here

_____

Date