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The Relationship Between Mindset and Motivation in an Alternative School Mathematics Classroom

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THE RELATIONSHIP BETWEEN MINDSET AND MOTIVATION IN AN ALTERNATIVE SCHOOL MATHEMATICS CLASSROOM

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DEDICATION

I dedicate this dissertation to my family for supporting me during the past four years. Thank you for assuming my domestic responsibilities so that I could fulfill my dream of advancing my education to the highest level. I also dedicate this dissertation to family and friends who supported me emotionally during this process and provided many hours of editing advice and quiet refuge.

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ABSTRACT

The purpose of this action research study was to determine the impact of a Khan Academy growth mindset lesson plan on the motivation of at-risk ninth grade students in a mathematics classroom. Data were collected for quantitative analysis of students' self-reporting of perceptions pertaining to mindset beliefs before and after a mindset intervention and perceptions about motivation in the mathematics classroom. Analysis revealed there was no relationship between mindset and motivation. A minimal decrease in fixed mathematical mindset was determined after a Khan Academy mindset intervention. Increases were found in students' beliefs in the importance of math, the usefulness of math, and that they would do well in math. No change was found among students regarding intrinsic motivation. Increases in motivation among students were attributed to classroom discourse and increased attention to a constructivist environment.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Teaching at an alternative school is different from teaching at a traditional high school. Students need more academic and emotional support. Teaching a population of at-risk, high school students is an exhausting, yet rewarding experience. Teachers develop strong relationships with students to help connect, emotionally. In addition to addressing the many emotional and academic needs of at-risk students, teacher accountability for academic standards, graduation rate, and standardized test scores increase responsibilities for which alternative school teachers are answerable. Experimenting with inventive pedagogic techniques and alternative behavior modification initiatives is used to encourage motivation toward academic success. This may include humor in the classroom, Positive Behavior Intervention Systems (PBIS), or mindset interventions.

This study took place at an alternative school for a school district in central South Carolina. Edgar-Smith and Baugher-Palmer (2015) define an alternative school to be, "educational programs [that] are designed to meet the academic, emotional, and behavioral needs of students who do poorly in the traditional school setting" (p. 134). The alternative school provides a blended classroom experience. Core classes such as mathematics, English, science, and social studies are taught by teachers in the classroom. Additionally, most electives are provided by the e-learning curriculum provided by Apex Learning, Inc. Teachers at the alternative school refer to this program as Apex.

Research has shown that both on-line curriculum and smaller class size provide positive academic outcomes for alternative programs (Eschen, 2014).

Students at the alternative school are enrolled for one of three reasons. Students attend in lieu of expulsion from their zone schools, as a transition from the Department of Juvenile Justice (DJJ) to their zone school, or by choice to earn more academic credits to facilitate graduating with their original class. Students who attend the alternative school in lieu of expulsion attend for numerous reasons. Minor infractions such as absenteeism, too many discipline referrals, or excessive tardiness may result in a referral to the alternative school. Students may have been found in possession of and/or under the influence of drugs or alcohol. Students may also be sent to the alternative school for fighting or gang affiliated activities. Examples of more serious infractions may be weapons charges or assault of an administrator.

If a student were recently released from DJJ, he or she attended the alternative school to facilitate the transition to his or her zone school. During students' time in DJJ, they may have missed many weeks or months of rigorous academic instruction. The alternative school offers remediation opportunities that the traditional schools do not offer. Remediation programs provide an opportunity for the students to acquire the academic skills necessary to successfully transition to their zone school classrooms. Research by Sheldon-Sherman (2013) found, "Youth with learning, developmental, and behavioral disabilities are at an increased risk both for educational failure and incarceration. They are more likely than their non-disabled peers to experience school failure and subsequent poor adult outcomes" (p. 228). Scholars and policy makers agree

education is the link to reintroducing them to society. The alternative school provides this link.

Students may attend the alternative school by choice. To attend by choice, students must meet with district personnel for approval. Students who are lacking credits and wish to graduate with their classmates often attend. The alternative school has more lenient policies than traditional schools in the district. Choice students attending the alternative school, may earn more credits in one year than students attending their zone high schools. Students with learning disabilities or emotional challenges may attend the alternative school because they find the smaller class sizes to be an advantage. For example, students with Attention Deficit Hyperactivity Disorder (ADHD) are more successful because they can be more mobile and experience more academic success in a smaller classroom. Bussing, Gary, Leon, and Garvin (2002) found class size and time to implement interventions for students were two of the biggest obstacles for teachers educating students with ADHD in the traditional classroom. Teachers at the alternative school have both smaller class sizes and more time to dedicate to each student's success.

Students that attend the alternative school face more challenges than most teenagers. All students at the alternative school are considered at-risk teens. Characteristics of at-risk students include low socioeconomic status, being of minority race, low Grade Point Average (GPA), having failed one or more grades, low discourse with parents about school, higher suspension rates, or attending many different schools (National Center for Education Statistics, 1992). Ninth-grade at-risk students have an additional challenge.

Ninth grade is considered a crucial year for students. Across the country, and consistent with data findings at the alternative school, it has been found that, "ninth grade students have the highest rates of truancy, discipline referrals, failures and retentions. A school's worst data points are usually found among freshman" (Habeeb, 2013, p. 18). Success or failure during the freshman year of high school can set the tone for students' futures. Many students experience new emotions, social situations, and academic challenges. Christie (2008) believed, "Eighth graders tend to get cocky about being older and worldlier than their younger middle school peers. So it can be a wakeup call when they start high school and they're at the bottom of the pecking order again" (p. 157). Academically, a low GPA earned during the first year of high school can create a major obstacle to be overcome for the next three years. On the contrary, a successful start to high school, during the ninth-grade year, "can open up a world of exciting opportunities" (Abbott & Fisher, 2012, Why We Created this Guide, para. 1). Success during the ninth-grade year has been positively linked to high school graduation. Teachers have become increasingly responsible for the academic success of their students.

Since the 1980s, public schools have been under scrutiny to increase student achievement and standardized test scores. The *A Nation at Risk* report enlightened the Reagan administration to the fact that our country's education was in dire need of reform. This report revealed the United States was academically behind many other nations. Twenty-three million adults were found to be functionally illiterate, college entrance exam scores were falling, and high school standardized test scores were declining in both science and mathematics (U. S. Department of Education, 1983). This report, ultimately led to the passing of *No Child Left Behind* (NCLB) during the Bush administration and

Race to the Top during the Obama administration. These reforms resulted in rigorous national standards, increased teacher qualifications and accountability, and increased standardized testing for students (Spring, 2014).

Currently, teachers grapple with the increased urgency of state mandated evaluations and increased graduation requirements, respectively. Yet, "while most teachers have taken the steps necessary to meet their states' Highly Qualified Teacher definition, there is little evidence to conclude that this provision has led to notable increases in the requisite subject-matter knowledge of teachers or to increases in measures of individual teacher effectiveness" (U. S. Department of Education, 2008, p. 6). Spring (2014) provided further details and evidence by stating:

> Combined with Race to the Top, the Common Core State Curriculum Standards, are linked to a massive data system of student test scores that create an authoritarian educational system that controls the behavior of students, teachers, school administrators, and college education. It completes the integration of the American school into a corporate-driven global economic system. (p. 449)

The increased responsibilities of both teachers and students in the current data-driven schools, has resulted in a resurgence of the traditionalist classroom. The current regulations have left teachers in the core, academic subjects scrambling for time to teach the numerous and rigorous standards and grappling with innovative strategies with which to convey the curriculum (Au, 2013). "Educators are seldom provided with concrete guidance on what they could do that would make an immediate difference in the success of their students" (The University of Chicago Consortium on Chicago School Research, UChicago CCSR, 2014, p. 1). This has resulted in teachers reverting to direct instruction

to disseminate the many academic standards and teaching to the test with little time to implement pedagogical strategies such as cooperative learning and/or discovery learning.

As teachers are put under more pressure to ensure the academic success of their students, high school graduation dropout rates are increasing and failure rates in the ninth grade are soaring. A report by the U. S. Department of Education showed high school drop-out rates to be high, especially among African Americans and Hispanics (McFarland, Cui, & Stark, 2018). This is a major concern to administrators and teachers at the alternative school. The UChicago CCSR (2014) states, "Developing effective approaches to reducing drop-out rates is one of the highest priorities in education today" (p. 1). The UChicago CCSR researchers studied multiple factors contributing to high school dropout rates and narrowed it to the ninth-grade transition as the single most important intervention point. Studies showed as students transitioned to high school, their attendance, grades, and engagement in school significantly decreased. "Course failure becomes common, even among students with strong grades and test scores in eighth grade" (UChicago CCSR, 2014, p. 2).

The cited research and teacher collected data from the alternative school, resulted in alternative school administrators and teachers collaborating to support increased high school graduation rate, by focusing on ninth-grade students. The purpose of this study was to provide support for ninth grade students by investigating effects of a mindset intervention on student motivation and to determine the relationship between ninth-grade students' perceptions of mindset before and after a mindset intervention.

The alternative school staff recognized a successful ninth-grade year is key to future success in high school, leading to graduation. With an average of 80 students

attending grades seven through 12, faculty develop strong relationships with students. To foster these close student relationships, the alternative school staff aspire to provide the most accommodating and resourceful educational environment for students. As a result, and to support the alternative school's mission statement, staff members work collaboratively to develop and/or implement new programs that provide students with support to complete high school, advance to higher education, or gain meaningful employment.

Problem of Practice

The identified problem of practice for this action research study, resulted from ninth-grade student retention and failure rates being higher than any other high school grade level at the alternative school. Administration and teacher collected data reported low advancement rates to tenth grade for alternative ninth-grade students. Teacher collected data revealed low achievement in ninth-grade Algebra 1 and English 1 classes. A candid group discussion with senior class alternative school students, revealed the ninth-grade year was a difficult adjustment period, and that many students were not promoted to the tenth grade.

Research Question

Data team reports from faculty and conversations with senior students at the alternative school, in addition to educational research, support ninth-grade is a critical year for students. Therefore, the researcher has designed an action research study to address the following question:

RQ1: What are ninth-grade students' perceptions of mathematical mindset before and after a mindset intervention consisting of Khan Academy videos about brain

function and growth mindset, an article describing how the brain grows, and journal writing?

Sub Question 1: What is the relationship between mathematical mindset and motivation of ninth grade at-risk learners enrolled in an alternative school mathematics classroom?

Purpose Statement

The purpose of this action research study is to provide support for ninth-grade students academic success by (a) encouraging an incremental mindset by teaching a Khan Academy mindset lesson plan and (b) exploring how mindset training impacts motivation in a mathematics classroom for ninth grade, at-risk students attending an alternative academy in accordance with the identified Problem of Practice for this Dissertation in Practice. Targeting ninth-grade students with mindset training should increase their chances of long-term academic success (Blackwell, Trzesniewki, & Dweck, 2007). The University of Chicago Consortium on Chicago School Research (2014) reported that even eighth-graders with strong tests scores can struggle and fail courses in the ninth grade. This study found if adolescents could make an effective transition through the first year of high school, they would be more successful throughout their consecutive years of high school, therefore increasing their chances of ninth-grade success which leads to graduation. The report acknowledged growth mindset as a factor for success.

Overview of the Methodology

To answer the research questions, two surveys were given. To analyze trends in fixed mindset before and after a mindset intervention, The Fixed Mindset Measure (Yeager, et al., 2016) was administered. To test for the relationship between mindset and

motivation, the Math Motivational Beliefs Scale was administered and descriptive statistics were used to investigate relationships. Six weeks of instruction using mindset discourse and activities took place between pre- and post-tests for both instruments.

The intervention was a lesson plan developed by Khan Academy and PERTS (Khan Academy & PERTS, n. d.). The lesson plan consisted of two videos. One described how the brain learns and the other video explained mindset. An article developed by Dweck and Blackwell (Mindset Works, n. d.). was read after the videos were shown. The teacher-researcher and students took turns reading the article. Following the article, a discussion took place where students told an example of how they overcame an obstacle where they persevered and were successful. Watching the videos, reading the article, and the article discussion took place during one class period. The next day, students wrote a letter to a future alternative school student describing the situation the students discussed the class the previous day.

Limitations of the Study

The current action research study identified sample size as a constraint. The specificity of the research question limited the participants to ninth grade students. Since the alternative school had a smaller population than most zoned schools, the number of final participants was six. The sample size was also influenced by the mortality rate of participants due to alternative school student population characteristics. Three participants were dropped due to expulsion or incidents of incarceration. A small N for quantitative data could have limited and/or skewed regression and correlation data while trying to determine a relationship between mindset and motivation. Because of inconsistencies between statements one and two in the Fixed Mindset Measure, the

reliability of the results must be questioned. Questions one and two addressed beliefs about increased intelligence. Since the two questions addressed the same concept of growing intelligence, consistent results would have been expected.

Significance of the Study

This action research study was important because it provided insight into the mindset and motivation of an overlooked population in educational research. Research on alternative schools and alternative school populations was difficult to locate. This action research study provided understanding for discourse in a mathematics classroom that resulted in higher motivation for students. Literature review revealed a lack of research relating mindset interventions with alternative populations.

Keywords/Glossary

Several terms appear in the text that may confusing to the reader. For the purposes of clarification, the following definitions have been defined.

Academic mindset. Psycho-social attitudes or beliefs one has about oneself in relation to academic work (UChicago CCSR, 2012).

Alternative school. Educational programs [that] are designed to meet the academic, emotional, and behavioral needs of students who do poorly in the traditional school setting (Edgar-Smith & Baugher-Palmer, 2015).

At-risk students. Students who are at-risk of failing to graduate and/or a student, "who is struggling and who may need supplemental or additional instruction to accelerate development in targeted instructional areas" (Zais, 2011, p. 68).

Fixed mindset (entity theory). Belief that intelligence is a fixed trait. This belief supports the idea that one is born with a certain amount of intelligence and it cannot be changed (Dweck, 2006).

Goal orientation theory. Students can adapt different definitions of success when pursuing goals, and each definition has a unique influence on the actions they take in pursuing those goals (Svinicki, 2016).

Growth mindset (incremental theory). The belief that intelligence can be increased through learning and effort. This belief supports the idea that the brain is malleable and can be trained (Dweck, 2006).

Implicit theories of intelligence. Perceptions or beliefs individuals hold about his or her intelligence, traits, or characteristics (Dweck, 2006).

Non-cognitive factors. Factors that enhance academic achievement but are not able to be measured by assessments (UChicago CCSR, 2012).

Student motivation. A willingness to engage in academic activities due to the enjoyment of the learning activity (intrinsic) or to achieve a benefit from the learning activity (extrinsic) (Tasgin & Coskun, 2018).

CHAPTER 2

REVIEW OF LITERATURE

Since the 1980s, public schools have been under scrutiny to increase student achievement and standardized test scores. The *A Nation at Risk* report was an admonition to the Reagan administration that our country's education was in dire need of reform. This report ultimately led to the passing of NCLB during the Bush administration and Race to the Top during the Obama administration. These reforms resulted in rigorous national standards, increased teacher qualifications and accountability, and increased standardized testing for students (Spring, 2014). As most teachers have taken the steps necessary to meet their states Highly Qualified Teacher status, there is little evidence to conclude that this provision has led to notable increases in the requisite subject-matter knowledge of teachers, or increases in measures of individual teacher effectiveness (U. S. Department of Education, 2008).

As teachers attempt to ensure the academic success of their students, high school dropout rates are increasing and failure rates in the ninth-grade are soaring (Department of Education, 2008). The UChicago CCSR (2014) stated, "Developing effective approaches to reducing drop-out rates is one of the highest priorities in education today" (p. 1). The UChicago CCSR studied multiple factors contributing to high school dropout and identified the ninth-grade year as the single most important factor. Studies showed as students transitioned to high school, their attendance, grades, and engagement in

school significantly decreased, even among students who showed strong test scores in their eighth-grade year (McCallumore & Sparapani, 2010; Wang & Eccles, 2012).

Because national- or state-mandated standardized testing, highly qualified teacher certification, and teacher evaluations have not been shown to have a positive effect on student achievement (Spring, 2014), other interventions were considered. Psycho-social mindset interventions have been proven to increase student achievement during adolescent transition, increase motivation in school, and increase achievement in general (Aronson, Fried, & Good, 2002; Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 1986; Paunesku et al., 2015).

Problem Statement

The identified problem of practice for this action research study resulted from ninth-grade student retention and failure rates being higher than other high school grade levels at an alternative school. Previously collected student data revealed high failure rates for ninth-grade students compared to other grade levels; 12 of twenty students who failed high school mathematics courses were enrolled in the ninth grade. In addition, teacher collected data revealed low achievement in ninth-grade mathematics and English I courses, due to teacher perceived lack of motivation. Conversations among colleagues during data team meetings revealed teacher perception resulted from teacher observations of students in the classroom.

Research Question

This Action Research study investigated the effects of a mindset intervention to answer the following research questions:

RQ1: What are ninth-grade students' perceptions of mathematical mindset before and after a mindset intervention consisting of Khan Academy videos about brain function and growth mindset, an article describing how the brain grows, and journal writing?

Sub Question 1: What is the relationship between mathematical mindset and motivation of ninth grade at-risk learners enrolled in an alternative school mathematics classroom?

Purpose Statement

The purpose of this action research study was two-fold. First, this study provided support for ninth-grade at-risk students' academic success in mathematics while encouraging a growth mindset by implementing a Khan Academy mindset lesson plan. Second, the teacher-researcher explored how the lesson plan impacted students' motivation in a mathematics classroom, while attending an alternative school.

This literature review provided a theoretical framework for the study including goal orientation theory, incremental and entity theory, growth and fixed mindset theory, and the theory of constructivism. To explain the history and evolution of educational psychology, this chapter provides an overview of human development, brain and cognitive development, and psycho-social development as it relates to adolescence. Previous research concerning growth mindset and mindset interventions, as they relate to education, will also be discussed. This research will provide evidence that a mindset intervention can increase motivation to reduce ninth-grade failure rates and offer other benefits to ninth-grade at-risk learners in a mathematics classroom.

Purpose of the Literature Review

The literature review helps the readers of the study to understand the research background and purpose. The literature review process helped the teacher-researcher refine the study and identify research relevant to the study. The literature review helped to guide the teacher-researcher toward a successful action research project. Machi and McEvoy (2016) define a literature review to be "… a written document that presents a logically argued case founded on a comprehensive understanding of the current state of knowledge about a topic of study. This case establishes a convincing thesis to answer the study's question" (p. 5). A literature review helped the teacher-researcher identify a topic, narrow its focus, and develop the overall project. The literature review provides the reader with a connection between what has already been discovered as it relates to the research topic (Mertler, 2014).

Conducting the literature review helped the teacher-researcher to understand previous research on growth mindset and the many areas to which it relates. The review provided valuable references for future study and helped the teacher-researcher locate options for mindset interventions, and measurement instruments for student mindset and motivation. The review also helped the teacher-researcher narrow the research focus to ninth-grade student mindset and motivation. Research is plentiful for mindset theory related to adolescent students; however, no research was found for mindset studies specifically for adolescent alternative school students.

Many searches in Google Scholar, ERIC and EBSCO databases took place during early research. Machi and McEvoy (2016) suggested selecting a perspective on which to base your research. Once the perspective was defined as educational psychology,

research through PsycINFO yielded numerous relevant studies to be scrutinized. Books purchased on mindset and motivational theory, as well as required books for doctoral classes, became valuable resources. Scholarly journal articles, research reviews, government websites, online articles, and previously written dissertations, were also helpful. Literature review revealed a lack of research relating mindset interventions with alternative populations. To fully understand the purpose of this study, theories pertaining to mindset, motivation, and constructivism were reviewed.

Theoretical Framework

This section of the literature review will define and explain theories related to mindset, motivation, and constructivism. In the last two decades, much research has taken place with attention to goal orientation theory and mindset theory (Dweck, 1986). Specifically, motivational achievement theory asserts that certain behaviors are a result of specific goals (Linnenbrink & Pintrich, 2002). For teachers to nurture a mastery goal orientation and foster growth mindset in the classroom, a constructivist approach to learning is encouraged. The theory of constructivism will also be examined as it applies to the mathematics classroom.

Perceptions of Intelligence and Mindset

Mindset is based on an individual's perception of intelligence. Researchers Molden and Dweck (2006) pointed out the importance of studying how one's assumptions about one's self, and one's social world influence one's perceptions. These perceptions fall into two categories: those that are permanent traits and those that can be changed. Dweck (1999) identified two theories about the way people perceive their intelligence. The author states:

> Some people believe that their intelligence is a fixed trait. They have a certain amount of it and that's that. We call this an 'entity theory' of intelligence because intelligence is portrayed as an entity that dwells within us and that we can't change. (p. 2)

On the contrary, for others, intelligence is not fixed but, "something they can cultivate through learning. We call this an 'incremental theory' of intelligence because intelligence is portrayed as something that can be increased through one's efforts" (Dweck, 1999, p. 3).

Dweck takes incremental and entity goal orientations further by suggesting that mindsets, or dispositional attitudes and beliefs, reflect the learners' underlying attributions (Cook & Artino, 2016). Dweck (2006) explained the difference between a growth and fixed mindset. A growth mindset is based on the belief that one can improve one's basic qualities through effort. People with a growth mindset believe, "everyone can change and grow through application and experience" (p. 7). These learners thrive on challenge and view failure as a way to grow and learn by trying new methods or strategies. Easy tasks hold no value for students with a growth mindset (Cook & Artino, 2016).

By contrast, a fixed mindset is based on the belief that one is born with a certain amount of intelligence, and nothing can change it. Students with a fixed mindset believe they are either smart, or they are not. Because stable traits cannot be changed, adolescents with fixed mindsets are concerned with looking dumb or stupid in front of their peers. This is a way for them to protect themselves from ridicule. Dweck (2006) provided an example of how students protect themselves leading to a lack of motivation

by stating, “It’s no wonder that many adolescents mobilize their resources, not for learning, but to protect their egos. And one of the main ways they do this (aside from providing vivid portraits of their teachers) is by not trying” (p. 58). Students with a fixed mindset prefer easy, low-effort tasks that result in success that make them feel smarter. Students with a fixed mindset perceive failure at tasks that require effort, and may result in poor performance, as a result of low ability that ultimately leads to disengagement. Learners self-sabotage by justifying the failure as a lack of effort (Cook & Artino, 2016).

This study addresses the relationship between perception of mindset and motivation in a mathematics classroom. A clear understanding of mindset and goal orientation theory is necessary to synthesize students’ perceptions. Measuring students’ perceptions before and after a mindset intervention legitimatized the intervention in an alternative school setting. Goal orientation theory will be reviewed at length.

Goal Orientation Theory

Academic motivational theories are numerous. Such theories include achievement goal theory which is based on approach and avoidance (Ames, 1992; Svinicki, 2016), self-determination theory which posits students are most motivated when they feel competent and supported (Cook & Artino, 2016; Svinicki, 2016), and expectancy-value theory where it is believed that students will be more successful at a task if they see value in what they are learning, (Svinicki, 2016; Xu, 2017). Goal orientation theories focus on the why and how of approach and engagement. Goal orientation theory posits that students can adapt different definitions of success when pursuing goals, and each definition has a unique influence on the actions they take in pursuing those goals (Svinicki, 2016).

Goal orientation theory resides within incremental and entity theory but differs from achievement theory in that controllability beliefs are within the individual, not an event. Cook and Artino (2016) describe the orientations as, "broad orientations or purposes in learning that are commonly subconscious" (p. 1006). Mastery and performance orientations are two fundamental concepts of goal orientation theory. Mastery orientation has a general mindset for learning in which the main concern is to get smarter while learning new knowledge or skills. Students who possess a mastery orientation focus on the intrinsic value of learning and hold an incremental mindset.

These students are known to take risks with learning and try new things. The learners are not afraid of mistakes, make good use of learning strategies, and ask for help when it is needed. They are willing to put time and effort into their learning to get the best results possible. Most students with a mastery orientation are self-motivated and take responsibility for their own learning (Cook & Artino, 2016; Svinicki, 2016).

The performance orientation has a general mindset for learning in which the chief concern is to look smart by demonstrating competence, and avoid looking dumb. Students who possess a performance orientation are anxious about getting a good grade, but not concerned with learning. Learners tend to judge themselves by comparing themselves to how others perform; for example, they want to earn the best grade or the highest Scholastic Achievement Test (SAT) score. These students work hard to achieve high status, but do not often try new strategies to solve problems; they stick to what they know will work. Learners with the performance orientation often appear to be highly motivated, but sustaining that motivation becomes a problem when they are faced with difficulties. Students with a performance orientation generally hold an entity mindset

(Cook & Artino, 2016; Svinicki, 2016). However, students can switch back and forth between orientations or change orientations. This switch is usually situational; for example, sports versus academics, or the level of confidence toward a subject (Svinicki, 2016).

Motivation and mindset theories set the construct for which the mindset training took place. Motivation plays an important role in academic success. Students need to be academically motivated to be successful in school. Motivation has been linked to metacognitive skills in the classroom, commitment to assigned tasks, and engagement within the classroom setting (Sungur, 2007). Metacognitive skills, engagement, and commitment to tasks are best cultivated through a learner centered ideology. To best support the learner centered ideology, a constructivist approach to instruction was implemented (Schiro, 2013).

Constructivism

The increased responsibilities of both teachers and students in the current data-driven schools, has resulted in a resurgence of a more traditionalist classroom as teachers spend more time teaching to the test (Au, 2013). The current regulations have left teachers in the core, academic subjects scrambling for time to teach the numerous and rigorous standards while grappling with innovative strategies with which to convey the curriculum (Spring, 2014; Sleeter & Stillman, 2013). UChicago CCSR (2014) validated this point by claiming, "Educators are seldom provided with concrete guidance on what they could do that would make an immediate difference in the success of their students" (p. 1). The lack of concrete guidance has resulted in teachers reverting to direct instruction to disseminate the many academic standards and teaching to the test with little

time to implement pedagogical strategies such as cooperative learning and discovery learning (Spring, 2014; Au, 2013). However, these realities should not overshadow a teacher's responsibility to create the best learning environment for his or her students.

Two proponents of constructivism were Piaget and Vygotsky. Piaget viewed constructivism from a cognitive stand-point and emphasized the structure of knowledge. Vygotsky viewed constructivism from a social stand-point. Vygotsky believed students needed the social and cultural experiences constructivism could provide to the learners. (Airasian & Walsh, 1997; McDevitt & Ormrod, 2016). Both views support the applicability of constructivism to learning and the learner-centered ideology. These two views were interpreted by Buoncristiani and Buoncristiani (2012) to develop a more inclusive view of the constructivist classroom where students create meaning through the active processes of engagement, questioning, and creative thinking.

Constructivism exists within the learner-centered ideology. Within this ideology, learning is personal and has different meanings to different people. Learning is not the transfer of information but something that is created by learners in response to their environment. Teachers give students a choice for tasks and assessments. Student growth is valued more than knowledge acquisition, and students are responsible for monitoring their own growth. Diversification and differentiation are critical concepts for the learner-centered teacher (Schiro, 2013).

A constructivist classroom encourages motivation. Motivation plays an important role in academic success (Slavin, 2000). Students need to be academically motivated to be successful in school. Guild and Garger (1998) state that:

> A student's motivation to learn is directly related to style of the learning experience as well as the value of the content. The two cannot be separated. A meaningful, intelligent curriculum offers a way for learners to develop understanding by actively creating their own connections to material. (p. 151)

Motivation has been linked to metacognitive skills in the classroom, commitment to assigned tasks, and engagement within the classroom setting (Sungur, 2007). Buoncristiani and Buoncristiani (2012) defined metacognition to be, "an individual's conscious thinking about cognition in a constructive manner (p. 7). Metacognition is nurtured through the level of engagement by the student and his or her commitment to given tasks (Buoncristiani & Buoncristiani, 2012). The teacher plays a role in committing students to their daily tasks. Explaining the importance of the assignment gives meaning to the task. Boaler (2016) encouraged teachers to give academic tasks relevance by reminding students that their brains grow when they encounter struggle.

Students who prefer the constructivist classroom have been linked to possessing mastery-goal orientations and intrinsic motivation (Kingir, Tas, Gok, & Vural, 2013). Characteristics of constructivist classrooms have been positively related to student motivation (Beerenwinkel & Arx, 2017). Constructivism is important to this study in its application to the mathematics classroom; constructivism focuses on cognitive development and deep understanding (Fosnot & Perry, 1996).

Historical Context

The concepts of mindset and motivation exist within the perspective of educational psychology. Educational psychology has many definitions put forth by many psychologists and researchers (Reilly & Lewis, 1983). However, Reilly and Lewis

(1983) simply define educational psychology as, “the application of the psychology to teaching” (p. 11). Glover and Ronning (1987) explain the relationship between developmental psychology and educational psychology. The authors state, “even though developmental psychology has evolved and separated from educational psychology, an accounting of human development is a significant component in thinking about the application of psychology to educational settings” (p.6).

This section will ground educational psychology by highlighting the concepts of human development, cognition, and representation. Piaget’s theory of cognition and Vygotsky’s social-cognitive theory explain concepts of cognition and representation. Mindset interventions are considered a psycho-social intervention, therefore Ericson’s adolescent stage of identity versus confusion will be addressed. These theories will be related to cognitive processing and social perceptions of self in the mathematics classroom. Also, the evolution of the interventions that affect the beliefs, emotions, and action tendencies (BEATs) that lead to one’s representations will be discussed. When appropriate, the above concepts will be linked to mindset and mindset interventions.

Cognitive and Social Development in the Mathematics Classroom

Adolescents experience many cognitive and social changes. These changes influence learning and behavior (McDermitt & Ormrod, 2016). This section highlights some of these changes and how mindset interventions have been used to offset negative effects.

Piaget’s study of human and cognitive develop has implications for education. Piaget was one of the first, significant, contributors to the educational field, (Reilly and Lewis, 1983). The authors state, “Piaget saw the study of children as the true basic

science for teachers, and his analysis of the development of thought in the child is the central core of what a teacher needs to know. Without this, all the methodology in the world may be of little use" (p. 57).

Piaget was considered the pioneer of maturation and spent his life studying infants and children to determine how they perceived the physical world. His later studies included theories of cognition and how new information was processed. Cognition is essential in the mathematics classroom. The development of algebraic thinking has been described as a process that leads to the representation of structure in mathematical expressions, (Sfard & Linchevski, 1994). This process was linked to the ability to establish generalizations and use appropriate representational forms to represent those generalizations (Chimoni & Pitta-Pantazi, 2017). In order to identify or construct multiple representations of a concept, one must identify commonalities and differences between patterns. Radford (2008), identified the action of noticing differences and commonalities in patterns as cognitive in nature.

Piaget's theory of equilibrium and disequilibrium helps to explain how the mathematical information is organized. During equilibrium, new information easily fits into an existing schema. When new information is learned and does not fit into an existing schema, disequilibrium takes place. It is during this state of disequilibrium that struggle occurs. During struggle, the brain processes where the new information should reside. Learning takes place during this stage and can create a new model in which the current knowledge can exist, creating a new state of equilibrium (Boaler, 2016; McDevitt & Ormrod, 2016).

While Piaget researched human development and cognition, Vygotsky researched social support. Vygotsky concentrated on tasks that students could accomplish with the help of an adult. Vygotsky's Zone of Proximal Development (ZPD) explains this area of development between what a student can do on his or her own, and what a student cannot do without the support of an adult, (Clapper, 2015; Danish, Saleh, Andrade, & Bryan, 2017; McDevitt & Ormrod, 2016).

Key ideas in Vygotsky's theory are that biological factors play a role in development, higher mental functions are unique to humans, children undergo developmental transitions in their thinking, through formal schooling adults convey methods for interpreting the world, mastering cognitive tools greatly enhances learning, and challenging tasks promote maximum cognitive growth (McDevitt & Ormrod, 2016). Vygotsky's theory supports the teaching of mathematical concepts, and tools such as manipulatives, graphing calculators, and computers to support higher mental function. The teacher's guidance to support students while grappling with concepts such as creating linear equations that model real-world problems is also backed by Vygotsky's theory. Vygotsky's theory of concept formation is suitable as, "an examination of how the individual relates to and give meaning to the signs (such as symbols and words) of the mathematical definition" (Berger, 2005, p. 155). Vygotsky's theory supports how cognition relates to the mathematics classroom. Erikson's stages of crisis help to explain how an adolescent may feel about mathematics and why they may disengage from the classroom.

Erikson believed that people grew from life experiences and challenges. Erikson posits that people endure eight crises during their lifetime and experience these crises

during different stages of their lives. During the adolescence stage, Erikson claims teenagers struggle with identity versus confusion. During this stage, students struggle with who they are and how they fit into the adult world. Adolescents will experiment with different sports and hobbies, and affiliate with different peer groups. Erikson poses most adolescents find a sense of identity and successfully transition to adulthood (McDevitt & Ormrod, 2016). However, students may struggle for identity in a mathematics classroom.

Research found high school mathematics students lacked identity in the mathematics classroom. Boaler, William, and Zevenbergen (2000) found students did not identify themselves as mathematicians despite being successful at mathematics. The authors explain:

> Most students in the US schools, despite being relatively successful mathematics learners, reported disliking mathematics, not because the procedural nature denied them access to understanding, although that was important, but because their perceptions of the subject as abstract, absolute, and procedural conflicted with their notions of self, of who they wanted to be. (p. 8)

This explanation highlights the trepidations some students feel when they enter a mathematics classroom that they may not encounter in other subject areas. For example, the study found that students did not experience the same disconnect in an English classroom (Boaler, Williams, & Zevenbergen, 2000).

To respond positively to social challenges and conflict, adolescents must be resilient. In a study by Schroder, Yalch, Dawood, Callahan, Donnellan, and Moser (2017), 1682 college undergraduates attending a midwestern university were surveyed for

stressful life events, anxiety, and Post Traumatic Stress Disorder (PTSD). The researchers found that students with a fixed anxiety mindset had statistically significant outcomes related to PTSD symptoms, depression symptoms, and drug abuse. Students with a growth mindset, compared to students with a fixed anxiety mindset, exhibited a strong relationship between the history of stressful life events and coping strategies. Yeager, Trzesniewski, Tirri, Nokelainen, and Dweck (2011) researched the relationship between mindset and revenge seeking behavior. The researchers found that students with an incremental theory of personality, "are less likely to condemn global, stable personal traits; they report feeling fewer negative emotions such as shame or hatred; as a result, they are less likely to desire revenge" (p. 307).

As adolescents grapple with cognition and social conflict, many changes are taking place in the brain. During adolescence, the brain continues to grow and develop. The cortex continues to develop which is responsible for executive brain functions. For example, interpreting, reasoning, communicating, and thinking processes take place in the cortex (McDevitt& Ormrod, 2016; Pascual-Leone & Taylor, 2011). Functional changes were detected for more complex cognitive control tasks of performance monitoring, feedback learning, and relational reasoning (Dumontheil, 2016). In a study by Mangels, Butterfield, Lamb, Good, and Dweck (2006), 535 Columbia University undergraduates were studied to identify the relationship between negative feedback on an assessment and cognitive reactive control. Electroencephalogram readings during an assessment found that entity theorists (participants who possess an entity belief toward intelligence) were found to spend less time processing the feedback than those with an incremental view. Less time processing the feedback implied entity theorists found the

negative feedback to be more stressful. The researchers concluded that, "incremental theorists demonstrated significantly greater overall gains in knowledge than did entity theorists, in that they demonstrated greater remediation of errors regardless of confidence with which the error was initially made" (p. 82).

Research that addressed mindset and processing time for feedback, determined incremental students who gravitated toward challenging situations found unexpected negative feedback to be less threatening. Entity theorists appeared less likely to engage in sustained semantic processing of the learning-relevant feedback when it arrived (Butterfield & Mangels, 2003). Thomas and Sarnecka (2015) found there were links between people's beliefs about intelligence and their beliefs about brain development. The researchers found the more a person believed intelligence was fixed, the more they believed a person's brain was fixed. The more people believed intelligence could change, the more they believed the brain could change from the result of practice. The study of this perception of mindset has developed over decades.

The Evolution of Mindset

To help explain the evolution of fixed and growth mindset, this section will explain how mindset evolved from Dweck's incremental and entity theories of intelligence. Dweck has excogitated these theories over the past 40 years. In the mid-1980s, Dweck (1986) proposed incremental and entity theories of intelligence. Incremental theory was based on the characteristics of learning goals, in which students seek competence, and entity theory was based on performance goals, in which students seek to look competent (Dweck & Elliott, 1983). Further research resulted in a book published by Dweck explaining the concepts of growth and fixed mindset. Dweck

explained growth and fixed mindset emerged when relating beliefs about malleability of the brain to incremental or entity beliefs about intelligence. Dweck's discoveries originated from a question she wanted to answer pertaining to how people perceive struggle; "Why do people differ?" (Dweck, 2006).

Previous theories ranged from differences in characteristics of the skull and brain to inherited genes. Others included theories about environmental factors and intelligence. Dweck found inspiration from Binet's work with underachieving students in Paris, France. During an era fixated on intelligence testing, Binet believed intelligence was not fixed and advocated for protest to this ideology. While talking with one of her graduate students, Dweck realized people had a choice about how they view failure; does one persist to try to get it right? Or, does one give up when times get tough? (Dweck. 2006). To answer these questions, Dweck's research led to theories about incremental and entity perceptions of intelligence; whether one believed one could change one's intelligence through effort (incremental) or if intelligence was a fixed trait (entity).

To add to the theories of intelligence, Dweck began research to address peoples' perceptions of brain malleability. Dweck found if persons believed they could change and grow their brain through effort and hard work, they could adopt an incremental belief of intelligence. A person who believed hard work and effort could grow one's brain and increase his or her intelligence is said to hold a growth mindset. If a person believes he or she cannot change his or her intelligence, then that person is said to hold a fixed mindset. Over the past twenty years, the concepts of growth and fixed mindset have been applied to many areas including sports, consumerism, relationships, education, and motivation (Dweck, 2006). Dweck's work regarding motivation is on-going.

Recently, Dweck (2017) proposed motivation is a result of merging learning theory and cognitive psychology with social-personality and developmental psychology. Dweck argues that the segregated theories for motivation, personality, and development can be combined to explain human behavior. The article posits, "that motivation is the core of human psychology and that understanding motivation is the key to understanding personality and development" (p. 689). Motivation is based on personal needs that lead to goals; these goals are based on mental representations held by individuals. Dweck coins the acronym BEATs to represent the beliefs, emotions, and action tendencies that form the mental representations. Dweck posits the BEATs individuals form, during infancy and childhood, develop their personality and goal setting behavior. One example is beliefs about the controllability of intellectual ability. Measures of growth and fixed mindset were found to predict challenge seeking behavior and resilience which resulted in increased task performance and grades (Blackwell et al., 2007). The following section describes the mindset interventions that were created to educate people with a fixed mindset.

Mindset Interventions

As Dweck's research with mindset continued, research revealed mindset could be learned (Dweck, 2006). Her interest in adolescents led her to develop a workshop to target adolescents who had lost interest in school. She organized an experiment to test mindset training. The experimental group attended the workshop that consisted of lectures pertaining to brain development and how the brain grows when people learn new things. Students were then taught study skills and how to apply them to their studying and school work. The workshops included activities and discussion sessions. The

control group attended a workshop consisting of only study skills and application activities. After these sessions, teachers reported changes of increased math grades and motivation in students who participated in the experimental group. No change was found in students who only received training on study skills. The workshop was found to be productive, however, a large staff was required to deliver the content, teachers were not involved, and it was not feasible to deliver the content on a large scale. This led to the design of Brainology® (Chao, Chen, Star, & Dede, 2016; Dweck, 2006).

The disadvantages of the workshop led Blackwell and Dweck to design an online program called Brainology®. The program was designed to teach students about the malleability of the brain and how effort in school can increase intelligence (Dweck, 2006). Brainology® is a computer-based program developed by educational experts, media experts, and brain experts. The program consists of six learning modules that follow two animated students Dahlia, who has trouble learning Spanish, and Chris, who has trouble with math. These two students meet Dr. Cerebrus, a slightly mad brain scientist, who teaches them how the brain works and grows, and how to care for their brains in such ways as eating right, getting enough sleep, and drinking plenty of water. Learning strategies are also incorporated into the Brainology® curriculum (Chao et al., 2016; Dweck, 2006).

Students learned the brain was like a muscle that grew stronger with rigorous exercise and that every time they took on challenges and persist, the neurons in their brain grew new, stronger connections. Students then learned to apply these lessons to their schoolwork. Brain-based study strategies helped accelerate students' academic progress, and were found to improve self-expectations, motivation, and effective

learning. This gave students and teachers a common language with which to communicate encouragement and praise to promote a growth mindset culture. The program helped schools increase student achievement, gain the most significant impact from available resources, take advantage of learning time, and generally develop a learning-focused culture (Davies, 2011; Dweck, 2006). Dweck (2008) described the success of the pilot study by stating, "Virtually all of the students loved it and reported (anonymously) the ways in which they changed their ideas about learning and changed their learning and study habits" (p. 3).

As described, Brainology® supports academic achievement by changing mindsets and teaching learning strategies. However, Brainology® has its critics. In an online article by Macnamara (2018), the results of a meta-analysis were discussed. As a result of the study, Macnamara and colleagues found an effect size of only .08 for the effect of Brainology® on overall GPAs for students. Higher effects were found for at-risk learners and students of poverty at .19 and .34, respectively. According to Hattie (2012), an effect size of .40 or greater is necessary to impact achievement. Kohn (2015) criticized mindset interventions by stating it was curriculum and pedagogy that affected student learning, not whether a student believed he or she could learn. Brainology® required a substantial time commitment and was an expensive program to purchase.

Since the development of Brainology, shorter and less expensive interventions have been created. Khan Academy, a non-profit educational organization that provides videos for learning, collaborated with the Project for Education Research That Scales (PERTS), a center at Stanford University that applies research to promote education, to create a lesson plan to develop growth mindset for school students (Yeager et al., 2016).

The lesson identifies three learner objectives. The students will understand intelligence can be developed, understand the brain is malleable, and understand engaging in challenging work is the best way to make the brain stronger and smarter. The lesson plan consists of three parts. The first part includes watching two videos about growing your mind and neuroplasticity. The second part consists of a discussion about students' personal experiences with struggle and how they were overcome. Part three has students write a letter to a future student about their learning-related struggle. The act of verbalizing and writing the letter is a "saying is believing" exercise. It is thought to make the information more relevant which results in easier recall and helps students to internalize the message. Students rehearse the process of struggling which can be of benefit to students during later struggles. Saying is believing exercises help the students convince themselves of the new information about learning instead of being told it is true (Yeager, Paunesku, Walton, & Dweck, 2013; Yeager et al., 2016).

Recently, researchers collaborated to refine a three-part mindset intervention. Mindset researchers and curriculum design experts worked together to design a new intervention designed specifically for the ninth-grade transition year. The three parts consisted of a computer-based curriculum to teach about the brain, a discussion activity, and journaling or letter writing. The new design resulted in less text and more videos on the computer component, and new and more relevant hypothetical scenarios designed specifically for ninth-grade students. When the new materials were presented to ninth-grade participants, researchers found the new materials were more effective in changing outcomes such as beliefs and short-term behaviors than the previous materials (Yeager et al., 2016).

The mindset lesson plan available from Khan Academy was used in the current study to help answer the research questions. The mindset intervention was required for the mindset and motivation surveys to be used as pre- and post-assessment instruments. The mindset and motivation surveys were administered to at-risk students. To better understand the background of alternative school learners targeted in the current study, the characteristics of at-risk students, and the importance of the ninth-grade year will be reviewed.

Characteristics of Alternative Students and the Transition to Ninth Grade

To better understand the struggles some alternative students beginning the ninth grade may encounter, characteristics of at-risk learners and importance of ninth grade will be discussed. This section contextualizes at-risk learners and the ninth-grade transition.

Characteristics of At-Risk Learners

A wide range of characteristics can be identified to define an at-risk learner. Characteristics of at-risk students include: low socioeconomic status, being of minority race, low Grade Point Average (GPA), having failed one or more grades, low discourse with parents about school, higher suspension rates, and attending many different schools (NCES, 1992). Hill and Rojewski (1999) found at-risk students were not dependable and had a much lower work ethic when compared to their peers. The authors concluded that, "at-risk students cannot be relied on to be in the right place at the right time or to be doing what they should be doing" (p. 275). The authors encourage the development of interventions to address these issues. In an experiment by Blau and Benolol (2016), the authors studied the effects of a mindset intervention with relation to the quality of digital

self-representations programmed though a creative computing application. The study found that at-risk students held an incremental theory of intelligence after a mindset intervention. As a result of the incremental mindset, these at-risk students designed more creative assignments than their "normative" peers.

All students at the alternative school possess one or more of the at-risk characteristics. Edgar-Smith and Baugher-Palmer (2015) define alternative schools to be, "educational programs [that] are designed to meet the academic, emotional, and behavioral needs of students who do poorly in the traditional school setting" (p. 134). Students at the alternative school are enrolled for one of three reasons; students attend in lieu of expulsion from their zone schools; they attend as a transition from the Department of Juvenile Justice (DJJ) to their zone schools, or they attend by choice to catch up on academic credits to graduate with their original class. Students who attend the alternative school in lieu of expulsion attend for numerous reasons. Minor infractions such as absenteeism, too many discipline referrals, or excessive tardiness may result in a referral to the alternative school. Students may have been found in possession of and/or under the influence of drugs or alcohol. Students might be sent to the alternative school for fighting or gang affiliated activities. Examples of more severe infractions would be weapons charges or assault of an administrator.

Research by (Paunesku et al., 2015) found a mindset intervention was particularly helpful for at-risk students. More specifically, this action research study targets at-risk students enrolled in the ninth grade. The ninth grade has been identified as an academically critical year for all students (Neild & Weiss, 1999). The following section describes how critical the ninth-grade transition can be.

Importance of Ninth Grade

Ninth grade can be a challenging year for many students. Research found students are particularly socially and academically vulnerable during school transitions (Felmlee, McMillan, Rodis, & Osgood., 2018; Neild & Weiss, 1999; Roderick & Camburn, 1999). Ninth-grade students that attend the alternative school are subject to additional vulnerability. Not only are they leaving a school where they have spent many years, but they are also leaving behind friends with whom they would normally rely during that transition to high school. "School transitions make contexts particularly salient, as students enter a new school milieu, have to reorient themselves to new social and academic demands, and have to renegotiate their sense of self, of academic impotence, and of belonging in a new and unfamiliar social space" (UChicago CCSR, 2012, p. 33). It is during these school transitions that the academic trajectories of dropouts diverged from those students who would later graduate from high school. Felmlee et al. (2018) cite that disruptions in the social network of adolescents are a problem during transitions.

Allensworth and Easton (2007) found that the relationship between ninth-grade course failure and the future dropout rate is so strong, that each additional failed semester course in the first year of high school is associated with a 15% decrease in the probability of graduating. Therefore, timing is essential for intervention. Yeagar and Walton (2011) found that the best time to implement a mindset intervention was just prior to or at the beginning of a transition to school. The authors state that a well-timed mindset intervention can cause lasting improvements in achievement and can change an adolescent's school trajectory.

UChicago CCSR (2012) claimed that half of the students entering the ninth-grade class would not graduate from high school. Of the students who graduated, a large number of minority students would not go to college, or would enroll in two-year colleges that had low rates of degree completion. Absences in Chicago Public Schools nearly tripled between the eighth and ninth-grade years. The UChicago CCSR researchers found that mindset interventions would most benefit students in middle school or early high school. The greatest leverage points for reducing gaps in educational attainment would be attained for these grade levels.

UChicago CCRS (2012) reported that on average, students' grades, attendance, and attitudes towards school decline after a school move. Further, urban and minority students are particularly at risk. UChicago CCRS researchers state, "Urban adolescents' school performance, involvement, and perception of the quality of their school environments decline markedly as they move to middle school and high school" (p. 60). In addition, declines in school performance are even more startling with the transition to high school where high rates of absenteeism and course failures abound. Course failure makes the impact of the ninth-grade year even more acute. Failing courses in high school is significant in a system where class advancement and graduation depends on the number of credits earned. Roderick and Camburn (1999) found students who fail a course in the first semester are at increased risk of failing future courses. The link between ninth grade transition and school dropout can be credited to the lack of credit accumulation. Neild (2009) characterized ninth grade as a "place in the educational progression where students…are at increased risk of getting stuck" (p. 56). The author

found that one-third of the high school dropouts never accumulated enough credits to move to the tenth grade.

Conversely, students who are on track at the end of the ninth grade are nearly four times more likely to graduate. The UChicago CCSR (2014) developed a quantitative indicator called the on-track indicator. The consortium researchers defined a student to be on track, "if he or she earns at least five full-year course credits (ten semester credits) and no more than one semester F in a core course (English, math, science, or social science) in their first year of high school" (p. 2). Also, student's academic performance in core courses during the ninth-grade year had a more significant impact on their chances of graduating than their academic skill levels (UChicago CCSR, 2012). Students ninth-grade year performances shape their chances of graduating more than their prior achievement (Allensworth & Easton, 2007).

Academic behaviors predict ninth-grade course failure more accurately than test achievement. It was found that using eighth-grade test scores only predicted eight percent of the ninth-grade failures. Rather, students failed courses because they did not attend class, did not do homework, or did not study. It was found that student absences quadrupled from the eighth-grade year to the ninth-grade year missing on average 27 days of school. Students' study habits also declined between the eighth- and ninth-grade years. Surveys given by UChicago CCRS (2012) every year showed study habits dropped by a fifth of a standard deviation in ninth and tenth grades compared to seventh and eighth grades. The decline in study habits was partially explained by the increased time students chose to spend with peers instead of studying. The Consortium states that the decrease in most ninth-grade grades can be attributed to absences and declining study

habits. Additional factors leading to lower grades included taking more rigorous classes, having to form new relationships with teachers and peers, and having to think more seriously about their goals in life, (Allensworth & Easton, 2005).

> In summary, UChicago CCSR (2012) had this to say about the ninth-grade year: As students start high school, particularly in urban areas, they experience dramatic increases in the complexity of their school environment – in the number of classes and teachers they interact with, in the academic demands of their coursework, and in the size of their school and peer groups. Students must learn to deal with increased independence and more diverse academic demands. (p. 59)

Supporting the ninth-grade year is critical in leading students to succeed in high school and ultimately graduation. Morgan, Sanatra, and Eschenauer (2015) reported, "Completing high school and entering institutions of higher education need to be a priority for our nation's youth, especially for those of minority and low socioeconomic status as a clear link exists between educational attainment and earning power" (p. 597). Many of the negative factors affecting students entering the ninth grade could be reduced or neutralized if students would adopt a growth mindset.

The Importance of Growth Mindset and its Benefits

Cognitive ability is not the only predictor of success over time. It has also been found that noncognitive factors such as mindset are important in academic success and motivation (Lleras, 2008; UChicago CCSR, 2012). This section explains the importance of noncognitive factors and how the factor of mindset has beneficial applications for at-risk students.

Noncognitive Factors

In a report by UChicago CCSR (2012), the importance of noncognitive factors was described. Economists refer to a long list of factors, including beliefs about students' own intelligence as noncognitive factors that were good predictors for future success in both college and the workforce. Research has moved away from the idea that cognition only takes place in the brain and that it can be influenced by such things as perception (Barsalou, 2010). The author states, "continuing to study cognition as an independent isolated module is on the fast track to obsolescence" (p. 325). Researchers expanded by stating, "Noncognitive factors are 'noncognitive' only insofar as they are not measured directly by cognitive tests. To affect learning and academic performance, however, noncognitive factors must engage a student's cognitive processes" (UChicago CCSR, 2012, p. 39). Mindset accomplishes this through students' perceptions of learning.

UChicago CCSR (2012) defined academic mindset, specifically, to be "psycho-social attitudes or beliefs one has about oneself in relation to academic work" (p. 9) or "beliefs, attitudes, or ways of perceiving oneself in relation to learning and intellectual work that support academic performance" (p. 28). Over the last 30 years, mindset has attracted the attention of researchers because many short-term interventions targeted at changing students' mindsets have been shown to have lasting effects on academic performance and increase of occupational earnings (Dweck, Walton, & Cohen, 2011; Lleras, 2008).

Students who believe they can grow their academic abilities through their own efforts, are more likely to strive toward building competence, self-motivation, and academic achievement. Dweck (1975) summarized by saying:

> The manner in which a child views an aversive event, such as failure, determines, in large part, the way in which he reacts to that event. Specifically, if a child believes failure to be a result of his lack of ability or a result of external factors beyond his control, he is unlikely to persist in his efforts. On the other hand, if a child believes failure to be result of his lack of motivation, he is likely to escalate his effort in an attempt to obtain the goal. (pp. 682-683)

In a review of evidence on academic mindsets as they relate to academic tenacity, Dweck et al. (2011) found, "educational interventions and initiatives that target these psychological factors can have transformative effects on students' experience and achievement in school, improving core academic outcomes such as GPA and test scores months and even years later" (p. 3). Therefore, mindset affects academic behaviors. UChicago CCSR (2012) found, "academic behaviors are a major determinant of course grades and that improving students' academic behaviors would increase students' course performance (p. 19). Perseverance is an important aspect of the academic process.

For students to complete the rigorous algebra tasks current state standards require, students must display academic tenacity. Academic mindset can determine whether or not students exhibit tenacity (UChicago CCRS, 2014). Other researchers have found other applications for growth mindset.

Other Mindset Advantages for At-Risk Students

A mindset intervention will benefit alternative, at-risk students (Paunesku et al., 2015). Blackwell et al. (2007) acknowledged the adolescent years are a critical point in development marked by increased antisocial behavior, declining self-esteem, reduced school engagement, and lower grades. Past research showed mindset interventions

helped to reverse poor academic achievement, even over an extended period of time, address achievement gaps, motivate students to work hard and not give up after setbacks in school, and reduce youth aggression (Blackwell et al., 2007; Cohen, Garcia, Apfel, & Master, 2006; Yeager, Trzesniewski, & Dweck, 2011). Mindset training has specifically been shown to increase achievement for low-income and minority students (Aronson et al., 2002; Blackwell et al., 2007).

A mindset intervention helped African American college students cope with stereotype threat. The intervention did not decrease the students' perception of stereotype threat. However, it did alter their response to it. The students who received the mindset intervention showed greater value in their academic work resulting in higher GPAs than their peers who did not receive the intervention (Aronson et al., 2002).

Dweck and London (2004) pinpointed many social development issues with which adolescents are faced and how their mental representations affect how they cope with those situations. The authors state, "Mental representations are the means through which children package their experiences and carry them forward" (p. 428). Adolescents who were faced with maternal depression, domestic violence with parents, and sexual abuse, for example, coped with these situations based on their mental representations. Those with a fixed mindset were later found to have more instances of depression and self-blame. Those with a growth mindset had better chances of overcoming the adverse effects. Thompson and Raikes (2003) identify mental representation as a bridge between children's backgrounds and their later behavior and suppositions. Dweck and London (2004) concur by stating:

> There is impressive evidence that children's beliefs play a highly important role in their coping, adjustment, and achievement in major areas of their lives. These beliefs are not only related to children's contemporaneous function but are also predictive of their functioning over time. (p. 433)

Benefits of a growth mindset were found well into adulthood. For older adults, Plaks and Chasteen (2013) found people who believe in the incremental theory of intelligence have better memory performance. It was found the stronger the incremental endorsement, the better the free recall.

As described above, the noncognitive skills have many applications that are advantageous to at-risk learners. However, without the proper classroom context and support of the teacher, students will not be able to apply newly learned growth mindset to academic situations (Boaler, 2016).

Classroom Context

Teachers have an important role in the development of growth mindset in the classroom (Boaler, 2016). The role of the teacher and importance of the classroom climate will be addressed in the following sections.

Mindset in the Classroom

There is a relationship between classroom context, noncognitive factors, and academic performance. School and classroom context affect academic mindsets, which lead to academic behaviors resulting in improved academic performance. The authors caution that student background can change every aspect of the model. This background would include all the characteristics a student would bring to the learning environment including, "demographic variables such as race/ethnicity, age, gender, language, and

socio-economic status, as well as family and neighborhood characteristics that might affect academic performance" (UChicago CCSR, 2012, p. 12). Additionally, "A student's previous academic achievement (including both grades and test scores), prior knowledge, past experiences in school, and pre-existing academic mindsets are also part of his or her background characteristics" (p. 12).

Mindset affects academic behaviors. UChicago CCSR (2012) found, "academic behaviors are a major determinant of course grades and that improving students' academic behaviors would increase students' course performance. There is also convincing evidence that academic behaviors are malleable and affected by classroom context" (p. 19). An academic mindset results in an increase in positive academic behaviors, and an increase in positive academic behaviors results in better course grades. Therefore, an academic mindset will result in better course grades. Classroom context influences academic mindsets, which affects academic perseverance within that context. The report found that if classrooms can support positive academic mindsets, then classrooms can contribute significantly to increasing students' perseverance in completing assignments leading to improved academic achievement.

Correctly using academic strategies is vital for academic success. The Consortium (UChicago CCSR, 2012) emphasized that positive academic mindsets drove the use of learning strategies. Learning strategies involve metacognition (the individual's knowledge of and control over his own cognition) which are necessary to achieve most learning outcomes. Specific to this study, Lleras (2008) found that noncognitive factors predicted better academic and occupational success for at-risk students.

Math anxiety is an enormous obstacle for many students. Richardson and Suinn (1972) define math anxiety to be, "feelings of tension and anxiety that interfere with the manipulation of numbers and solving of mathematical problems in a wide variety of ordinary life and academic situations" (p. 551). Responses to math anxiety can be both physical and/or mental and can lead to panic, helplessness, paralysis, and mental disorganization (Cemen, 1987). Many students believe math is a gift or often say, "I don't have a math brain." However, Boaler (2016) refutes these perceptions by stating:

> Although I am not saying that everyone is born with the same brain, I *am* saying that there is no such thing as a 'math brain' or a 'math gift,' as many believe. No one is born knowing math, and no one is born lacking the ability to learn math. (p. 5)

The benefits of promoting a growth mindset in the mathematics classroom are obvious. However, the teacher plays an important role in the process. The teacher has a responsibility to his or her students to provide equitable education to all students (Bell, 2013) and provide a classroom environment that is conducive to learning (Boaler, 2016).

The Teacher's Role in the Mathematics Classroom

Educators are responsible for the education of all their students, to ensure students' future success; this means no matter what their socioeconomic status (SES), gender, race, or sexual orientation, teachers have a responsibility to do what is necessary to provide an equal education to all. Helping to narrow the gender gap in mathematics is the responsibility of teachers. In a study by Leslie, Cimpian, Meyer, and Freeland, (2015) it was found that college professors in the mathematics field held the most fixed mindsets about who could learn. Boaler (2016) wrote that she believes it is imperative for our

society to move toward a more equitable and informed view of mathematical learning in our daily conversations and interactions with students. With the exception of particular special education needs, "everyone, with the right teaching and messages, can be successful in math, and everyone can achieve at the highest levels in school" (Boaler, 2016, p. 4).

Boaler (2016) wrote of a safe classroom environment where students are free to share their strategies and ask questions. Teachers must engage in dialogue with students concerning the importance of mistakes. Research by Moser, Schroder, Heeter, C., Moran, and Lee (2011) showed that synapses fired and the brain grew the most during times of struggle. In addition, brain activity was at its highest when students made mistakes. Teachers must engage in dialogue with students concerning the importance of errors. "When we teach students that mistakes are positive, it has an incredibly liberating effect on them" (Boaler, 2016, p.15). To promote an opportunity for mistakes, challenging problems must be given to the students to create a state of disequilibrium as described by Piaget.

The teacher must help students correct their perceptions of a mathematics classroom. Many students enter the classroom thinking mathematics always has a correct answer. Many teachers fail to make the connections of mathematics to the physical world using patterns. For example, the Fibonacci sequence is found in pine cones and many shells, and the golden ratio is found in art and architecture. Recently, the Fibonacci sequence has been found in tissue histology where mathematical rules are helping researchers understand how tissue renewal is disrupted resulting in a better understanding of some cancers (Boman et al., 2017). Teachers must commit to communicate growth

mindset through discourse, classroom climate, and rigorous lessons, to propel the mindset intervention.

Summary

Clearly, the ninth-grade year is difficult for many students. Students are faced with uncertainty in a new school, the teachers they will meet, and the peers with whom they will interact. If a student does not have academic success during the ninth-grade year, he or she may struggle academically in subsequent years of high school or drop out of high school prior to graduation.

Teachers have a moral and ethical responsibility to do what is necessary to ensure the academic success of their students. This moral responsibility includes providing creative and challenging lessons to offer opportunities for learning and brain growth, teaching students that anyone can learn math and be successful, and encouraging a learning environment that values mistakes and creative strategies for solving problems.

Mindset interventions have been shown to provide many benefits to students. When students hold incremental theories of intelligence, they have the beliefs that they are responsible for their own outcomes, both academic and personal. Mindset interventions increase motivation, academic achievement, and GPAs. Mindset interventions decrease stereotype threat, anxiety, and adverse reactions to PTSD.

Students must be willing to engage in rigorous, challenging math activities and problems. Possessing a growth mindset has been found to increase motivation to persist through challenging problems and activities. When teachers and students share a connection, such as a love for learning, motivation and achievement will increase, resulting in higher class grades and GPAs; most importantly teachers and students must

have a shared appreciation for the beauty of mathematics and patterns in our physical world.

CHAPTER 3

METHODOLOGY

The purpose of this action research study was to examine the impact of a Khan Academy growth mindset intervention on the motivation of at-risk, ninth-grade students in a mathematics classroom. To accomplish this, data were collected to allow quantitative analysis of students' self-reporting of perceptions pertaining to mindset beliefs before and after a mindset intervention and perceptions about motivation in the mathematics classroom.

The review of literature indicated that the adolescent years are significant for students with regards to human growth and development. Many physiological, psychological, and sociological changes occur during this time-period (McDevitt & Ormrod, 2016). The ninth-grade year is especially arduous due to challenges related to this transition period. Students are socially and academically vulnerable during school transitions (Felmlee et al., 2018; Neild & Weiss, 1999; Roderick & Camburn, 1999). Holding a growth mindset helped to reverse poor academic achievement even over an extended time, address achievement gaps, and motivate students to work hard and not give up after setbacks in school (Blackwell et al., 2007; Yeager et al., 2011). Thus, the following questions were researched:

RQ1: What are ninth-grade students' perceptions of mathematical mindset before and after a Khan Academy mindset intervention consisting of videos about the

brain and growth mindset, an article describing how the brain grows, and journal writing?

Sub Question 1: What is the relationship between mathematical mindset and motivation of ninth-grade at-risk learners enrolled in an alternative school mathematics classroom?

These questions resulted in the action research design described in the following section.

Action Research Design

The design of this study was based on the principles of action research. Action research is defined as a systematic inquiry conducted by teachers with a vested-interest in the teaching and the learning process. The purpose of action research is to gather information about how students learn, analyze the data, and reflect on the data to develop a plan of action (Mertler, 2014).

Action Research

The best learning takes place when someone is actively engaged in a process. Action research provides that opportunity for an educator. The teacher-researcher can test proven theories in the classroom while learning and growing through the reflective process. The results of the research can be used to enhance learning in the classroom or identify areas the teacher-researcher may need to explore as future professional development. This action research study will use quantitative methods and descriptive statistics to analyze pre- and post-test results of mindset and mathematics motivation Likert scales to determine changes in students' perceptions of mathematical mindset and its relationship to academic motivation in an alternative school mathematics classroom.

Action research differs from traditional research in several ways. Brydon-Miller, Greenwood, and Maguire (2003) stated, "Conventional researchers worry about objectivity, distance, and controls. Action researchers worry about relevance, social change, and validity tested in action by the most at-risk stakeholders" (p. 25).

Action research benefits the teacher-researcher, staff, and students. Action research is much more collaborative. In traditional research, only the researchers make decisions about how the project will progress. In action research, collaboration is necessary to conduct effective research. Since collaboration between staff members was high at the alternative school, action research was be the best choice to study the effects of mindset training for the students. The teachers' input was an integral part of planning the project which helped to guide the direction of the study. Murray (2015) described collaboration as, "more than simply meeting with other teachers. It requires providing teachers with the opportunity to examine, critique, and support one another's work in a safe and supportive environment" (p. 23). Brydon-Miller et al. (2003) emphasized that action research is not only about social justice of doing good, but doing things well. Without a collaborative relationship among stakeholders, the research is likely to be incompetent.

As the name implies, action research is not a passive form of research. Action research stems from an individual's values and recognizing when those values are being challenged within an institution or social situation and acting on those values. "These values require action. Knowledge comes from doing. Action researchers feel compelled to act collectively on and with the knowledge" (Brydon-Miller et al., 2003, p. 14). This form of active research is supported by the educational philosophy of Dewey who

believed most learning takes place when someone is actively doing something (Dewey, 1938).

Research Site

The study took place at an alternative school in central South Carolina. Edgar-Smith and Baugher-Palmer (2015) defined alternative schools to be, "educational programs [that] are designed to meet the academic, emotional, and behavioral needs of students who do poorly in the traditional school setting" (p. 134). The alternative school was located within a wing of a five-year-old magnet high school in a central South Carolina school district. The school consists of two floors with 17 classrooms, two computer labs, and smaller rooms for the guidance counselor, social worker, and school psychologist.

The physical school environment is visually pleasing and provides the most up to date technology available including, interactive boards, computers, and Chromebooks for students' use. The building is clean and signs hang from the ceiling that announce the Positive Behavior Intervention System (PBIS). PBIS is a foundational intervention at the alternative academy. Simonsen and Sugai (2013) reported that alternative schools often adopt more punitive responses to behavior due to the high concentration of problem behaviors found in an alternative population of students. However, Walker, Ramsey, and Gresham (2004) found punitive reactions to problem behavior to be the least effective in alternative education settings. When PBIS was implemented in an alternative education setting, research showed increased appropriate behavior, decreased problem behaviors, and decreased use of crisis-emergency responses such as restraint.

To simplify PBIS for students, the alternative school uses the acronym PACK, which stands for Perseverance, Accountability, Cooperation, and Kindness. The alternative school students originate from four high schools in the district. Two of the schools are sports rivals. To encourage cohesiveness among students, the alternative school has the wolf as its mascot. The wolf was chosen because wolves work together to ensure the survival of the pack.

To encourage student success, both academically and behaviorally, students receive PACK points for good behavior, kindness toward others, intelligent contributions to class discussions, or for seeing a challenging problem through to fruition. A new program was purchased to simplify the process for teachers to reward PACK points to students. When students receive PACK points, it is school-wide protocol for the teacher to explain why the students have been given the PACK points. There is a comment section in the program where teachers can quickly type the reason a student received the points. The PACK points may then be spent at the school den store. The den store is a small room that contains items for students to purchase with den dollars such as snacks, clothes, or school supplies. Simonsen, Britton, and Young (2012) found that School-Wide Positive Behavior Support (SWPBS) in an alternative school education setting was associated with an overall decrease in serious behavior incidents and an increase in the percentage of students who refrained from serious physical aggression. Edgar-Smith and Palmer (2015) found that more preemptive approaches work better with at-risk youth than more punitive methods.

Through PACK, the alternative school focuses on Habits of Mind (HOM). HOM are a set of sixteen problem solving and life related skills necessary to be productive in

society and help to promote reasoning in everyday situations. As a school, teachers and staff focus on these habits of mind to decrease behavior problems among students. Specifically, the categories of persisting, managing impulsivity, thinking interdependently, and listening with understanding and empathy are emphasized. Burgess (2012) found in her research that for an increase for each of the sixteen HOM investigated, there was a general decline in problematic behaviors.

The PBIS program helps students build an attachment to the school. Edgar-Smith and Palmer (2015) found when students are supported by staff and treated more fairly, they perceive a sense of belonging within the school and therefore do better academically and behaviorally. In addition, this sense of community and belonging decreased school violence and disciplinary action. Research also supports, "praising the student's process - which could be their effort, strategies, concentration, choices, persistence - helped them remain motivated, confident, and effective" (Dweck, 2007, p. 9). Staff recognized relationships with students were important and strived to make personal connections with each student. Teachers stand at their doors during class changes to welcome students to their classes, usually greeting students by name. Morale is high in the school and teachers are often seen laughing and interacting with each other and their students. The atmosphere is usually relaxed. However, during the close of semesters, the student numbers increase and hallways can become loud and chaotic.

The high school is run by a principal, administrative assistant, two secretaries, a guidance counselor, and seven curriculum teachers. Total high school student enrollment is usually between forty to sixty-five students. Tenth grade contained the highest percentage of overall enrollment. Student population varied from day to day due to

admittance of new students, current students returning to their zone schools, or expulsion. The average stay for a student at the alternative school was one to two semesters. Some students with an IEP left after 45 days. An expulsion hearing officer determined how long a student was required to attend the alternative school. After a student completed his or her requirements at the alternative school, he or she returned to his or her zone school.

The alternative school values diversity, individuality, and learning. Alternative school curriculum parallels the students' zone schools. Therefore, the same textbooks were used for core subjects, district curriculum guides, and course pacing guides were strictly followed to guarantee instructional uniformity throughout the district. The pacing guides and South Carolina state curriculum standards were reflected in teacher lesson plans. However, scheduling at the alternative academy is different. High schools in the district run on an A-B block schedule where four 90-minute classes are taught on an A day, and four different 90-minute classes are taught on a B day. At the alternative school, all eight classes were taught daily for 48 minutes each. This helped accommodate students with learning disabilities such as Attention Deficit Disorder (ADD).

Student Participants

Students who participated in this study were ninth-grade mathematics students at an alternative school. Students at the alternative school are enrolled for one of three reasons: they attend in lieu of expulsion from their zone schools; they attend as a transition from the Department of Juvenile Justice (DJJ) to their zone schools; or they attend by choice to earn more academic credits to ensure graduating with their original class. Students who attend the alternative school in lieu of expulsion attend for numerous

reasons. Minor infractions such as absenteeism, too many discipline referrals, or excessive tardiness, may result in a referral to the alternative school. Students may have been found in possession of and/or under the influence of drugs or alcohol. Students may be sent to the alternative school for fighting or gang affiliated activities. Examples of more serious infractions may be weapons charges or assault of an administrator.

If a student were recently released from DJJ, or were transferred to the district from another alternative school, that student attended the alternative school. This policy helped to successfully transition the student to his or her zone school. Time spent in DJJ, reduced rigorous academic instruction by weeks or months. The alternative school offers remediation programs that provide an opportunity for the students to acquire the academic skills necessary to successfully transition to their zone school classrooms. Research by Sheldon-Sherman (2013) found, "Youth with learning, developmental, and behavioral disabilities are at an increased risk both for educational failure and incarceration. They are more likely than their non-disabled peers to experience school failure and subsequent poor adult outcomes" (p. 228). Scholars and policy makers agree education is the link to reintroducing them to society. The alternative school provided this link.

Students may attend the alternative school by choice. To attend by choice, students must meet with district personnel for approval. Students who were lacking credits and wished to graduate with their classmates attended. The alternative school had more lenient academic policies than traditional schools in the district. Choice students attending the alternative school, may earn more credits in one year than students attending traditional high schools. Students with learning disabilities or emotional

challenges attended the alternative school because they found the smaller class sizes to be an advantage. For example, students with Attention Deficit Hyperactivity Disorder (ADHD) are more successful because they can be more mobile and experience more academic success in a smaller classroom (Bussing et al., 2002).

Since alternative school populations are relatively small comparted to zone school student populations, all ninth-grade students at the alternative school were included in this action research study. All ninth-grade participants in this research study were considered at-risk students. There is no consistent definition of the term at-risk. The definition largely depends on the context in which the term is used. For the purposes of this research study, an at-risk student refered to a student, "who is struggling and who may need supplemental or additional instruction to accelerate development in targeted instructional areas" (Zais, 2011, p. 68). Characteristics of at-risk students included: low socioeconomic status, being of minority race, low GPA, having failed one or more grades, low discourse with parents about school, higher suspension rates, and attending many different schools (NCES, 1992). Academic behaviors predict ninth-grade course failure more accurately than test achievement. It was found that using eighth-grade test scores only predicted eight percent of the ninth-grade failures. Rather, students failed courses because they did not attend class, did not do homework, or did not study. It was found that student absences quadrupled from the eighth-grade year to the ninth-grade year missing on average 27 days of school. Students study habits also declined between the eighth- and ninth-grade year. Surveys given by the consortium at UChicago (2012) every year showed study habits dropped by a fifth of a standard deviation in ninth and tenth grades compared to seventh and eighth grades. The decline in study habits was

partially explained by the increased time students chose to spend with peers instead of studying.

Most ninth-grade students enroll at the alternative school with a low GPA, history of high absenteeism, and/or high suspension rate for problem behaviors. The following demographics were collected from the district office for current ninth-grade students: Sixty-four percent of students lived in a single parent household, 67% of students were male, 86% of ninth-grade students lived in poverty, 23% had an individual education plan (IEP), behavioral intervention plan (BIP) or 504 Plan, and 86% of students were considered minority race.

Specific participant characteristics for this action research study included one male student enrolled in an Algebra 1 class. This student was a Hispanic male not considered to be living in poverty and did not have academic accommodations. This student was re-taking the class for the second time due to expulsion from his zone school late in the previous academic school year. Five students were enrolled in the basic Foundations of Algebra class as early promotion students. Early promotion students are students that are behind academically and are being socially promoted to the ninth grade. This class consisted of four African American males and one Caucasian female. All four males were advancing from the eighth grade instead of repeating the eighth grade a second time. The female was held back in sixth grade and was advancing from the seventh grade. She never attended eighth grade. Three of these five students were living in poverty and one student had an active IEP. Four of the five students were of minority race. During the action research study, one African American male was referred to the Student Assistance Team (SAT) to be evaluated for a 504 Plan. The South Carolina

Department of Education defines the SAT to be, "a group of teachers, administrators, and other professionals who identify needs and provide plans to assist students to be more successful in school" (Zais, 2011, p. 74). During this process, the mathematics and English teachers of the student scribed daily anecdotal records for a period of two weeks. The team, consisting of the student's parent, a teacher, the guidance counselor, the principal, and a resource teacher, met to determine if any academic or behavior interventions were necessary. This meeting took place after the study was completed.

Teacher Role

The researcher found the most effective way to implement the research project was by using an action research design. In action research, collaboration is necessary to conduct an effective project. The researcher's role was teacher–researcher. The researcher collaborated in an action research study while simultaneously performing required duties as a teacher. Banegas (2012) explained:

> Teacher-researchers may assume the identity of facilitators in the sense that they may organize meetings, lead CAR [collaborative action research] cycles and stages, provide input materials for their colleagues with which to create knowledge (Avgitidou, 2010; Goodnough, 2010) but simultaneously ensuring that research standards and methodologies are observed. In addition, these teacher-researchers are also teachers and therefore may be part of the teachers wishing to introduce changes locally. (p. 31)

As a classroom teacher, the teacher–researcher will assume the role of full participant. Mertler (2014) stated:

> A full participant is simultaneously a fully functioning member of a "Community" as well as a researcher (Glesne, 2006). In this role, the researcher is first and foremost part of the group – as opposed to being an "outsider" – who also happens to be collecting data on the group. (p. 94)

The teacher-researcher used a lesson plan from the Khan Academy web-site (Khan Academy & PERTS, n. d.) to develop a growth mindset for students.

Design of the Study

The design of the current action research study was a collaborative effort between staff at the alternative school and the teacher-researcher. Staff from the alternative school were involved with the identification of the problem of practice and brainstorming solutions. The teacher-researcher used current research to plan and implement the mindset intervention and data analysis.

Identifying an area of focus. At the alternative school, topics concerning the school environment were discussed during faculty meetings or during our common planning time. During these meetings, teachers and staff were encouraged to discuss concerns about student behavior or overall school climate. Concerns about graduation rate, ninth-grade students' retention rates, academic achievement, and motivation to complete assignments, were expressed. The alternative school has a PBIS team that specifically focuses on improving the PBIS system. This team was responsible for training new teachers at the beginning of every school year. The training took place during an in-service day before the students began in August. Teachers reflected on and re-evaluated the productivity of our PBIS system. Student achievement, motivation,

ninth-grade retention rates, and graduation rate were, again, a topic of concern, and therefore, a problem that required further attention and research.

Supporting the PBIS model with growth mindset training was identified to increase student motivation and achievement for ninth-grade students. Research was used to help justify this decision. Teaching a growth mindset to students was identified by leading researchers as a problem that needed to be addressed by legislators, the U. S. Department of Education, and schools (Rattan, Savani, Chugh, & Dweck, 2015). Dweck (2006) explained that the adolescents with fixed mindsets were concerned about looking dumb or stupid in front of their peers. This was a way for them to protect themselves from ridicule. "It's no wonder that many adolescents mobilize their resources, not learning, but to protect their egos. And one of the main ways they do this…is by not trying" (p. 58). It is important as an education community to use available resources to help students be academically successful. Mindset training has been found to be successful, especially for the at-risk student (Oyserman, Bybee, & Terry, 2006). A mindset intervention was found to have a positive impact on the GPAs of core academic subjects for at-risk students. These students' class grades in core academic subjects increased an average of 6.4 percentage points (Panuesku et al., 2015). Mindset training has specifically been shown to increase achievement for low-income and minority students (Aronson et al., 2002; Blackwell et al., 2007). Mindset training has also been shown to decrease aggression and stress in response to peer victimization or exclusion which resulted in enhanced school performance (Yeager & Dweck, 2012).

Mindset intervention. Brainology® was the first consideration for the mindset intervention. Brainology® was designed to teach students about the malleability of the

brain and how effort in school can increase intelligence (Dweck, 2006). Brainology® is a computer-based program developed by educational experts, media experts, and brain experts. The program consists of six learning modules that follow two animated students Dahlia, who has trouble learning Spanish, and Chris, who has trouble with math. Brainology® required a substantial time commitment and was an expensive program to purchase. Therefore, Brainology® is not appropriate for the time constraints and budget associated with an action research study.

Khan Academy is a non-profit educational organization that provides videos for learning. Khan Academy collaborated with the Project for Education Research That Scales (PERTS), a center at Stanford University that applies research to promote education, to create a lesson plan to develop growth mindset for adolescent school students (Yeager, et al., 2016). PERTS created a lesson plan (see Appendix A) available on the Khan Academy website (Khan Academy & PERTS, n. d.) to educate, and promote growth mindset for, students. The lesson identified three learner objectives: The students will understand intelligence can be developed, the students will understand the brain is malleable, and the students will understand engaging in challenging work is the best way to make the brain stronger and smarter (Khan Academy & PERTS, n. d.). The lesson plan consisted of three parts. The first part included watching two videos about growing your mind and neuroplasticity. These two videos provided the information to satisfy the three learner objectives. The second part consisted of a discussion about students' personal experiences with struggle and how they were overcome. A short article about how the brain learns and grows (see Appendix B) was read as a whole-class activity. This article was available online at

https://www.mindsetworks.com/websitemedia/youcangrowyourintelligence.pdf (Mindset Works, n. d.) (see Appendix C for copyright permission). Students and the teacher-researcher took turns reading the article. This discussion provided an opportunity for students to verbalize a personal example where effort was exerted to conquer a challenge. This stimulated students to connect to a prior situation (connecting to prior knowledge) where effort resulted in a positive outcome. These first two parts took place during a 45-minute class block. Part three had the students write a letter to a future student about their learning-related struggle (see Appendix D for sample student letters). The act of writing the letter was a "saying is believing" exercise. This exercise made the information more relevant which resulted in easier recall and helped students to internalize the message. Students rehearsed the process of struggling which benefited students during later struggles. It helped the students convince themselves of the new information about learning instead of being told it was true (Yeager, et al., 2013; Yeager et al., 2016). The writing activity took approximately 20-minutes on the second day of the intervention. In addition, the lesson plan provided lesson extensions and activities that could supplement the lesson objectives. However, due to constraints from the district mathematics pacing guides, the teacher-researcher did not take advantage of these activities. This lesson plan provided the foundation to investigate a change in fixed mindset and student motivation in a mathematics classroom.

To facilitate the change in classroom discourse to a more positive, growth mindset atmosphere, a bulletin board was created to help guide classroom discussion. Figure 3.1 shows the bulletin board that was displayed in the classroom. The bulletin board was colorful and the main focal point of the room. The teacher-researcher would often refer

to the bulletin board when students would verbalize fixed mindset statements. For example, if a student would get frustrated and state, "I give up!" the teacher-researcher would ask what strategies he or she could use, instead of giving up.

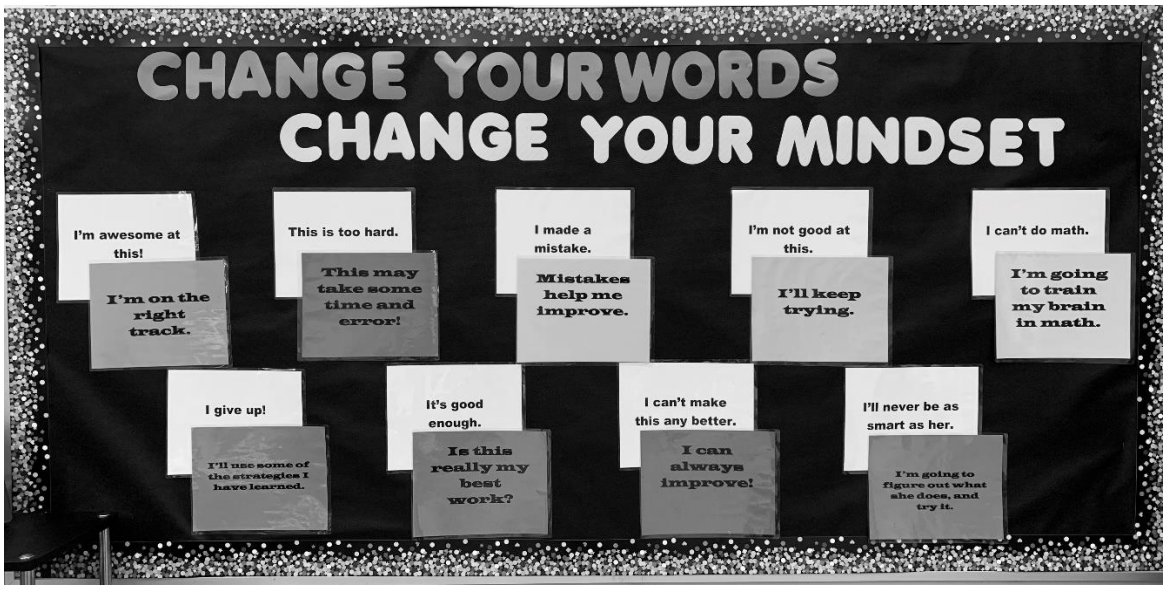

Figure 3.1 Growth mindset bulletin board.

Data Collection

This section explains the steps taken to obtain permission to collect data, and the instruments used to collect data. Likert-scales were selected for data collection because, "responses to such a survey can be reduced to numbers" (Mills, 2007, p. 75). This facilitated the teacher-researcher with quantitative data collection. Mills (2007) also suggested Likert scales and quantitative data as the best way to describe students' attitudes. Mertler (2014) concurred with Mills in that Likert scales are best for describing students' attitudes, but adds that Likert scales are the best way to measure students' perceptions. Further explanation is needed to describe the actual survey used and these instruments will be described in detail.

Table 3.1 shows the schedule the teacher-researcher followed during data collection and data analysis.

Guardian permission forms. All participants were under the age of eighteen. Therefore, guardian permission forms (see Appendix E) were sent home with students. The teacher-researcher explained the background of the study to the students. Students were told that participation was voluntary and that all students would be participating in

Table 3.1 Data collection and analysis schedule

9-17 and 9-18	Guardian Consent forms distributed to students and email sent home to parents explaining research and forms
9-24 to 9-26	Pre-test Fixed Mindset Scale and Math Motivational Beliefs Scale administered to students
10-1 and 10-2	Khan Academy lesson plan taught
10-8 to 10-19	Analyze pre-test data
10-22 and 10-23	Administer post-test for Fixed Mindset Scale and Math Motivational Beliefs Scale
10-29 to 11-4	Analyze and compare data

the surveys and classroom activities. The permission slip was only to allow the surveys to be used as data for the action research study. The teacher-researcher sent an email home to parents explaining the study and that their student would be bringing home a form for them to sign to allow their surveys to be used as data in the action research study. Two students were out of the classroom for testing and one was absent. The email explained that students who did not have the paper that day, would have it the following day. However, a tropical storm resulted in the delay of the return of permission forms and data collection.

Two instruments were used to provide information to answer the research questions. The Fixed Mindset Measure was used to measure increases in growth mindset among students. The Motivational Beliefs Scale was used to measure student motivation towards mathematics.

Fixed mindset measure. To measure students' mathematical mindsets before and after the mindset intervention, the Fixed Mindset Measure (see Appendix F) was used. The Fixed Mindset Measure consisted of three items designed to measure the extent to which respondents perceived that intelligence is a fixed entity that could not be changed with experience and learning: 'You have a certain amount of intelligence, and you really can't do much to change it,' 'Your intelligence is something about you that you can't change very much,' and 'Being a 'math person' or not is something that you really cannot change. Some people are good at math and other people aren't.' Each statement was ranked on a five-point scale from 1 (Strongly disagree) to 5 (Strongly agree). The instrument was designed for ninth-grade students, ages 13-17, experiencing a transition to high school which aligns with the problem of practice. A Cronbach's alpha of .74 was revealed following a reliability analysis an no data was available for validity (Yeager, et al., 2016).

It was expected that the mindset intervention would decrease the number of students who perceive a fixed mindset. The results of the Fixed Mindset Measure provided the teacher-researcher with information on which to base future decisions. If analysis revealed a decrease in fixed mindset among students, the intervention would be promoted in future years to guide instruction and discourse in the classroom.

Math motivational beliefs scale. To measure students' perceptions of motivation toward mathematics, the Math Motivational Belief Scale (see Appendix G) was administered (Watt et al., 2012). This instrument was designed specifically to measure students' perceptions of their ability and expectancy of success, intrinsic value, and attainment and utility values for mathematics (Watt et al., 2012). The first four questions assess students' perceptions of mathematical ability or expectancy of success. The questions and statements were:

1. If you were to list all the students in your grade from worst to best in math, where would you put yourself?

2. How good at math are you?

3. How well do you expect to do at math this year? and

4. How good would you be at learning something new in math?

These four questions are ranked on a five-point scale ranging from 1 (not at all) to 5 (very). Questions five and six assess the intrinsic value of math to the learners. The questions or statements were:

5. How much do you like math? and

6. In general, I find working on math assignments: (very boring, very interesting)

The questions ranked on a scale from 1(not at all) to 5 (very). To measure attainment and utility values, these questions are asked, or statements of truth were ranked:

7. Compared to other activities, how important is it to you to be good at math?

8. For me, being good at math is: (not at all important, very important);

9. Compared to other activities, how useful is what you learn in math? and

10. In general, how useful is what you learn in math?

Questions nine through eleven were ranked on a scale from 1(not at all) to 5 (very).

Minor changes were made to the Math Motivational Belief Scale. Due to an administrative error, one question on the original Math Motivational Beliefs Scale was excluded from the pre-test. Therefore, the same question was deleted from the post-test. Since the deleted question from the original Math Motivational Beliefs Scale was a question regarding intrinsic motivation, this was the only section of the test that may be considered unreliable. The teacher-researcher changed the original Math Motivational Beliefs Scale from a seven-point scale to a five-point scale to match the number of responses in the Fixed Mindset Measure. The teacher-researcher made the adjustments for the purposes of quantitative data analysis.

It was expected that the mindset intervention would increase the number of students who demonstrated an increased motivation in the mathematics classroom. The transition to high school has been found to have a negative impact on academic motivation, interest in school, and academic achievement (Eccles & Roeser, 2011). The results of the Math Motivational belief Scale provided the teacher-researcher with information on which to base future decisions for ninth-grade students. If there showed to be an increase in motivation among students, the mindset intervention would be taught in future years to guide instruction and discourse in the classroom. The teacher-researcher had a responsibility to do what is necessary to help his or her students be academically successful (Mertler, 2014). If the mindset intervention proved to be

beneficial, it should become an integral part of teacher-researcher's future instruction. To help determine whether the intervention provided a benefit, data were analyzed.

Analyzing and interpreting data. When analyzing whether to use qualitative, quantitative, or mixed methods for an action research study, mixed-methods may appear to be the best choice. However, there are both advantages and disadvantages to using mixed-methods which were considered before choosing this form of data collection. Fraenkel, Wallen, and Hyun (2015) explained mixed-methods research can be used to help clarify and explain the relationships that exist between variables, to allow the exploration between those variables in more depth, and to help confirm or cross-validate relationships discovered between variables. Mertler (2014) stated many action research designs may align better with mixed-methods research. The benefits include analysis of statistical data from the quantitative research and the insight given by the participants that can be gained from the qualitative research. The author also found mixed-methods advantageous when a researcher may want to extend from one phase of research to another. "For example, one might want to first collect qualitative data in order to guide the development of a quantitative survey instrument" (p.104).

Fraenkel et al. (2015) identified three main disadvantages to mixed-methods research. The researcher must analyze two types of data. This process can be very time consuming. In addition to analyzing two types of data, these data must be evaluated to identify trends or commonalities that exist between the two sets of data thus extending the time requirement even further. Second, analyzing two types of data can be expensive to carry out. More types of data collected results in more computer software programs to execute the statistical tests required. Lastly, expertise is required for both types of data

collection. If the researcher is not an expert in both types of data collection, the authors suggest collaborating with another researcher which is not feasible for this action research study.

Inferential and descriptive statistics are both ways to analyze quantitative data. The goal of inferential statistics is to, "determine how likely a given statistical result is for an entire population based on a smaller subset or sample of that population" (Mertler, 2014, p. 174). "Inferential statistics are more complex and permit researchers to test the statistical significance of the difference between two or more groups or to test the degree of correlation between two variables" (p. 11). This type of research is useful if one were to use more traditional research. Due to the time constraints and subject numbers of this action research plan, inferential statistics would not be appropriate.

Descriptive statistics benefited the action research plan. Mills (2007) states descriptive statistics is the best way to give, "lots of information about a range of numbers using only one or two numbers" (p. 223). Mertler (2014) explained, "Descriptive statistics allows researchers to summarize, organize, and simplify data. Specific techniques include such statistics as the mean, median, mode, range, standard deviation, correlation, and standardized scores" (p. 11). These statistics were easy to compute and were executed using a calculator and Excel analysis extension. Due to the small number of participants and use of Likert-Type rating scales, it was determined by the teacher-researcher to use mean to determine the average responses for each question. Mills (2007) stated a mean allows for comparison of how participants performed on average. Since the Likert-Type rating scales maintained a range of four, outliers were not a concern for analyzing the data. Range was used to describe variance instead of

standard deviation. Comparing measures of central tendency allowed the teacher-researcher to organize data collected from both inventory Likert-Type scales. Descriptive statistics allowed the teacher-researcher to identify trends. Due to the low number of participants, bar graphs for each question comparing pre- and post-test results were created. These bar graphs allowed readers to visually compare results. Due to the demographics of the participants, any statistics and trends including race or gender were not relevant. After the data were analyzed, the data were used to develop a plan of action.

Developing a plan of action. Reflection was an important element of this action research plan of action. In action research, reflection requires active thinking and engagement. Mertler (2014) described reflection as a process that can reveal where your research has taken you, what you have learned, and where it can take you moving forward. Reflection involves effort. This effort forces the teacher-researcher to act on a situation to improve understanding (Dick, 2015). Dick claimed, "Without effortful reflection, however, the understanding may remain as tact knowledge" (p. 438).

There are two main ways this active reflection can enhance the teacher-researcher's understanding. The first is reflecting on the outcomes of the study to guide future planning for professional development (Mertler, 2014). As the data are analyzed, trends will appear that reveal weaknesses in the teacher-researcher's area of expertise. These weaknesses would be evaluated by the teacher-researcher as possible areas for professional development to further improve teacher-researcher effectiveness. The second is to reflect on the action study itself, paying attention to methodologies. The teacher-researcher should reflect on the research questions to evaluate whether the

methods used answered the research questions or whether the research will be used to determine what could be changed to improve the study for the next cycle of the action plan.

The entire research plan was formed by two needs observed by the teacher-researcher. First, the students at the alternative school often expressed their lack of ability in mathematics and dismissed their poor performance in math as something they could not change. Second, the increase in standardized testing and teacher accountability over the past twenty years was interpreted as a reason to try more innovative techniques to improve graduation rate by increasing motivation in the mathematics classroom. The teacher-researcher observed two areas that were addressed by the mindset intervention for the sake of social justice.

Social Justice

Educators are responsible for the education of all their students to ensure students' future success; this means no matter what their socioeconomic status (SES), gender, race, or sexual orientation, teachers have a responsibility to do what is necessary to provide an equal education to all. Bell (2013) states, "social justice involves social actors who have a sense of their own agency as well as a sense of social responsibility toward and with others" (p. 21). Bell defines social justice as, "full and equal participation of all groups in a society that is mutually shaped to meet their needs" (p. 21). Dana and Yendol-Hoppey (2014) addressed the teacher's responsibility by stating:

> Engaging in inquiry is a responsibility you accept as a teacher that enables you to take a stand and effect educational change. By generating data and evidence to

support the decisions and positions you take as an educator, you help reform classrooms and schools, which results in the promotion of social justice. (p. 56)

The teacher-researcher has a professional responsibility to teach mathematics students the content standards so students can perform at a proficient level. Based on professional knowledge and research, the teacher-researcher believed mindset training would benefit alternative school students. Teaching a growth mindset was specifically shown to increase achievement for low-income and minority students and increase motivation (Aronson et al., 2002; Blackwell et al., 2007). The teacher-researcher also believed that teaching students to monitor their own learning would lead to greater future success.

Research supports the teacher-researcher's views toward the importance of mindset training for at-risk students. Mindset intervention was identified by leading researchers as a problem that needs to be addressed by legislators, the U. S. Department of Education, and schools (Rattan et al., 2015). Yeager and Walton (2011) identify poor academic achievement as a social problem that needs to be addressed. The authors believe, "psychological interventions have a demonstrated potential to address fundamental problems, including low student achievement and large group differences, at low cost and over significant periods of time" (p. 294). There are social justifications for the teacher-researcher to study the effects of a mindset intervention. However, the possible negative impacts that the intervention may have for the students must also be considered.

Ethical Considerations

Mertler (2014) describes ethics recommendations and emphasizes that adhering to ethics rules is the primary responsibility of the researcher. Participating alternative school students were under the age of eighteen, therefore, informed consent forms were provided to parents. Specifics of the research and confidentiality requirements of the district were explained in the guardian consent. Student assent forms were not provided to the students. Research indicates bringing attention to the intervention can cause questionable results, especially when self-reporting is concerned (Yeager and Walton, 2011). However, students were not required to participate in surveys and refusal to participate did not affect their academic grade since all grades were standards based. It was also the teacher-researcher's responsibility to request permission from the school district and principal to collect data from students, inform them of the nature of the research, and explain how the research would benefit the students and the district. The school district has procedures for this request online. The teacher-researcher completed the form and submitted it to the appropriate person. The teacher-researcher received site approval from the principal (see Appendix H) and an email from district office personnel explaining that specific permission from the district was not necessary since the research was conducted as part of regular classroom instruction. Even though data for only ninth-grade students were included in the study, it was determined by administration and faculty that all alternative school students would participate in the mindset training. The University of South Carolina Internal Review Board (IRB) excused the study from any restrictions (see Appendix I).

Confidentiality laws will be strictly adhered to in the school setting. Teachers must already adhere to strict confidentiality laws; therefore, no specific changes to practice were required. Research results were available to parents who wished to receive them. However, no parents requested the results. No physical or emotional harm affected the students. No academic content was jeopardized due to scheduling of Khan Academy units during the research. The teacher-researcher fell behind the pacing guide two days however, the content was made up without incident.

The authors Dana and Yendol-Hoppey (2014) caution that there can be a conflict of interest when the teacher and researcher are the same person. However, this was not an issue with this Dissertation in Practice because the planned research did not alter instruction in any way and there was no bias as to how the teacher- researcher treated, or behaved around, individual students.

Teachers are also responsible for the safety and academic success of their students. Past research shows mindset interventions help to reverse poor academic achievement even over an extended time-period, address achievement gaps, motivate students to work hard and not give up after setbacks in school, and can reduce youth aggression (Blackwell et al., 2007; Cohen et al., 2006; Yeager et al., 2011). Yeager and Walton (2011) summarize by stating, "Psychological interventions have a demonstrated potential to address fundamental problems, including low student achievement and large group differences at low cost and over significant periods of time" (p. 294).

Chapter Four will reveal the findings of the research. Chapter Five will detail compelling discoveries from analysis and reflections.

CHAPTER 4

RESULTS

Data collection resulted from administrative and staff identified weaknesses observed from student data. Observations revealed a high ninth-grade retention rate. The teacher-researcher developed the Problem of Practice, purpose of the study, and research questions based on student data. The identified problem of practice for this action research study resulted from ninth-grade student retention and failure rates being higher than other high school levels at an alternative school. Student data showed high failure rates for ninth-grade students compared to tenth, eleventh, and twelfth grades. The purpose of this action research study was two-fold. First, this study provided support for ninth-grade at-risk students' academic success in mathematics while encouraging a growth mindset by implementing a mindset intervention. Second, the teacher-researcher explored how this intervention impacted students' motivation in a mathematics classroom.

The purpose of this chapter is to explain the data analysis process and organize the collected data as it relates to fixed mindset and motivation in a mathematics classroom. This chapter will include the intervention strategy and data collection details including graphs displaying survey question results for each participant.

Intervention Strategy

The intervention strategy was a multi-week process. The process began by obtaining the many consents needed to conduct the research within the school. Consent

from building administration, district administration, and University of South Carolina Internal Review Board (IRB) were needed. Consent from student guardians was necessary to collect data that were required to address the research questions.

Consent for Research

Prior to pre-test data collection, permissions to collect data were obtained by the alternative school principal, school district, and the University of South Carolina Internal Review Board. The principal gave permission to the teacher-researcher in the form of a formal letter granting site approval for research. The letter was on alternative school letterhead and contained the signature of the principal. The school district representative sent an email to the teacher-researcher stating that formal authorization for research was not necessary since the intervention was to be included in classroom lessons. The teacher-researcher received a formal letter from the University of South Carolina IRB explaining the action research was exempt from any university restrictions and could be conducted as planned. These previous permissions allowed for data collection to begin.

The data collection process began with the students. The students were informed of the study by the teacher-researcher. It was explained that the teacher-researcher was working on her doctorate at the University of South Carolina. All students would be involved in the process by taking the surveys and learning about the brain. Only certain students would receive a request for their data to be used in the research paper. The request would be in the form of guardian consent that had to be signed by a parent or guardian. Students were informed that their names would not be used in the action research study and only the data from the anonymous surveys would be used. Guardian Consent Forms were distributed to students to take to their guardians for consent. An

email from the teacher to the guardians was sent the same day the forms were given to students. The email informed the guardians that the teacher-researcher was completing her doctorate and that data was necessary for the action research study. Guardians were also informed that their students' names would not be identified in the paper. Only one paper was returned within a ten-day period, therefore the teacher made personal phone calls to guardians asking them to sign the consent forms. Two more consent forms were returned after the phone calls. Other forms were signed at the teacher-researcher's request during parent night. This process took six weeks to collect the necessary consent forms which were necessary to fulfill the ethical requirements for research. All affected parties were informed that research was taking place within the classroom.

Pre-Test Likert-Type Scales

Nine students in the teacher-researcher's mathematics classes were identified as ninth graders. These nine students were assigned random numbers ranging from one to 100. The random number generator on a TI-Nspire CX calculator was used to assign numbers to students. Students' names and corresponding numbers were written on a piece of paper and taken to the teacher-researcher's house for confidentiality purposes. The numbers were written at the top of the pre-tests and distributed to the corresponding students. Students who were not part of the data process did not have a number written at the top of their pre-tests. All students returned the pre-tests. Students who did not have numbers at the top of their survey papers did not notice that some students did have a number at the top of their survey papers and vice versa.

A test-retest method was used for data collection. Fraenkel (2015) described this method as, "administering the same test to the same group after a certain time interval has

elapsed" (p. 159). A six-week interval was planned by the teacher-researcher. However, due to a weather event, students missed five days of school. Therefore, the interval between the pre- and post-test was extended to seven weeks. During this time, subject mortality became an issue.

Nine students participated in answering the pre-test for the Fixed Mindset Measure and the Mathematics Motivation Scale. Between the pre- and post-test for the measurement instruments, three students were dropped from the study due to subject mortality. Fraenkel (2015) acknowledged mortality is to be expected, especially in intervention studies, since these studies take place over time. Student # 88 was incarcerated for the murder of a father and his infant son in the midlands of South Carolina. Student # 11 was recommended for expulsion for numerous classroom behaviors and rule violations. Since the student had an IEP, he could not be expelled, but was recommended for homebound instruction and was not attending school to receive the mindset intervention. In addition, during his time out for suspension, he attended a court hearing where he was ultimately arrested and taken to DJJ. Student # 86 engaged in a fight during lunch and she was expelled from school for the remainder of the semester.

Mindset Intervention

The mindset intervention took place during a six-week period. The Khan Academy lesson plan was followed, along with an article from mindsetworks.com that explained how the brain grows. The students then wrote a letter to future middle school students who would attend the academy. The lesson plan took two class periods to complete. During the first day, two videos were shown (See appendix A for lesson plan).

The *Growing your Mind* video ran for three minutes. After the video, a question and answer session took place, during which, the following questions were discussed:

- How do people become more intelligent?
- How does the diagram of the neurons "At birth vs. At age 6" demonstrate this?
- How does the second diagram of the nerves of the animal living in a cage vs. an animal living with other animals and toys demonstrate this?
- How are our brains like muscles?
- When do our brains grow the most? (Clarify that it is when you get an answer wrong and then figure out strategies to correct your mistake!)

After this discussion the *Neuroplasticity* video, that lasted 2 minutes, was viewed.

When the second video was finished, the question "What is neuroplasticity?" was asked and discussion took place. In addition to the videos, students took turns reading the mindset article from https://www.mindsetworks.com/websitemedia/youcangrowyourintelligence.pdf (See appendix B).

During the following seven weeks, mindset discourse and constructivist activities were used during class periods. The mindset discourse was continuously used and the constructivist activities took approximately 20 to 40-minutes to complete. Since algebra is structural and procedural, not all lessons could be replaced with discovery lessons. However, attempts were made to use card sort activities as pair activities and individual practice was viewed as a time to grow their brains because struggle took place. Students were encouraged to work with a partner after the equations were solved to compare

answers, look for alternative ways to solve the problem, check for mistakes, and correct the mistakes.

My Favorite No was used for lesson openers. During this exercise, students were given a common equation to solve on an index card. Upon collection of the cards, the teacher-researcher sorted them into a correct (yes) pile and an incorrect (no) pile. The teacher-researcher reviewed the incorrect cards to find one that contained a mistake from which the students can learn. To keep the students confidential, the teacher-researcher rewrote the exact work on another index card. The problem was projected on the board for all students to see. The teacher-researcher always started with something positive that was worked correctly and had the students identify all the things that were solved correctly. Then the teacher-researcher asked that the mistakes be found and had the students give ideas on how to correct the mistakes. Students enjoyed this activity. Research shows students learn the most when they correct mistakes, (Boaler, 2015).

A mindset bulletin board display was constructed to address commo n fixed mindset comments with growth mindset alternatives. This was useful to reference when a student would say he or she could not do the work or when a student wanted to give up working a problem.

Post-Test Likert-Type Scales

The post-tests for Math Motivational Beliefs Scale and Fixed Mindset Scale were administered following six weeks of classroom instruction. After the post-tests were collected, the teacher-researcher entered the information in Microsoft Excel using Excel Analysis ToolPak. The Analysis ToolPak was not originally available in the Excel program; therefore, the teacher-researcher followed the instructions available in

Appendix D of *How to Design and Evaluate Research in Education* (Fraenkal, 2015) to download the analysis software add-in. A description of this analysis follows in the results section.

Student numbers previously assigned by random numbers generator, were used to identify the students. For gender, female was assigned a rank of one, and male was assigned a rank of two. To identify race, African American was assigned a rank of one, American Indian a rank of two, Caucasian a rank of three, Hispanic a rank of four, and other a rank of five. All questions were Likert-Type questions with answers that consisted of a five-point scale. Therefore, all question answers were entered as numbers ranging from one to five. These codes were used to enter data from both the pre-tests and the post-tests. The results of six participants were analyzed.

Results

This section shows the result of the Fixed Mindset Measure and the Math Motivational Beliefs Scale. Since participant numbers were low, each table shows the responses of the six students comparing the pre- and post-test results. Ranking numbers from one to five were substituted for qualitative data in all survey questions or statements. One represented the lowest ranking and five represented the highest ranking. This ensured descriptive statistics could be used to determine trends, averages, and ranges to ascertain whole-group comparisons.

Fixed Mindset Measure

The first research question, what are ninth-grade students' perceptions of mathematical mindset before and after a mindset intervention consisting of videos about the brain and growth mindset, an article describing how the brain grows, and journaling,

was measured using the Fixed Mindset Measure. The Fixed Mindset Measure rated students' perceptions of math intelligence based on a five-point scale. This scale measure students' beliefs using three statements. Since this instrument measures fixed mindset, a decrease in whole-class average was preferred. Figures one through three show pre- and post-test results for six participants.

The first statement addressed students' perception of intelligence and whether they felt it could be changed. The average response for the pre-test was 2.67 with a range of 3. The post-test average was 2.00 with a range of 3. Figure 4.1 shows student responses for Statement 1 on the pre- and post-tests. Although one student displayed in increase in fixed mindset, the overall average shows that students' perception of intelligence as static, decreased. A decrease in post-test results was preferred to show growth mindset. Post-test results showed students' beliefs about changing their intelligence increased.

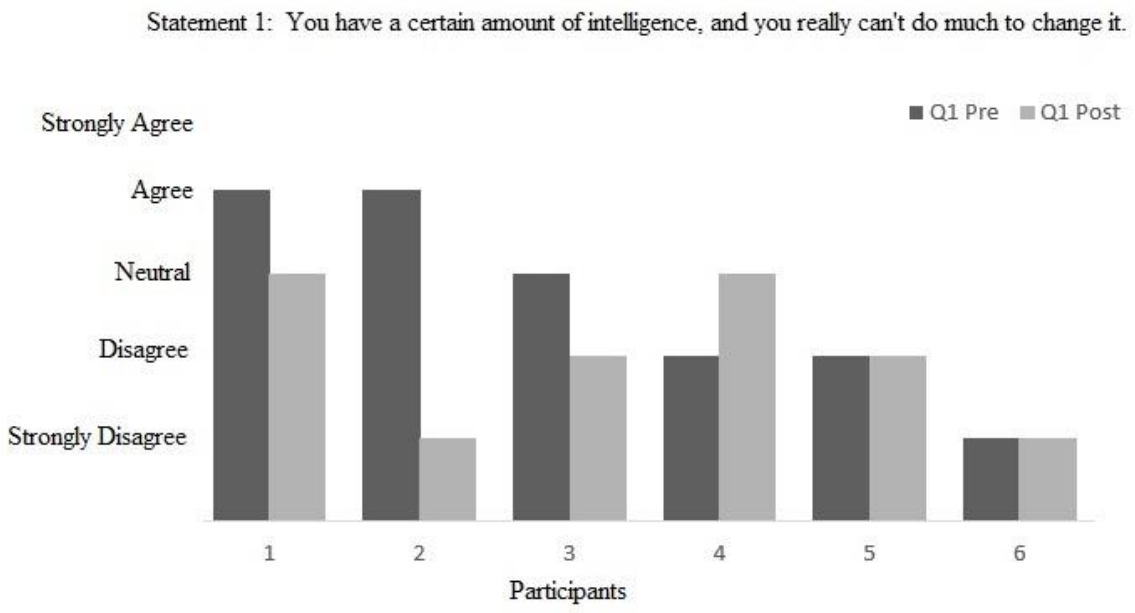

Figure 4.1 Pre- and post-test results for statement of the Fixed Mindset Measure

The second statement, also measures students' perceptions of intelligence and it was static. The average response for the pre-test was 2.17 with a range of 3 and the average response for the post-test was 2.67 with a range of 3. Figure 4.2 shows student responses for Statement 2 on the pre- and post-tests. Students' overall perception regarding fixed intelligence increased from pre- to post-test results. Contrary to statement one, this would indicate the mindset intervention reduced students' beliefs about changing their intelligence.

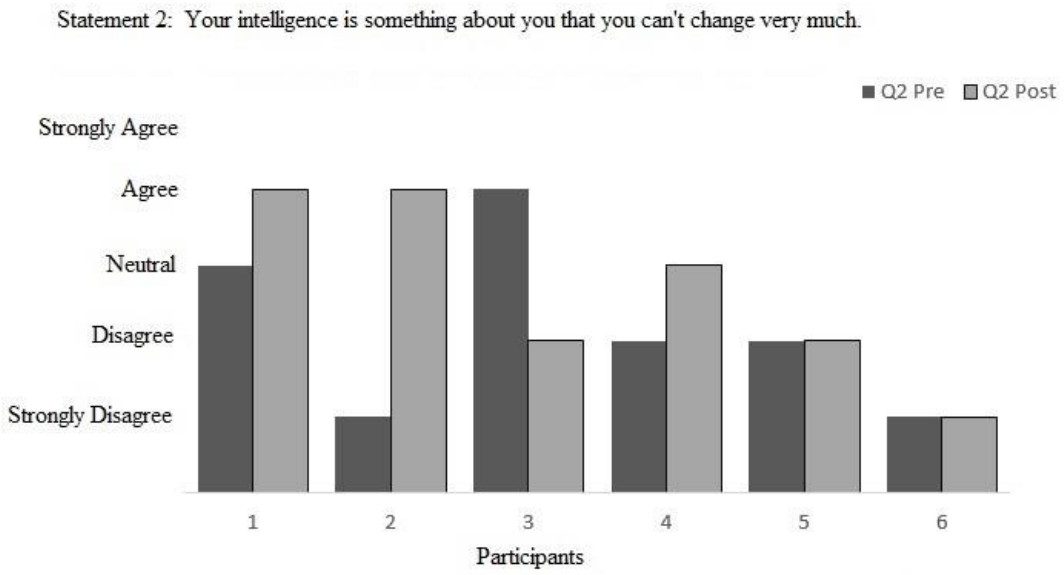

Figure 4.2 Pre- and post-test results for statement two on the Fixed Mindset Measure

Statement three addressed student perceptions about math intelligence and whether some students are just "math people". The average response for the pre-test was 3.17 with a range of 2 and the average response for the post-test was 2.83 with a range of 3. Figure 4.3 shows student responses for Statement 3 on the pre- and post-tests. The

overall decrease in the post-test response would indicate that students increased their belief that they can learn mathematics.

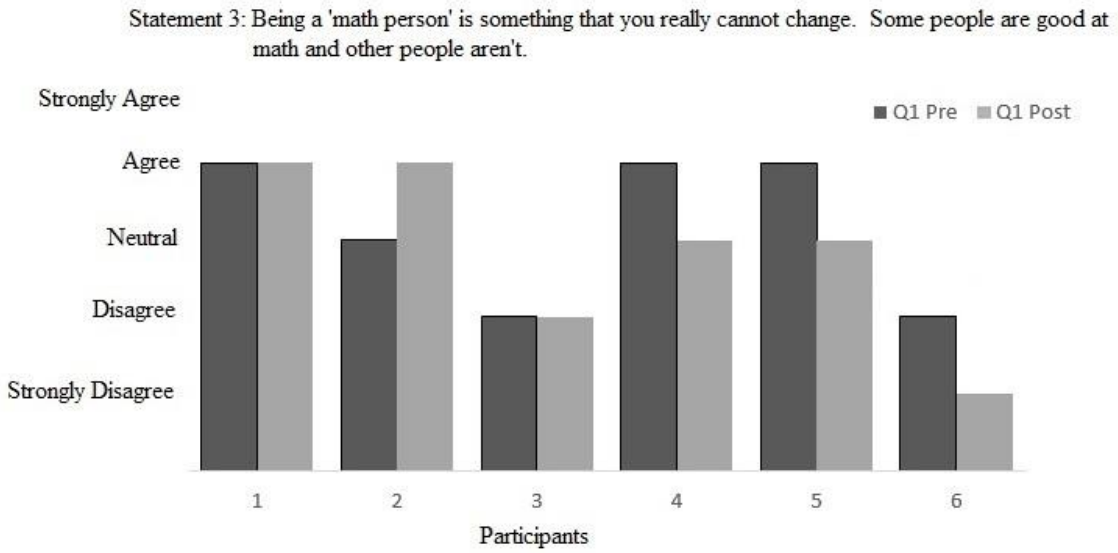

Figure 4.3 Pre- and post-test results for statement three on the Fixed Mindset Measure

Pre-test ratings were closer to 3 indicating most students were neutral with the fixed mindset statements. Post-test results revealed the whole-class average decreased nearing the disagree mark. Post-test results divulged inconsistent responses for questions one and two. It would be expected that both responses would be consistent since both questions address the same concept concerning malleability of intelligence.

Math Motivational Beliefs Scale

To answer the sub-question, what is the relationship between mathematical mindset and motivation of ninth-grade at-risk learners enrolled in an alternative school mathematics classroom, the Math Motivational Beliefs Scale was used. The Math Motivational Beliefs Scale measures students' perceptions of their ability and expectancy of success, intrinsic value, and attainment and utility values for mathematics. The first

four questions assess students' perceptions of mathematical ability or expectancy of success.

Question one asked students to rank their mathematical ability where they believed they rank compared to others in their grade. The average response for the pre-test was 3.00 with a range of 3 and the average response for the post-test was 3.67 with a range of 3. Figure 4.4 shows the results for student responses to question one. Overall, students believed they do as well or better than most of their classmates.

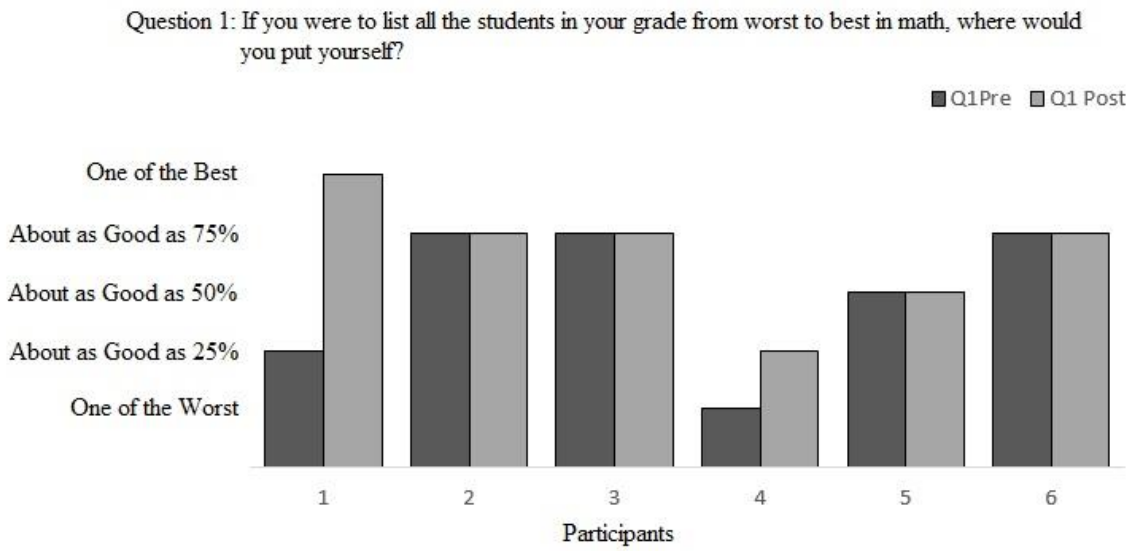

Figure 4.4 Pre- and post-test results for question one for the math motivational scale.

Question two asked students to rate how good they think they are at math. The average response for the pre-test was 2.50 with a range of 3 and the average response for the post-test was 3.17 with a range of 3. Figure 4.5 shows the results for student responses to question two. Students' beliefs about their math abilities were maintained or increased.

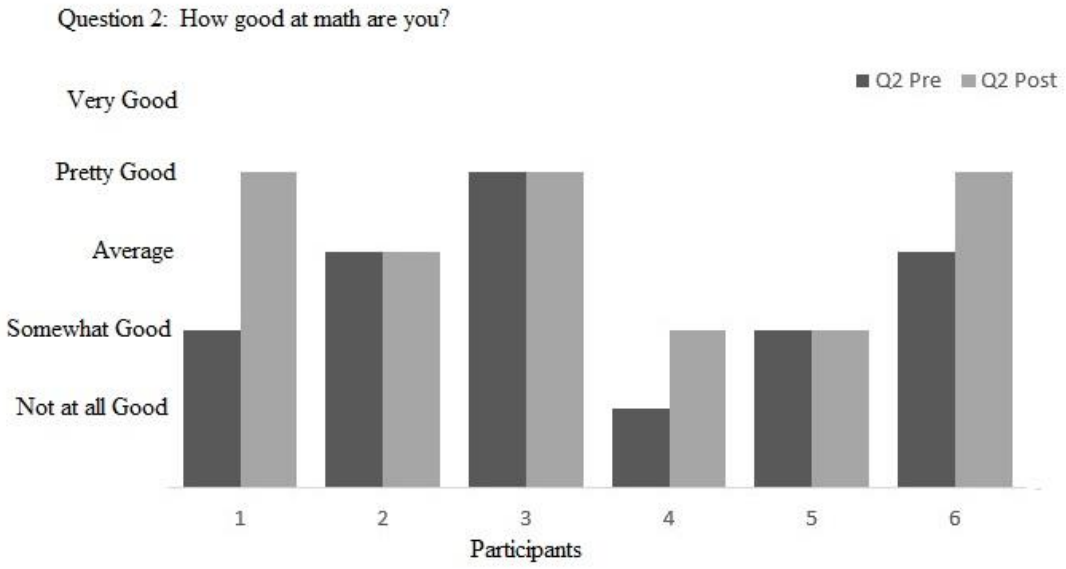

Figure 4.5 Pre- and post-test results for question two for the math motivational scale.

Question three asked students to rank how well they believed they would do in math this year. The average response for the pre-test was 2.33 with a range of 1 and the average response for the post-test was 3.83 with a range of 2. Most students' beliefs in how they are going to perform in math this year, increased. Overall, the three questions indicated students believed they had ability and expected to be successful in math this year. Figure 4.6 shows the results for student responses to question three.

Question four addresses how well the students felt they would be at learning something new in math this year. The average response for the pre-test was 3.00 with a range of 2 and the average response for the post-test was 3.17 with a range of 2. Figure 4.7 shows the results for student responses to question four. Confidence in their ability to learn something new slightly increased, as a group, from pre- to post-test. However, overall individual results indicated beliefs were stagnant.

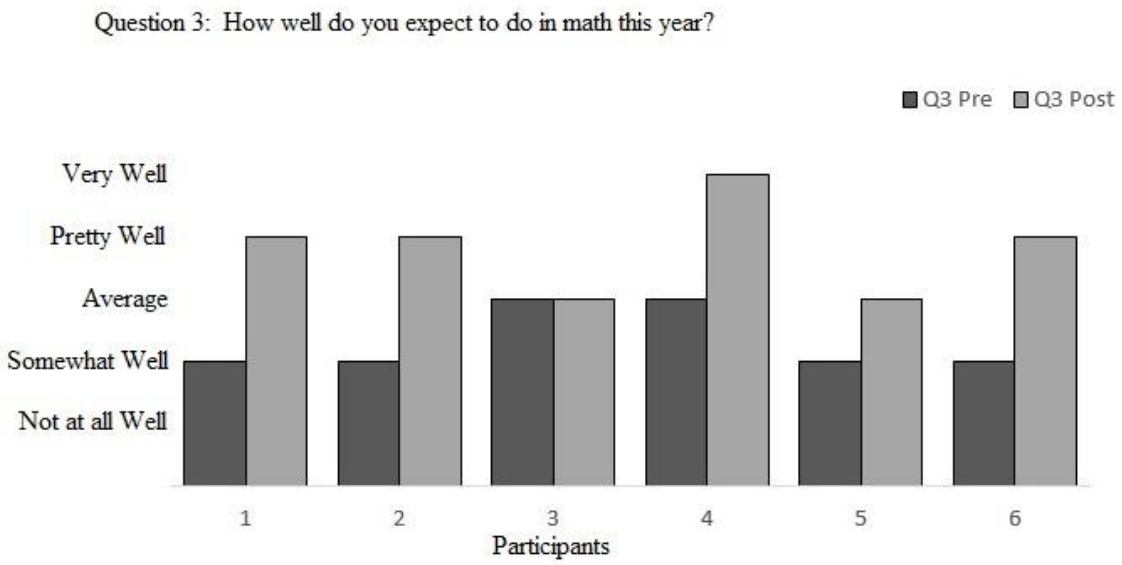

Figure 4.6 Pre- and post-test results for question three for the math motivational scale.

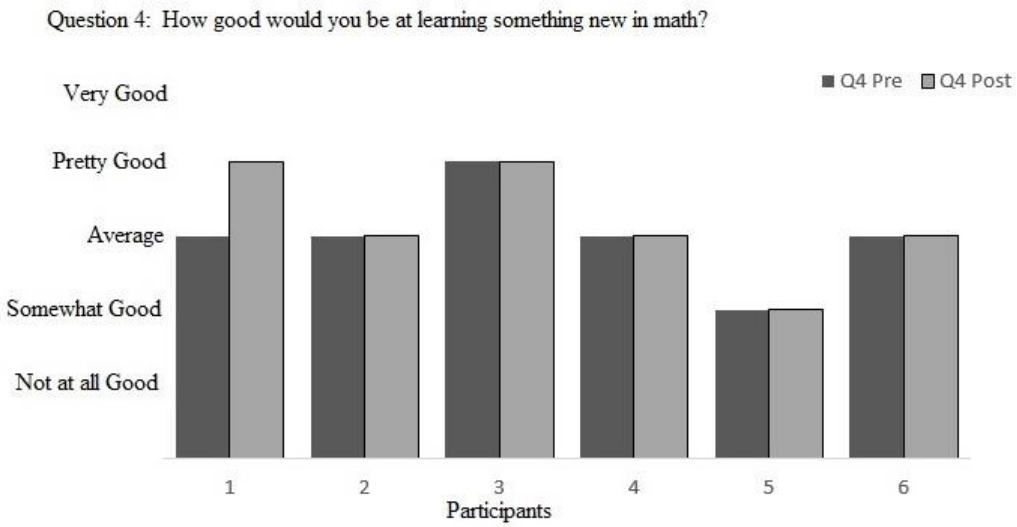

Figure 4.7 Pre- and post-test results for question four for the math motivational scale.

Pre-test results show students had moderate perceptions of math ability and viewed themselves as good as most classmates in math. Most students viewed themselves as capable of learning something new in math. Overall post-test results of the first four questions indicated an increase in expectancy for success in mathematics after

the growth mindset intervention. The largest gain was question three indicating students were confident they could be successful in math class this year. Also, the four questions indicated students believed they had ability and expected to be successful in math this year.

Questions five and six assessed the intrinsic value of math to the learners. Specifically, how much the students enjoyed working math problems and if they enjoyed solving math problems. Question five asked students how much they like doing math. The average response for the pre-test was 2.83 with a range of 4 and the average response for the post-test was 2.83 with a range of 4. Figure 4.8 shows the results for student responses to question five. There were mixed results from this question. Only one student showed an increase in enjoying doing math. Most students had no change or they had a decrease in liking math. When considering overall results, there was no change for this question.

Statement six asked students to rank if they found working on math assignments very boring to very interesting. The average response for the pre-test was 2.83 with a range of 2 and the average response for the post-test was 3.33 with a range of 2. Figure 4.9 shows the results for student responses to question six. Students' interests in working math assignments stayed the same, or increased.

Pre-test results showed most students did not enjoy math and they found working on math assignments, average. When results for both questions were considered, only a slight increase in intrinsic motivation was observed.

Attainment and utility values were assessed using questions seven through ten. These questions assessed students' value of math; specifically, whether students found

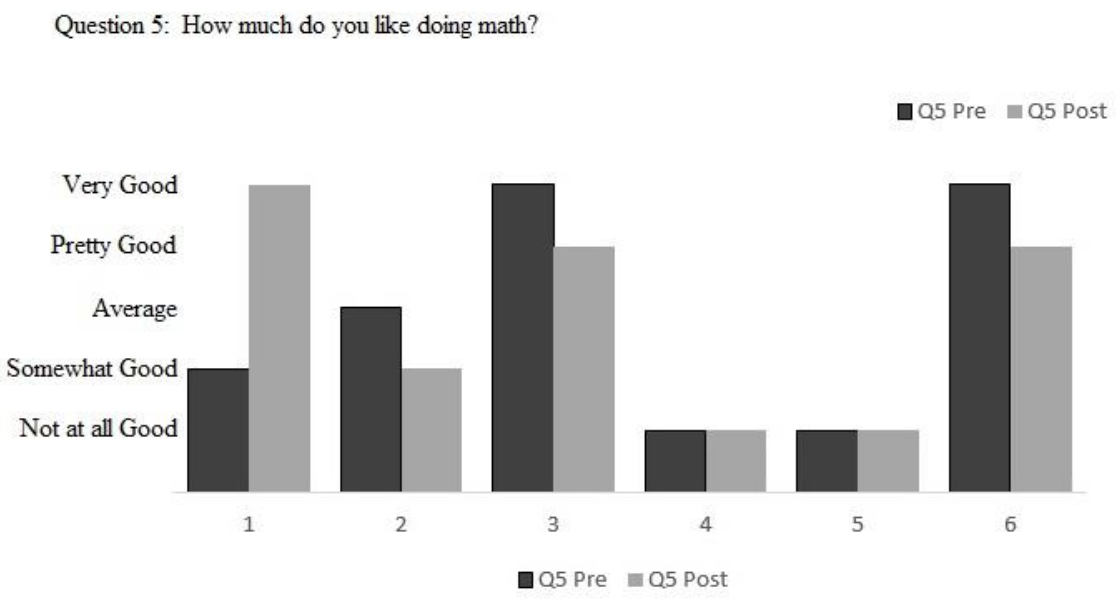

Figure 4.8 Pre- and post-test results for question five for the math motivational scale.

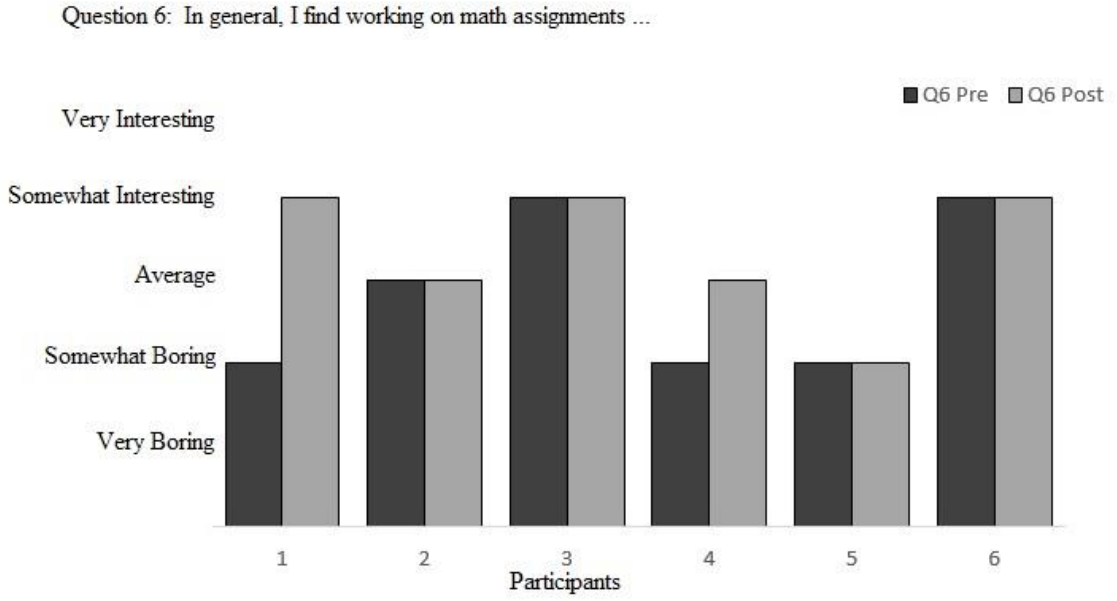

Figure 4.9 Pre- and post-test results for question six for the math motivational scale.

math useful and important. Question seven asked students to rate how useful what they learn in math is useful compared to other activities. The average response for the pre-test was 3.33 with a range of 4 and the average response for the post-test was 3.33 with a range of 2. Results were mixed for the usefulness of math. Overall, results did not

change. However, the range decreased for the post-test indicating there was less variation among student responses. Figure 4.10 shows the results to question seven.

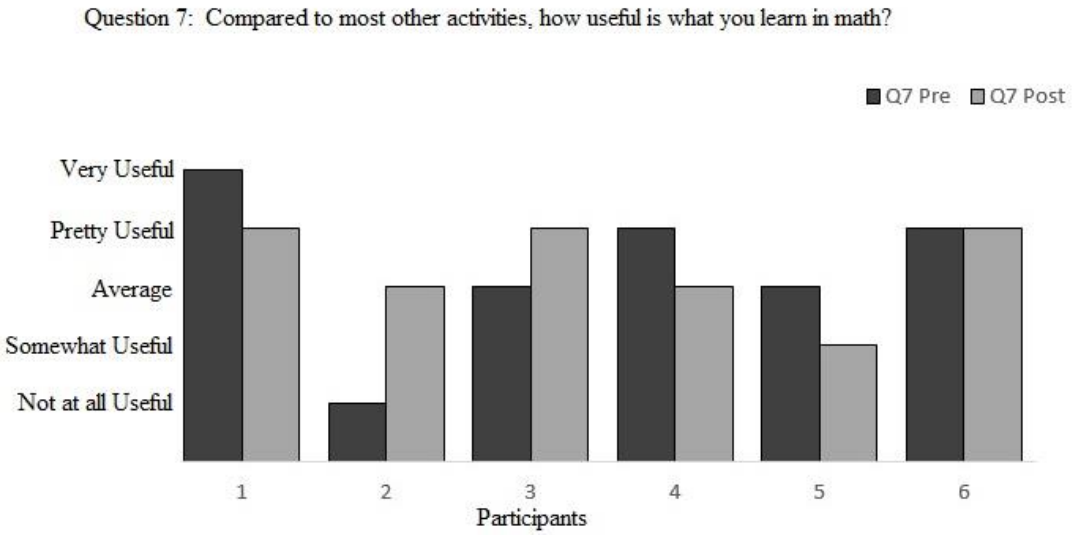

Figure 4.10 Pre- and post-test results for question seven for the math motivational scale.

Statement eight asked students to rank how important it was to them to be good at math. Ratings ranked from not at all important, to very important. The average response for the pre-test was 3.00 with a range of 2 and the average response for the post-test was 4.33 with a range of 1. There was high increase in students' who indicated they wanted to be good at math. Figure 4.11 shows student responses to question eight. This question had one of the highest overall increases for the average between pre- and post-tests.

Question nine asked students to indicate how important it was for them to be good at math compared to other activities. The whole-group average response for the pre-test was 2.50 with a range of 3 and the average response for the post-test was 3.67 with a range of 2. Figure 4.12 shows the results for student responses to question nine. There were gains in students' individual beliefs about how important it is to do well in math,

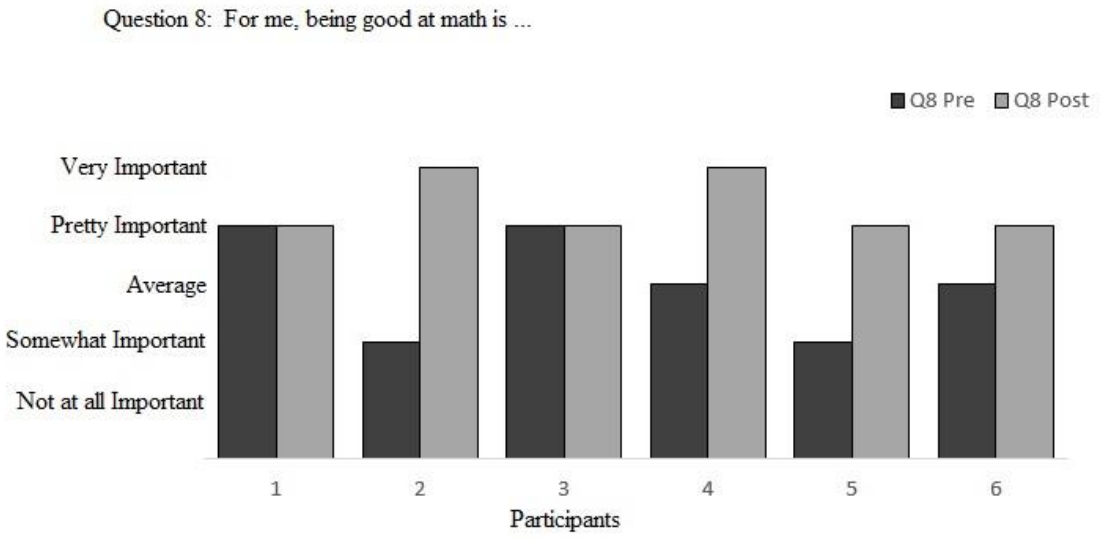

Figure 4.11 Pre- and post-test results for question eight for the math motivational scale.

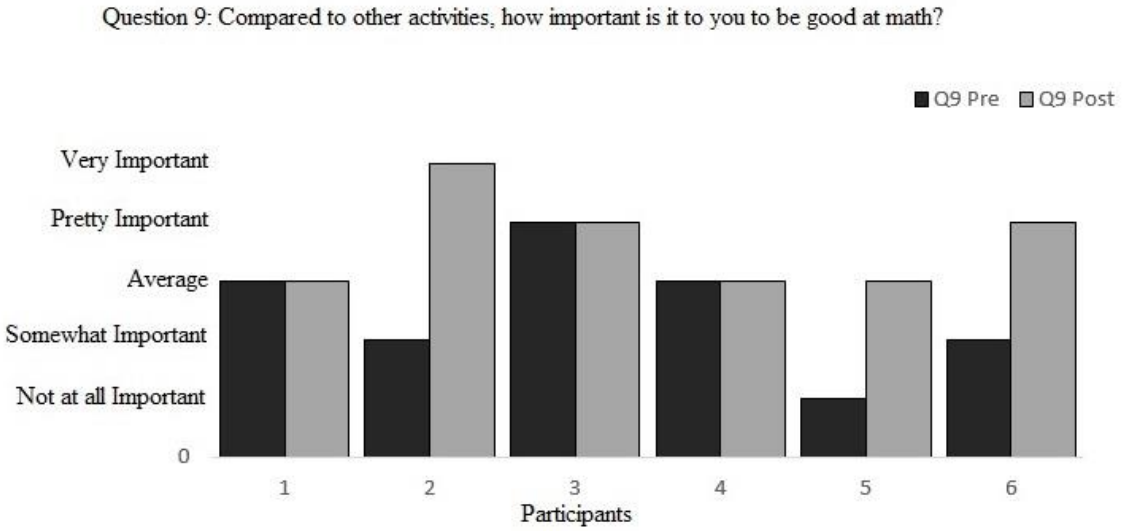

Figure 4.12 Pre- and post-test results for question nine for the math motivational scale.

compared to other activities.

Question ten asked students to rank how useful is what they learn in math. The average response for the pre-test was 2.83 with a range of 1 and the average response for the post-test was 4.17 with a range of 2. According to Figure 4.13, almost all students

showed an increase in their belief that what they learn in math is useful. This question had the highest increase in the average responses between pre- and post-tests.

Pre-test results indicated students felt the math they learned was useful and had future value. Students also felt it was important to be good at math, but it is not important compared to other activities. However, the overall results for questions seven through ten indicated an increase in students finding math useful and important. To further support the result for research question one, scatterplots were created, regression lines were created, and correlation coefficients were calculated.

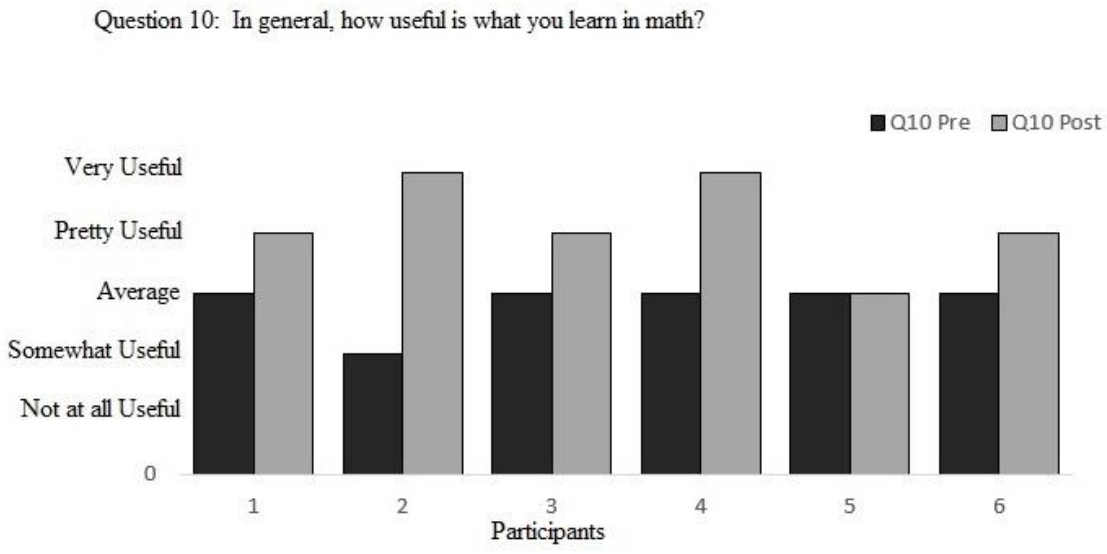

Figure 4.13 Pre- and post-test results for question ten for the math motivational scale.

Scatterplots and regression lines showing the relationships between Fixed Mindset and intrinsic value, attainment value, and utility value of mathematics were created for both pre- and post-test results. See Figures 4.14 – 4.19 for these results. Correlation coefficients comparing fixed mindset and the three forms of mathematical motivation were calculated. These correlation coefficients ranged from -0.12 to -0.39 and 0.02 to 0.31. One negative and one positive correlation could be described as a weak

relationship. However, the overall correlation coefficients indicated no relationship existed between fixed mindset and mathematical motivation. When comparing the scatterplots for pre- and post-tests representing mindset and perception of ability, Figures 4.14 and 4.15 showed a stronger relationship before the intervention than after the intervention. Figures 4.16 and 4.17 revealed the same is true for fixed mindset and intrinsic motivation. Figures 4.18 and 4.19 showed the strongest relationship existed between fixed mindset and utility value where correlation coefficients increased from -0.12 to -0.31 from pre- to post-test.

In summary, the growth mindset intervention minimally increased students' perceptions about intelligence. Therefore, the answer to the first research question, what are ninth-grade students' perceptions of mathematical mindset before and after a mindset intervention consisting of Khan Academy videos about brain function and growth mindset, an article describing how the brain grows, and journal writing, is that their perceptions increased minimally. To address the second question, what is the relationship between mathematical mindset and motivation of ninth-grade at-risk learners enrolled in an alternative school mathematics classroom, no relationship was found. However, increases were found in students' beliefs about the importance of math, the usefulness of math, and students' beliefs that they would do well in math. No change was found among students regarding intrinsic motivation.

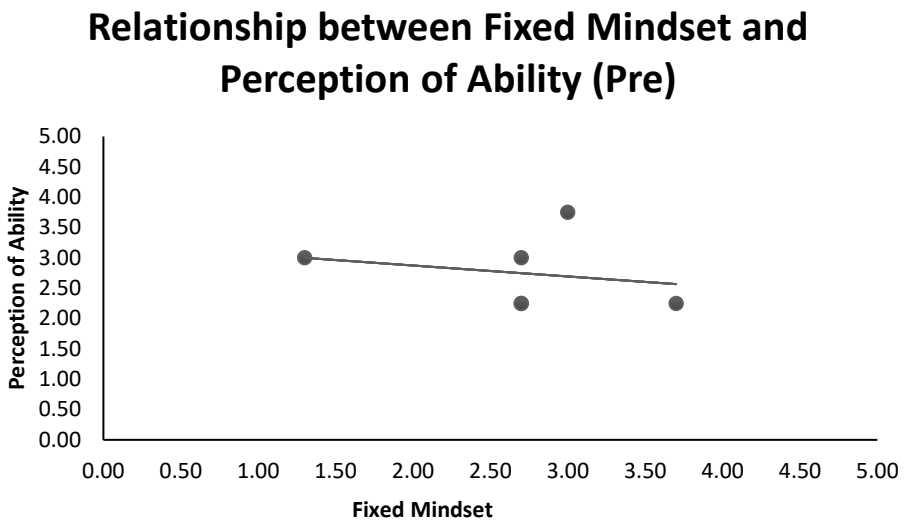

Figure 4.14 Linear regression with r = -0.23

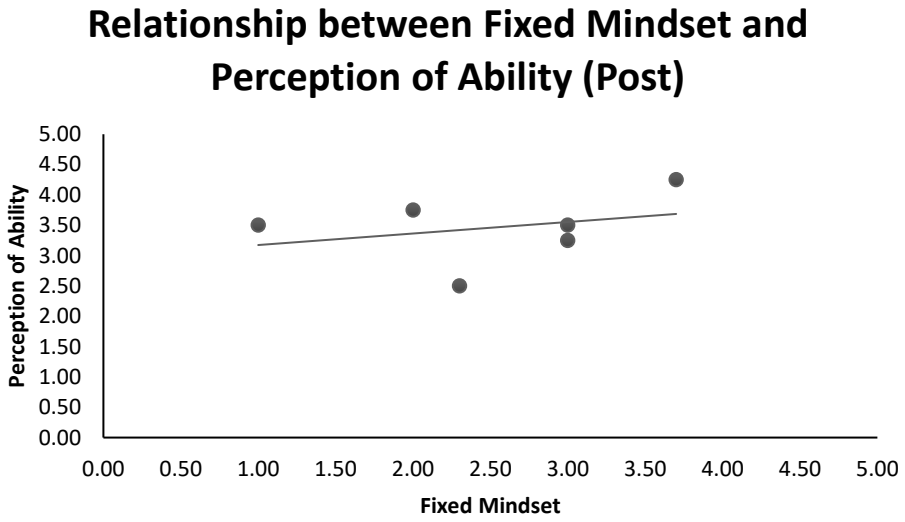

Figure 4.15 Linear regression with r = 0.31

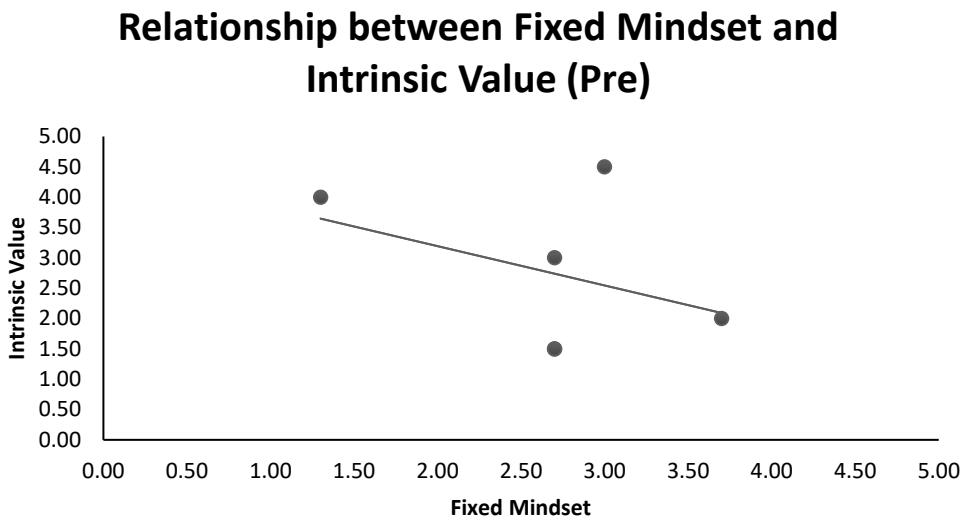

Figure 4.16 Linear regression with r = -0.39

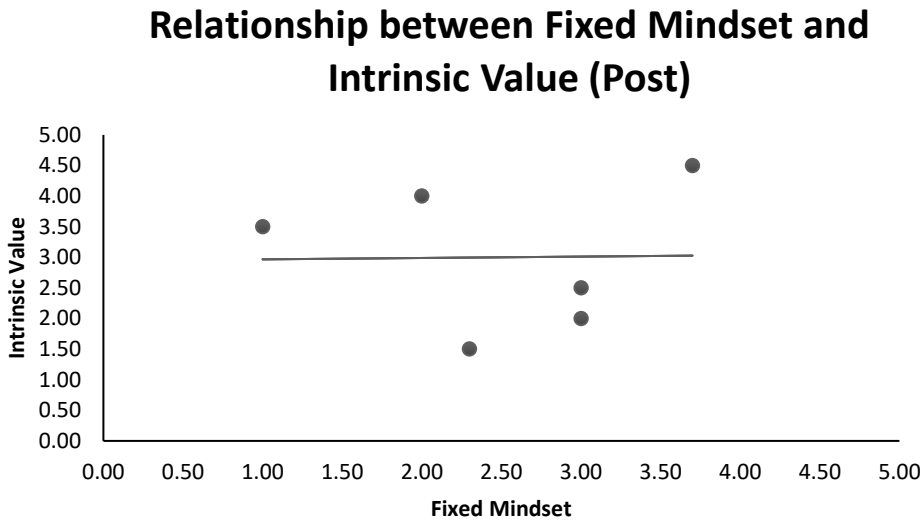

Figure 4.17 Linear regression with r = 0.02

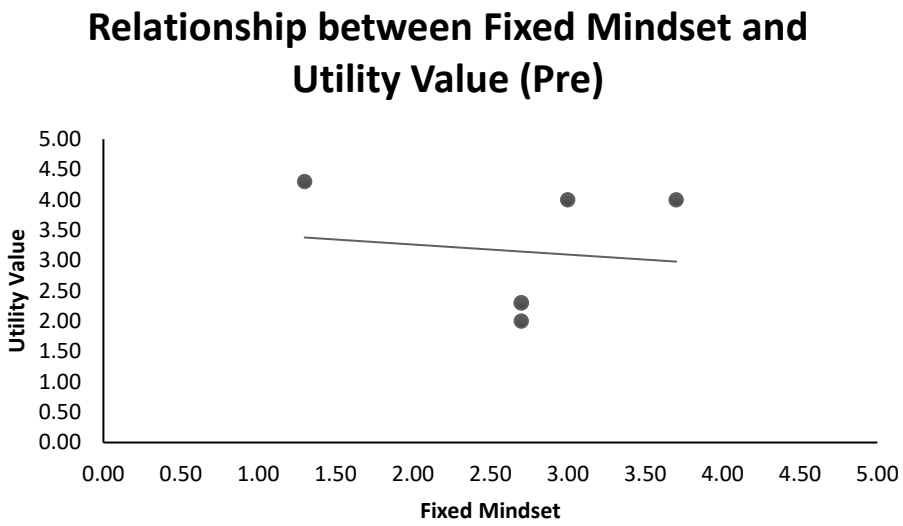

Figure 4.18 Linear regression with r = -0.12

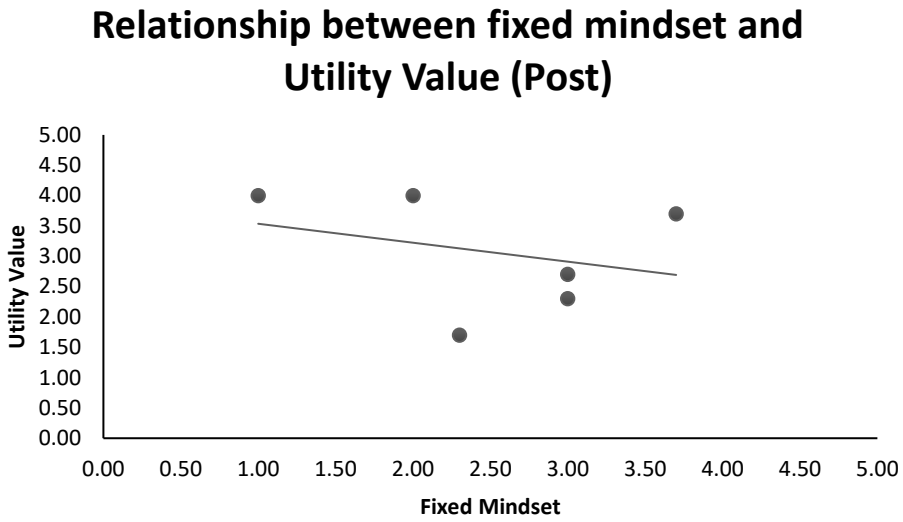

Figure 4.19 Linear regression with r = -0.31

CHAPTER 5

FINDINGS

The current action research study was developed to address the concern of alternative school staff regarding the high number of ninth-grade failures. The study employed a mindset intervention to address the following questions:

RQ1: What are ninth-grade students' perceptions of mathematical mindset before and after a mindset intervention consisting of Khan Academy videos about brain function and growth mindset, an article describing how the brain grows, and journal writing?

Sub Question 1: What is the relationship between mathematical mindset and motivation of ninth grade at-risk learners enrolled in an alternative school mathematics classroom?

The results found that students' perceptions of mathematical mindset were minimally increased by a mindset intervention developed by Khan Academy and PERTS. The relationships between mathematical mindset and motivation were found to be that as mindset minimally increased, the importance of math, the usefulness of math, and students' beliefs that they would do well in math, increased; and no change was found among students regarding intrinsic motivation. This chapter will include interpretation of the findings, limitations, implications for social change, recommendations for action, and recommendations for further study.

Interpretation of Findings

To address the first research question, what are ninth-grade student's perceptions of mathematical mindset before and after a mindset intervention consisting of Khan Academy videos about brain function and growth mindset, the Fixed Mindset Measure was administered. When comparing results of pre- and post-test Likert-Type rating scales, it was found that there was a minimal decrease in fixed mindset. Statement one was, you have a certain amount of intelligence and really can't do much to change it. Statement two was, your intelligence is something about you that you can't change very much. These two statements are basically the same. Since statement one was found to have a decrease and statement two was found to have an increase, they negate each other resulting in a neutrality for the two statements. Therefore, no decrease in fixed mindset can be claimed. Only one student stayed consistent with his or her answer for one and two. Therefore, it is puzzling why there is a consistency in students' responses showing an overall decrease in fixed mindset for statement one and an overall increase in fixed mindset for statement two. The statement was written negatively and may have been misinterpreted. Perhaps the students were overthinking the questions and questioning themselves because the two questions were basically the same. After discussion with colleagues addressing the discrepancy in the two questions, it was determined that perhaps the students lack test taking skills. Perhaps the students did not understand that more than one question can assess the same concept. Colleagues verbalized that often see students answer oppositely on like-questions to try to ensure getting one of the two correct. This would imply a lack of confidence in their knowledge. Statement three was, being a 'math person' is something that you really cannot change. Some people are good

at math and other people aren't. An overall decrease was found for this statement indicating that students' beliefs that they can learn math, increased.

These findings are inconsistent with most research discussed in Chapter Two. Numerous previous studies found an increase in growth mindset, or decrease in fixed mindset, after a mindset intervention (Dweck, 2006). However, some of these studies used a computer program (Blackwell et al., 2007; Dweck, 2006) that included a unit that taught study skills that the current research study did not include. These findings may suggest the computer program is necessary for a decrease in fixed mindset to occur.

To address the second research question, what is the relationship between mathematical mindset and motivation of ninth grade at-risk learners enrolled in an alternative school mathematics classroom, the Math Motivational Beliefs Scale was used. Results indicated that there were increases in students' beliefs about the importance of math, the usefulness of math, and students' beliefs that they would do well in math this year. However, no change was found among students regarding intrinsic motivation. Since there was minimal decrease among students' fixed mindsets, increases in the importance of math, the usefulness of math, and students' beliefs that they would do well in math this year, are likely to be attributed to curriculum and pedagogical changes, and classroom discourse guided by the classroom bulletin board. These findings are supported by Khon (2015) who critiqued Dweck's findings that it was curriculum and pedagogy that affected student learning and motivation, not whether a student perceived a growth mindset. Hattie (DeWitt, 2017) tags mindset with a low effect size of 0.19. However, Hattie believes the low effect size may be attributed to teachers' fixed mindsets. Hattie posits the mindset effect size may increase as teachers develop and

teach with a growth mindset. The teacher-researcher possess a growth mindset. It is possible the classroom bulletin board and discourse had the largest effect on student motivation. These findings are also supported by the theory of constructivism. Results may also have been affected by the many limitations described in the following section.

Limitations

The current action research study identified sample size as a constraint. The specificity of the research question limited the participants to ninth grade students. Since the alternative school had a smaller population than most zoned schools, the number of final participants was six. The sample size was also influenced by the mortality rate of participants due to alternative school student population characteristics. Three participants were dropped due to expulsion or incidents of incarceration. A small N for quantitative data could have limited and/or skewed regression and correlation data while trying to determine a relationship between mindset and motivation. Because of inconsistencies between statements one and two in the Fixed Mindset Measure, the reliability of the results must be questioned. Questions one and two addressed beliefs about increased intelligence. Since the two questions addressed the same concept of growing intelligence, consistent results would have been expected.

Recommendations and Implications for Social Change

Following teacher-researcher recommendations will result in social change in the classroom, and graduation rate which will impact local, state, and federal economies. The teacher-researcher has a professional responsibility to teach mathematics students the content standards so students can perform at a proficient level. Based on professional knowledge and research, the teacher-researcher believed mindset training would benefit

alternative school students. Teaching a growth mindset has specifically been shown to increase achievement for low-income and minority students and increase motivation (Aronson et al., 2002; Blackwell et al., 2007). The teacher-researcher also believed that teaching students to monitor their own learning would lead to greater future success.

Research supported the teacher-researcher's views toward the importance of mindset training for at-risk students. Mindset intervention was identified by leading researchers as a problem that needs to be addressed by legislators, the U. S. Department of Education, and schools (Rattan et al., 2015). Yeager and Walton (2011) identified poor academic achievement as a social problem that needed to be addressed. The authors believe, "psychological interventions have a demonstrated potential to address fundamental problems, including low student achievement and large group differences, at low cost and over significant periods of time" (p. 294).

However, due to the minimal effects of the mindset intervention regarding decreased fixed mindset, the teacher-researcher recommended that growth mindset discourse be encouraged in mathematics classrooms, and the use of constructivist activities be employed. Evidence indicated that changing the verbiage in classroom to more positively stated comments, increased student's motivation for learning mathematics and increased students' views of the usefulness of math. Motivation was linked to commitment to assigned tasks and engagement within the classroom setting (Sungur, 2007) which led to academic success (Slavin, 2000) thus, decreasing ninth-grade failure rates (UChicago CCRS, 2012).

Ninth-grade success was identified by UChicago CCRS (2012) as the single most significant predictor of graduation rate, therefore, graduating more high school students

results in increased economy. According to the Alliance for Excellent Education (n.d.) website, the current graduation rate for the greater-Columbia area is 71%. In addition to increasing the number of graduates earning a diploma, increasing the graduation rate to 90% would result in increases of $42.7 million in home sales, $3.7 million in auto sales, $3.8 million in Federal tax revenue, $24.5 million in earnings, $1.8 million in state and local tax revenue, $18.7 million in spending, $39.2 million in savings on healthcare, and $35 million in Gross Domestic Product.

The recommendations and implications for social change were shared with leadership groups in which the teacher-researcher belongs. The teacher-researcher shared the results with colleagues during the March faculty meeting. Members of staff were present who helped to define the problem of practice during early stages of the action research study. The school principal was also present. During this time the principal asked if the teacher-researcher believed if mindset teaching was something that should be considered for the school. It was discussed as a faculty that mindset training would be necessary for alternative school staff. A meeting with the district grant writer would be necessary to procure a grant to fund the training. The alternative school could be used as a pilot study for possible district training for teachers.

The teacher-researcher shared the findings and recommendations with mathematics teachers from across the district at the March leadership meeting. The district math coordinator was present at the leadership meeting. This ensured district administration leaders were aware of results and recommendations as well. The audience included middle school and high school mathematics department chairs and other school leaders from various middle and high schools within the district. Results were also

shared with the teacher-researcher's Algebra 1 data team in February. During these meetings, the teacher researcher shared that intrinsic motivation among students was an area that demanded more attention from teachers in the classroom.

Reflection

One of the main components of any action research study is the reflection process (Dana & Yendol-Hoppey, 2014; Mertler, 2014). This section describes the benefits and challenges the teacher-researcher encountered during various phases of the action research study and multiple roles played by the teacher-researcher.

Teacher-Researcher as a Curriculum Leader

The teacher-researcher modeled curriculum leadership skills in the classroom with participants throughout the study. This section will address the leadership skills present during the action research study and personal challenges the teacher-researcher experienced.

Changes in classroom discourse took place during the six-week period. The students experienced changes with teacher-researcher's leadership style and classroom environment. According to Valle (2001) a transformational leader is better suited for changing environments. Since pedagogical strategies and mathematical discourse were changing, a transformational leadership style was used by the teacher-researcher. The transformational leadership style values the opinions of students and expects the students to work as a team to solve problems and be part of the decision-making process. Valle (2001) emphasized the importance of effective leadership in public institutions where pressure for success in the classroom is high.

The teacher-researcher strived for a high Emotional Quotient (EQ) during the discourse transition from a traditional mathematical discourse to a growth mindset mathematical discourse. Goleman (2001) believed a leader must have a high Emotional Quotient (EQ) be effective. Goleman describes five components: Self-awareness where one is able to recognize how his or her moods or emotions affect others; self-regulation where one is able to control those moods or emotions and to suspend judgement when the emotions are running high; motivation where one works for a cause; empathy where one is able to understand someone else's point-of-view or emotions; and social skill where one is able to manage relationships and build rapport. Emotional Quotient was important for management of the classroom. With the many changes that took place in the classroom, a high EQ was most effective. The teacher-researcher's high EQ motivated students during the transition to growth mindset thinking and discourse.

Throughout the process, the teacher-researcher attempted to remain humble. Murphy (2013) acknowledged that good leaders should remain humble. The author believed we should keep in mind that we can learn from others and recognize that we may not always have the best answers. The teacher-researcher admitted to making mistakes while working problems on the board and continuously asked students to correct her if she were wrong. The teacher-researcher also called upon her principal to help with acquisition of demographics data from the district office regarding participants. Despite a conscious effort by the teacher-researcher to employ effective leadership skills, challenges were encountered.

Data Collection Process

One of the most frustrating challenges, was the acquisition of Guardian Consent Forms. At-risk students often lack organizational skills. Therefore, multiple forms were given to students and constant reminders were required to obtain the forms. Fortunately, Parent Night took place before the pre-tests were administered and two Guardian Consent Forms were collected that night. Calls to parents were also made on the days new form were given to students to ask parents to please request the forms from their student to sign that evening.

Request for demographic data, regarding participants, from the district took time. Five weeks elapsed before a spreadsheet of data was sent to the teacher-researcher which affected the completion date for the written description of the research participants. The writing process was also affected by a natural disaster that took place during the six-week intervention. The teacher-researcher and participants missed five days of instruction due to school closures caused by a hurricane.

Methodologically, the teacher-researcher would make changes in the future. First, the teacher-researcher would change one of the instruments. The teacher researcher would change from the fixed Mindset Measure to the Dweck Mindset Instrument (DMI). The teacher-researcher chose the Fixed Mindset Measure because it was specific for math, and it contained three questions instead of thirteen. The Fixed Mindset Measure was also developed by leading mindset researchers. After this research process, the DMI was found to contain more positively worded questions, since it measures growth mindset, versus the more negatively worded statements used by the Fixed Mindset Measure. This would support the analysis of more quantitative data such as correlation

between mindset and motivation using linear regression and correlation coefficient; comparing growth mindset and motivation, where a positive relationship is preferred, is easier to comprehend than comparing fixed mindset and motivation, where a negative relationship is preferred. In addition, the thirteen questions on the DMI would give more data to compare and result in more insight as to students' perceptions of intelligence, than the three statements for the Fixed Mindset Measure.

The teacher-researcher would incorporate more qualitative data collection techniques than quantitative. More field notes should have been kept to record students' comments and student work observations. Interviews with students would have allowed questions to be answered that emerged during data analysis. Such comments and observations may have explained the inconsistencies between statements one and two on the Fixed Mindset measure.

The teacher-researcher recognized areas of improvement for professional development resulting from the action research study. After determining motivation was due to classroom discourse and engaging lesson activities, this became the area of focus for future professional development. The teacher researcher will read *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching* (Boaler, 2016) in its entirety. Only portions of the book were read to include in Chapter II and Chapter III. This book contains many engaging lessons and suggestions for encouraging a growth mindset in the mathematics classroom that the teacher-researcher would like to investigate further. The teacher-researcher is currently participating in a professional development series for teaching children of poverty. This professional development sequence will continue to support at-risk students and the high

percentage of children of poverty enrolled at the alternative school. The teacher-researcher will recommend to attend the T-cubed conference led by Texas Instruments to continue to learn engaging activities using the graphing calculators for algebra classes.

Data Analysis

The teacher-researcher would recommend more qualitative research data. Upon reflection, qualitative data analysis is better for an action research study. The teacher-researcher regretted not having a means in which to ask students about their responses to certain statements or questions. Data analysis helped the teacher-researcher understand the power of classroom discourse. The Khan Academy mindset training did not change students' overall mindset. However, there were gains in students' motivational beliefs. This can only be explained by the changes that occurred in the classroom regarding mindset discourse guided by the classroom bulletin board. When a student turned in a test, he or she was asked if it were their best work. Often, the student took the test back and worked harder on the test. Students stopped saying, "I can't do this" and would ask for help, instead.

Developing an Action Plan

There were many conditions to consider when developing the action plan. With the many standards that are required to be taught in algebra courses, time is a major factor. The teacher-researcher reflected on the amount of time spent implementing the Khan Academy lesson plan, and the academic instructional time lost to help determine an action plan.

The Action Plan

The teacher-researcher used conclusions from the action research to develop a plan of action. The Kahn Academy lesson plan took two class periods to complete. If the recommended computer course (Brainology) were used, it would take six class periods for computer instructions, plus extra class periods for activities. Data analysis does not show a relationship between mindset training and math motivation. However, results may change if the intervention were given more than seven weeks between pre- and post-tests. Therefore, the teacher-researcher recommends continuing the intervention one more year and collecting data after a longer time period to check for differences. There were overall increases in motivation which the teacher-researcher contributed to the changes that took place in classroom discourse, guided by the mindset bulletin board. The teacher-researcher will keep the bulletin board to facilitate growth mindset discourse in the classroom. The teacher-researcher will continue to develop more engaging lessons for students. Students enjoyed the card sorts and other activities that freed them from monotonous problem-solving using paper and pencils.

The discrepancy in perceptions for question one and question two sparked a discussion between colleagues. One conclusion from the discussion was that perhaps the discrepancy was due to lack of test taking skills. This discussion reiterated the fact that students continuously need reminders for test taking skills. Therefore, the teacher-researcher will be more conscientious towards making these test-taking skills a part of daily discourse with problem solving strategies.

The above recommendations will take place throughout the remainder of the academic year, and henceforth. It does not take class time to incorporate growth mindset

discourse in the classroom. The only requirement is that the teacher-researcher teach with growth mindset words and phrases and encourage the students to adopt the same discourse. This new way of talking in class has become habitual and the new norm for classroom discussions.

Recommendations for Further Study

The teacher researcher recommended that further study concentrate on increasing intrinsic motivation with ninth grade students. Intrinsic motivation was the factor that had the least increase in all motivational categories among ninth grade students. Teachers should use action research to experiment with curriculum and pedagogical practices that help students appreciate learning as a way for self-improvement.

More research specific to alternative schools and alternative populations should take place. The teacher-researcher discovered a gap in research will developing the review of literature pertaining to alternative schools and alternative populations.

To conclude, it was not changing students' mindsets that increased motivation in the classroom; it was changing the way the teacher-researcher talked with students and statements that students were or were not allowed to be make, that made the difference. Expectations for students were increased through the discussion. The teacher-researcher was the difference. Curriculum and pedagogy mattered These findings parallel research they teacher-researcher sited in Chapter II of this dissertation in practice. When students changed their own thought processes about what was acceptable work to turn in, and that it is not acceptable to give up, students grew, their motivation increased, and they learned that they could be successful in math. As reflected in the review of literature, teachers

must commit to communicate growth mindset through discourse, classroom climate, and rigorous, engaging lessons.

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APPENDIX A

KHAN ACADEMY MINDSET LESSON PLAN

Growth Mindset

Lesson Plan

Khan Academy and PERTS, Stanford University's applied research center on academic mindsets, created this lesson together in order to provide a few activities to introduce students to the concept that intelligence can be developed. Feel free to adapt and edit these activities below to meet the needs of your classroom!

By the end of this lesson, students will understand:

- Intelligence can be developed
- The brain is malleable
- Doing challenging work is the best way to make the brain stronger and smarter

Before we get started...

Past learnings

Cultivating a growth mindset in students *can* (unfortunately) *be quite tricky*. Researchers and educators have spent years thinking about this, and we are still learning! From our experience thus far, we have learned that:

- **Simply telling students to have a growth mindset can backfire.** Students can have a negative reaction to being told how to think. Instead, a more scientific and practical explanation about how intelligence works — *that the brain can get stronger and smarter with new learning* — has been demonstrated to be effective.

- **In the same vein, reiterating the message "just try harder" can also be problematic.** The reason is that most students have heard "*just try harder*," but a growth mindset isn't just about trying harder. Students need to understand *why they should put in effort and how to deploy that effort*.

From what we know so far, sometimes a better strategy is more useful than additional effort spent doing the same thing.

Also, beyond conducting this introductory lesson, there are many ways teachers can foster a culture in which students embrace the growth mindset in practice!

Materials needed

A few things you'll need for the lesson and other activities:

- Projector or Large Monitor
- Laptop/Computer, internet connection, access to YouTube
- Markers
- Poster-sized paper
- *Optional: Pencils and paper for students*

Here's the plan

Part I: Video & debrief

Estimated time: 20 minutes

View either (or both!) of these videos with your class to begin a discussion about the brain's malleability.

Watch "Growing your mind" by Khan Academy (3:04).
[Note : If you have younger students, consider using one of the videos on page 9.]
After you have watched this video with your class, hold a small discussion about the science behind the brain as it learns. Here are a few questions to get your discussion started:

- How do people become more intelligent?
- How does the diagram of the neurons "At birth vs. at age 6" demonstrate this?
- How does the second diagram of the nerves of the animal living in a cage vs. an animal living with other animals and toys demonstrate this?
- How are our brains like muscles?
- When do our brains grow the most? (Clarify here that it is when you get an answer wrong and then figure out strategies to correct your mistake!)

Watch "Neuroplasticity" by Sentis (2:03). This is a good visual introduction to the concept of how the brain can be rewired as we learn and think differently.

- What is neuroplasticity?

Part II: Personal discussion

Estimated time: 15 minutes

Discuss a time when you overcame a struggle in learning and learned to solve a problem.

As a teacher, share a personal story about a time you had to work hard to get better at some- thing and relate it to the video. In this story, highlight:

1. Hard work
2. Strategies
3. Help from others

Here's an example below of a personal story to share with students:

> When I was in middle school, I remember struggling with adding negative numbers. I had a hard time figuring out what a 'negative' even meant when talking about a number - how can you have less than nothing? I ended up going through many practice problems and continuing to get many of them wrong. I was a very shy kid, so I didn't ask my teacher many questions. My thought was that I had reached 'the peak' of my math talent, and it was all downhill from here. I eventually asked my mom about this topic and she explained to me the basic concept of negative numbers. This helped me understand it a little, but it was still fuzzy to me. I then researched online for some real-life contexts to show what these mysterious numbers represented outside of some abstract universe. Some of them made sense, and others didn't. I still didn't entirely get it and I was so frustrated that I wanted to just give up (or continue hoping that negative numbers were not going to appear in math class ever again). I started to dislike math simply because I couldn't understand it anymore. Instead of entirely giving up on my academic career, I eventually mustered up the courage to ask my teacher for help as well. She explained it in a few different ways, and gave me new strategies to try out. After some practice with these new strategies, I started to solidify my understanding of

negatives which allowed me to quickly pick up basic algebra afterwards. While it was a lot of work and I wanted to give up at many points during my journey, I eventually was able to 'rewire' my brain so that negative numbers actually made sense to me.

In a small group, ask students to share a story about a time that they made their brains smarter. This leads to a discussion about how working hard, taking on challenges, and finding the right strategy can make people smarter.

In the case that your students are not ready to be vocal with their classmates about their stories, it might be a good idea to try Part III (below) after sharing your personal story in- stead.

Part III: Letter t o a future student

Students write a letter about a learning-related struggle (*worksheet on pg. 5*).

Ask your students for a short story about a struggle they had when they were learning. How did it make them feel? How did they overcome it, and what did it teach them? Tell them to write a letter to this future student to tell them about their struggle, what they learned from it, and any advice they could give for the student. Collect their letters, and save them in order to give them back to them during difficult testing periods, such as final exams.

LETTER TO A FUTURE STUDENT

Take a few minutes to think of a time when you overcame a struggle to learn something. It could be anything - from adding negative numbers to learning a technique in baseball to writing an introduction for a difficult essay. Reflect on the times when you failed at first but through persevering your brain created new neural connections and you eventually became better at the task at hand.

Write a letter to a future student of your class about this struggle. In at least five sentences, tell this student your story and give them advice on what they should do next

time they encounter an obstacle when learning something new. An example is below. Feel free to be as creative as you would like.

	Dear Future Student,
	When learning my multiplication tables I found it really hard to memorize the 7's table.
	With 5 and 10 there's a pattern to their products, but 7 really gets complicated.
	I got kind of down for a while, but then I remembered how I learned to make free throws
	in basketball. It took try after try to get them in. I had to start from two feet from the
	basket and keep practicing my form. Only after a long time could I make them in with some
	consistency. With that in mind, I stuck with it and learned all the way from 7 x 1 to 7 x
	12. Even though it took me a little longer than other students at that time, I am now able
	to recall them very easily. Stick with what you're working on. The struggle means you're
	getting close.
	Sincerely,
	Charlie

More activities :)

*You can use these activities below interchangeably with the ones provided above **or** use them later on in the school year to refresh your students' minds on the growth mindset!*

Activity 1: Research Project

Using the brief guidelines below, get students to make a project on how the brain grows as it struggles to learn something new.

Ask students to create a poster, diorama, painting, video, PowerPoint presentation or simple computer program to showcase how the brain works. You can either allow them to choose from the options listed or choose for them - whichever works for your particular class. If they are relatively young and struggle with research, here is one kid-friendly resource from Brainology to get them started. The article on pages 1-3 is a brief overview of the science behind the growth mindset.

Each teacher-approved project must at least answer these questions, either within the project itself or in a separate 1-page essay. Also be sure that your students include evidence to back up your claims (ex. Are there studies that show this? Don't forget to cite your sources!):

- What is neuroplasticity and how does it work?
- What are neurons? How can they change over time? How do we know this?
- What are ways of making your brain grow?
- What is a growth mindset?

Encourage your students to be creative and scientific when explaining how learning can help develop the brain. If possible, allow them to research for themselves.

Display these projects around your room and refer to them throughout the year as motivation and a friendly reminder about the brain's plasticity.

Activity 2: Growth vs. Fixed Mindset Poster

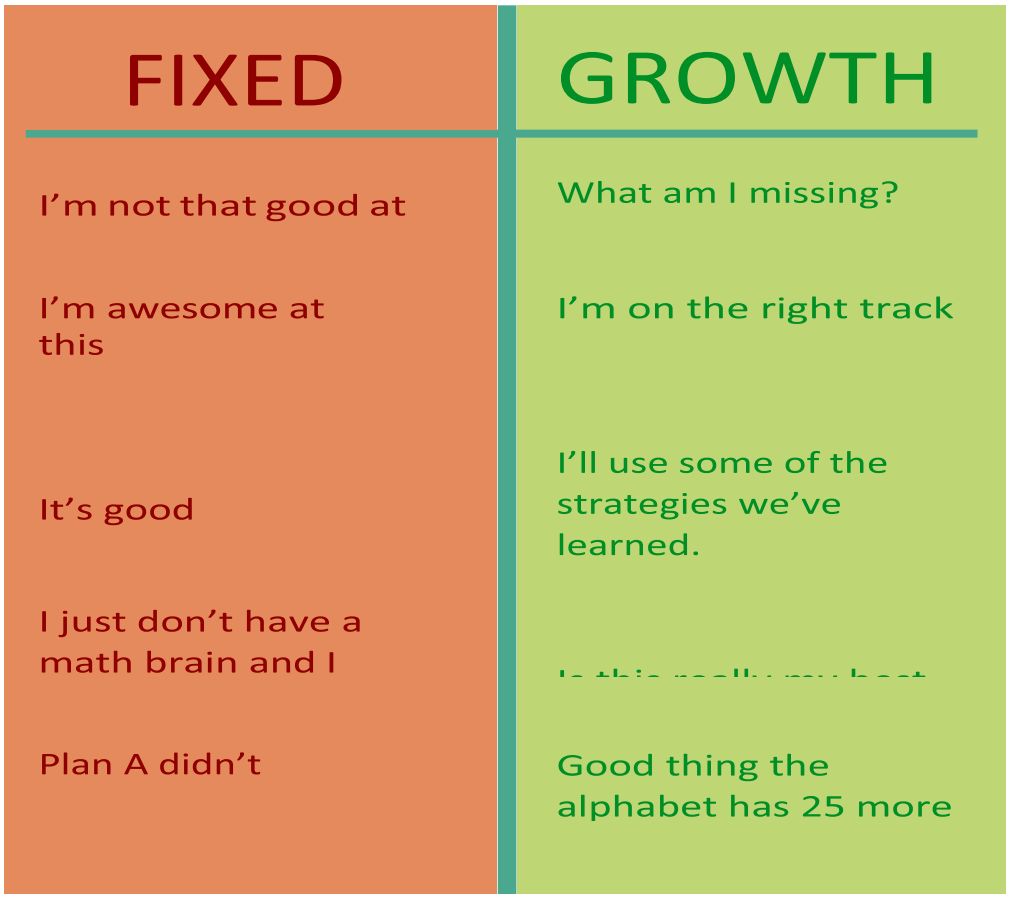
Using your students' input, make a two-column poster on the beliefs and behaviors of a growth mindset and how it compares to a fixed mindset. Explain that you can have a fixed mindset in one domain and a growth mindset in another - they aren't necessarily black and white concepts. Urge students to map out how beliefs influence behaviors which ultimately lead to results.

If they need scenarios to help them brainstorm, use the examples below or create your own! What are the behaviors/thoughts of people that believe intelligence can be developed when:

- ...they put a lot of effort into practicing for a basketball game but still lose?
- ...they don't understand what they are learning in math class?
- ...they are not putting any effort into a project but got an A anyway?

Use this poster as a reference throughout the year to help students recognize when they have a fixed mindset and to give them ideas on methods to shift towards a growth mindset.

Here's an example of what this poster might look like:



Activity 3: "The Power of Belief" video

Estimated time: 20 minutes

This video is about how a growth mindset can help students succeed. For students who might be resistant to the idea that intelligence can change, we suggest starting with an activity that helps students understand the neuroscience of how the brain changes. Then, you can use this activity to show the power of believing that the brain is malleable.

Watch "The Power of Belief" TED Talk (10:52) with students and stop to discuss it as you go along. Note that this video might be more suitable for students 6th grade and above.

Stop at 1:57

Briefly discuss Josh's story and the quote

- "The moment we believe that success is determined by an ingrained level of ability, we will be brittle in the face of adversity." - Josh Waitzkin

Stop at 4:20

Discuss the study about 7th graders with both fixed and growth mindsets

- What is a growth and fixed mindset?
- What happened to the 7th graders' scores over the next two years?

Stop at 5:36

Discuss differences in Growth and Fixed Mindsets

- What do people with fixed mindsets focus the most on? How do both mindsets view effort?
- How do both mindsets view obstacles?

Optional viewing and discussion from 5:36-7:55

Gauge whether your students would respond positively to this study on praise and its overall take- away.

- What was this study about?
- What kind of praise did the kids in the "Fixed Mindset" group get?
- What kind of praise did the kids in the "Growth Mindset" group get?
- What were the results of this study?

Optional viewing from 7:55 - 9:40

Watch remaining video, then ask students:

- How does their brain change?
- How does it grow?

Additional Resources

Below are a variety of resources to use when preparing for your lesson as well as additional materials for your students' use during the year. The resources below are just the tip of the iceberg, so do not hesitate to do your own research as well!

Books

Carol Dweck, *Mindset: The New Technology of Success* (2006)

Daniel Coyle, *The Talent Code: Greatness isn't born. It's grown. Here's how.* (2009) Malcolm Gladwell, *Outliers: Stories of Success* (2008)

Videos

Khan Academy

- John Legend - "Success Through Effort"
- Khan Academy - "You Can Learn Anything"

TED Talks

- Angela Lee Duckworth - "Grit" (Note: Make it clear that grit is a behavior that happens only when you have a growth mindset.)
- Derek Sivers - "Why You Need to Fail to Succeed"

Other

- Sesame Street, musician Janelle Monae sings about "The Power of Yet"
- Kizoom, Brain Jump with Ned the Neuron: Challenges Grow Your Brain

Articles, visuals, and more

- Complete Mindset Kit by PERTS, a complete guide to the growth mindset
- Infographic by Nigel Holmes on Growth vs. Fixed Mindsets
- Edutopia writes about how the brain can continue to grow much longer than we thought possible: "Neuroplasticity: Learning Physically Changes the Brain"
- Carol Dweck talks about parenting tips to encourage positive learning attitudes: "The Perils and Promise of Praise"
- Paul Tough discusses experiments in college that drastically boost learning by helping students feel like they belong: "Who Gets to Graduate?"
- Carol Dweck, "Even Geniuses Work Hard"
- Edudemic "Why the Growth Mindset is the Only Way to Learn" article
- Brainology, "You can grow your intelligence" article and reflection worksheet

APPENDIX B

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Date: 04/11/19 Approved By: Elisha Perez Signed:

Mindset Works, Inc.

Support and Operations Team

If you have any questions please email us at support@mindsetworks.com or call us at +1-888-344-6463.

APPENDIX C

COPYRIGHT PERMISSION

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Walnut, CA 91789

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To Whom It May Concern:

We Grant Jo Dowdy (AFS HS Math Teacher) permission to print "You can Grow your Intelligence" (Mindset Works, Inc. copyright material) for use in the classroom with her students. One condition is that you use the version of the article found here and keep all branding, copyright, and website information intact.

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Date: 03/28/19 Approved By: Elisha Perez Signed:

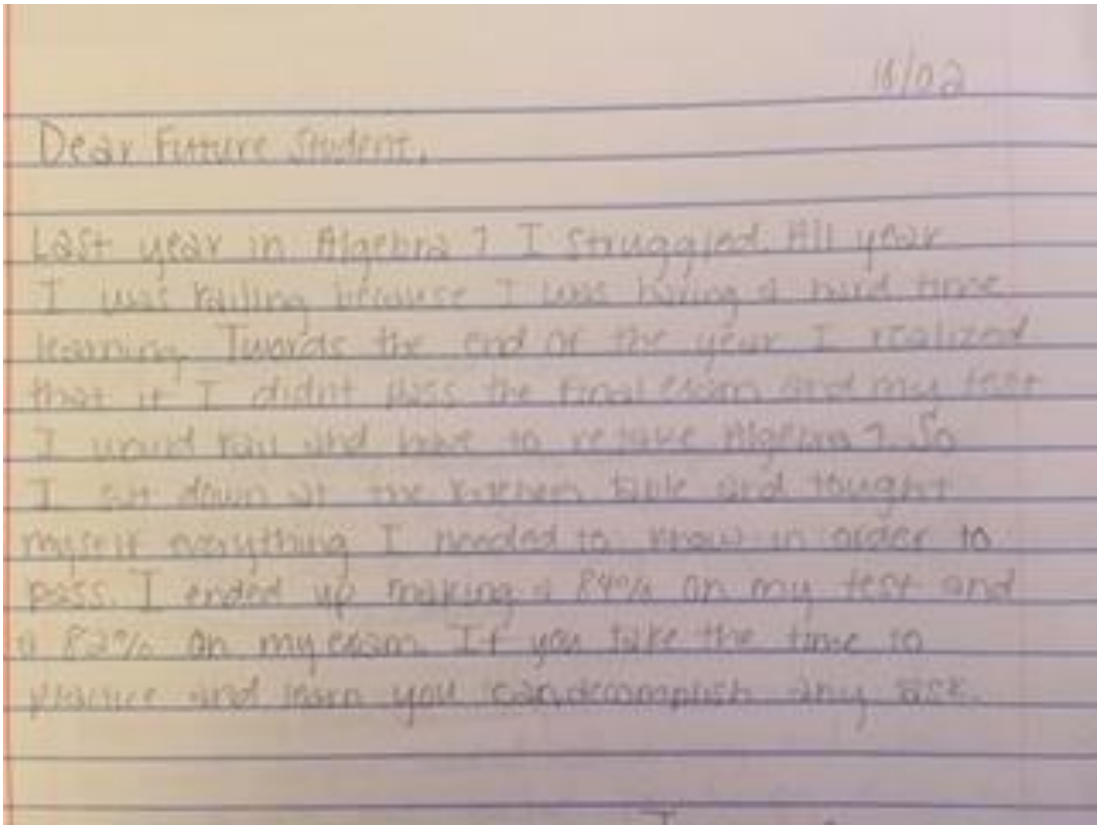
Mindset Works, Inc.

Support and Operations Team

If you have any questions please email us at support@mindsetworks.com or call us at +1-888-344-6463.

APPENDIX D

SAMPLE STUDENT LETTER



18/02

Dear Future Student,

Last year in Algebra 1 I struggled all year. I was failing because I was having a hard time learning. Towards the end of the year I realized that if I didn't pass the final exam and my test I would fail and have to retake Algebra 1. So I sat down at the kitchen table and taught myself everything I needed to know in order to pass. I ended up making a 89% on my test and a 82% on my exam. If you take the time to practice and learn you can accomplish any task.

APPENDIX E

GUARDIAN PERMISSION FORM

GUARDIAN AUTHORIZATION:
Your child is invited to participate in a research study conducted by Jo Dowdy, from the University of South Carolina, Department of Education. I hope to learn if a mindset intervention will help your child to improve his/her academic performance and motivation in the mathematics classroom. Your child was selected as a possible participant in this study because research shows failure and retention rates are highest during the ninth-grade year.

This intervention is research based and has been found to close gender gaps in mathematics and decrease achievement gaps in minority students. However, I cannot guarantee that your child will personally receive any benefits from this research.

Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission or as required by law. Subject identities will be kept confidential as I will be the only person collecting data.

Your child's participation is voluntary. If you decide to allow your child to participate, you and/or your child are free to withdraw your consent and discontinue participation at any time without penalty.

If you have any questions about the study, please feel free to contact me at jdowdy@lexrich5.org or 803-575-5300. (Dr. Peter Duffy is my advisor from USC).

Your signature indicates that you have read and understand the information provided above, that you willingly agree to allow your child to participate, that you and/or your child may withdraw your consent at any time and discontinue participation without penalty, that you will receive a copy of this form, and that you are not waiving any legal claims. You may obtain results of this study upon request.

Parent/Guardian Signature_____ Student's Name:_____

Date:_____

APPENDIX F

FIXED MINDSET MEASURE

Survey

Demographics

Circle the appropriate answer for each statement.

1. I consider my race to be:

   African American American Indian Caucasian Hispanic

   Other

2. I consider my gender to be:

   Female Male

Mindset Measure

Rank the following statements based on your beliefs from Strongly disagree to Strongly agree.

1. You have a certain amount of intelligence, and you really can't do much to change it.

   Strongly disagree Disagree Neutral Agree Strongly agree

2. Your intelligence is something about you that you can't change very much.

   Strongly disagree Disagree Neutral Agree Strongly agree

3. Being a 'math person' is something that you really cannot change. Some people are good at math and other people aren't.

   Strongly disagree Disagree Neutral Agree Strongly agree

APPENDIX G

MATH MOTIVATIONAL BELIEFS SCALE

Survey

Demographics

Circle the appropriate answer for each statement.

3. I consider my race to be:

   African American American Indian Caucasian

   Hispanic Other

4. I consider my gender to be:

   Female Male

Math Beliefs

1. If you were to list all the students in your grade from worst to best in math, where would you put yourself?

   one of the Worst about as good as 25% about as good as 50% about as good as 75% one of the Best

2. How good at math are you?

   not at all good somewhat good average pretty good very good

3. How well do you expect to do in math this year?

   not at all well somewhat well average pretty well very well

4. How good would you be at learning something new in math?

   not at all good somewhat good average pretty good very good

5. How much do you like doing math?

   not at all good somewhat good average pretty good very good

6. In general, I find working on math assignments: (very boring, very interesting)

   very boring somewhat boring average somewhat interesting very interesting

7. Compared to most other activities, how useful is what you learn in math?

   not at all useful somewhat useful average pretty useful very useful

8. For me, being good at math is:

   not at all important somewhat important average pretty important very important

9. Compared to other activities, how important is it to you to be good at math?

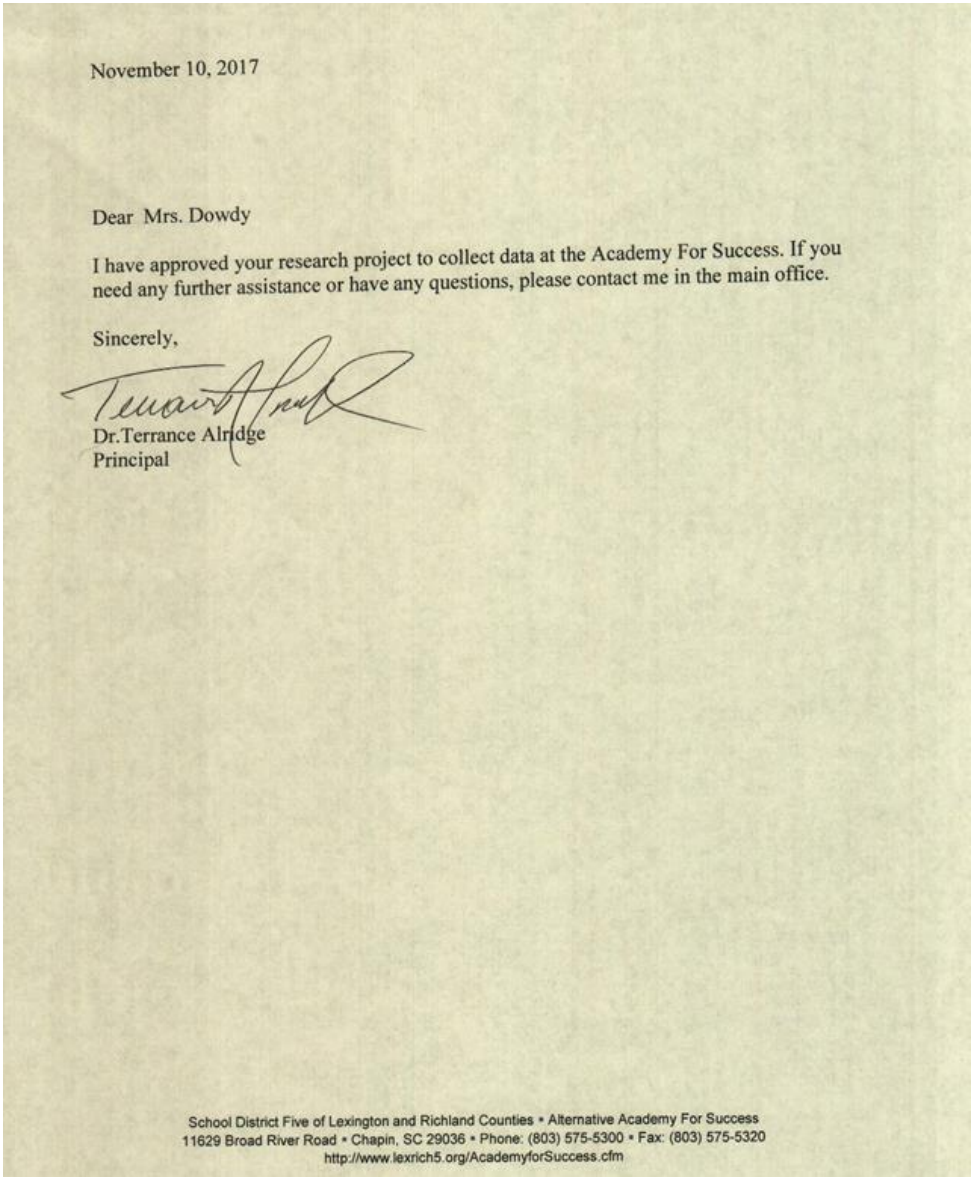
   not at all important somewhat important average pretty important very important

10. In general, how useful is what you learn in math?

    not at all useful somewhat useful average pretty useful very useful

APPENDIX H

SITE APPROVAL



November 10, 2017

Dear Mrs. Dowdy

I have approved your research project to collect data at the Academy For Success. If you need any further assistance or have any questions, please contact me in the main office.

Sincerely,

Dr.Terrance Alridge
Principal

School District Five of Lexington and Richland Counties • Alternative Academy For Success
11629 Broad River Road • Chapin, SC 29036 • Phone: (803) 575-5300 • Fax: (803) 575-5320
http://www.lexrich5.org/AcademyforSuccess.cfm

APPENDIX I

USC INTERNAL REVIEW BOARD APPROVAL

OFFICE OF RESEARCH COMPLIANCE

INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH

DECLARATION of NOT RESEARCH

Jo Dowdy
120 Press Lindler Rd
Columbia, SC 29212 USA

Re: **Pro00081542**

Dear Mrs. Jo Dowdy:

This is to certify that research study entitled ***Mindset of Ninth-Grade Students in an Alternative Mathematics Classroom*** was received on **8/9/2018** by the Office of Research Compliance, which is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). The Office of Research Compliance, on behalf of the Institutional Review Board, has determined that the referenced research study is not subject to the Protection of Human Subject Regulations in accordance with the Code of Federal Regulations 45 CFR 46 et. seq.

No further oversight by the USC IRB is required. However, the investigator should inform the Office of Research Compliance prior to making any substantive changes in the research methods, as this may alter the status of the project and require another review.

If you have questions, contact Lisa M. Johnson at lisaj@mailbox.sc.edu or (803) 777-6670.

Sincerely,

Lisa M. Johnson
ORC Assistant Director
and IRB Manager