THE RELATIONSHIP BETWEEN CRITICAL THINKING ABILITY AND GROWTH MINDSET IN 7TH GRADE MATH STUDENTS

By

Racheal L. Watson

An Abstract
of a thesis submitted in partial fulfillment
of the requirements for the degree of
Education Specialist in Elementary Mathematics
in the School of Teaching and Learning
University of Central Missouri

November 2018

ABSTRACT

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The purpose of this research was to investigate if a student's critical thinking ability and exposure to critical thinking activities has any effect on his or her growth mindset in a math class. Students' critical thinking ability and growth mindset were both assessed using a critical thinking pre-survey and growth mindset pre-survey. During one quarter, data collection was from four different fifty-minute periods of a seventh grade math class. Specific critical thinking strategy implementation went into weekly instruction, growth mindset instruction was administered, and there was a direct focus on the eight mathematical practices. At the end of the quarter, the students took the same critical thinking and growth mindset surveys again as post-surveys to measure growth in both areas.

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CHAPTER 1
NATURE AND SCOPE OF THE STUDY

In Jo Boaler's book *Mathematical Mindsets,* she says, "It used to be believed that the brains people were born with couldn't really be changed, but this idea has now been resoundingly disproved. Study after study has shown the incredible capacity of brains to grow and change within a really short period." (p. 1) Through research, the belief is shifting from the fixed mindset of the intelligence a person is born with is all that person will ever be able to achieve to a mindset of a person can change his or her intelligence greatly. Even though intelligence can and does influence learning, does a student's mindset about his or her intelligence affect his or her learning? Can exposure to critical thinking activities increase a student's critical thinking ability, thus increasing his or her confidence and mindset? Can this fixed mindset of a person being born with the maximum amount of intelligence he or she will ever possess be proven through research? There has been research completed in recent years to support a mindset opposite of the fixed mindset previously mentioned, and that is what researchers are referring to as a growth mindset. Dweck (2010) charges that growth mindset is the belief that one can develop his or her intelligence over time, whereas a fixed mindset is the belief that one's intelligence is simply an inborn trait—one has a certain amount, and that's that. Dweck has devoted her research and writing to growth mindset and the motivation behind it. She is fascinated with the reasons behind why people succeed and the motivation behind their success. Through her research, she has found a growth mindset will not only affect a person's intelligence, but also has the potential to affect other areas of his or her life. Boaler (2016) applies the work of Dweck's further and incorporates it directly to mathematical learning. Her

term “mathematical mindsets” refers to having a belief that mindset is just as important, if not more important, than one’s innate ability to learn math. She explains that if one learns something deeply, the synaptic activity will create lasting connections in one’s brain. Her work has helped educate teachers about how to create a safe climate in which students embrace their mistakes as opportunities to learn rather than feel shamed into being “wrong.”

Statement of Problem

Students who have a fixed mindset have a narrow view of the world. Those students believe no matter how hard they work at something, they will never get better at it. They do not enjoy even productive struggle because they feel like if they are unable to figure out the problem immediately, they are not smart enough to figure it out at all. Those students would rather give up when a problem is posed without a quick answer than work hard and try different strategies to see if they could develop a way to solve the problem. However, students with a growth mindset enjoy productive struggle because those problems are not so “easy” and “boring.” They believe that the effort behind the struggle is what defines success not how smart a person is. When given feedback, these students are reflective and use that feedback in future situations. The thinking behind a fixed mindset, is more prevalent in math classrooms than in other subjects (Boaler, 2016). Since math is a subject that builds and builds as time goes on, it is essential that students do not develop a mindset of “being bad at math.”

Background

Teachers hear attitudes about math, and educational ability in general, displayed every year in ways such as, “I’m not good at math” or “I’ll never understand this.” Once students’ beliefs about themselves and their abilities have been developed, even if those beliefs are right or wrong, it becomes engrained in their minds. Much of the inspiration for this study came from the

work of Boaler and Dweck who challenge the belief that students are either good or bad at math and that's that. In studies done about students' mindsets, the research (Dweck, 2010) shows that the consequences of a child having a fixed mindset can foretell if that child will be successful in math or not. To be successful in math, a student needs to be comfortable with taking risks, and students with a fixed mindset do not like effort. They think everything should come naturally if you are born with that ability.

Purpose of the Study

This study was an inquiry-based study meant to investigate if there was any relationship between a child's critical thinking ability and that child's growth mindset in math. The study also contemplated the question if students were directly taught the research behind growth mindset coupled with a focus on critical thinking activities if their mindset would change at all. If the study uncovered that there is, in fact, a positive relationship between a child's critical thinking ability and that child's growth mindset in math, differentiated instructional activities could be developed to aid students who tend to struggle in math. In response to the research supporting there is a positive correlation between critical thinking ability and growth mindset in math, curriculum could be developed to stimulate a growth mindset, which would help students stray from thinking their intelligence is fixed. This would ultimately help the students throughout their entire lives, not just their lives spent within the walls of the school building.

Research Questions

The following research questions guided this study.

(1) Does incorporating more critical thinking activities into math lessons increase a student's critical thinking ability?

(2) Does incorporating more critical thinking activities into math lessons have an effect

on a student's growth mindset?

(3) If students are explicitly taught the research behind growth mindset and critical thinking, will that influence his or her ability to think critically in math thus affecting his or her growth mindset in math?

CHAPTER 2
REVIEW OF LITERATURE

There has been significant research related to critical thinking ability, mindset and mathematical performance, and it has generally supported the there is a positive correlation between critical thinking ability and having a growth mindset with above average achievement. In this chapter, research on the brain and its relationship to learning will be presented followed by an explanation of what knowledge the Common Core State Standards and the Standards for Mathematical Practice expect students to possess. Next, specific studies related to critical thinking and students' mindsets and how it relates to academic achievement will be presented. Finally, growth mindset and the impact on student achievement when explicit growth mindset instruction is administered will be discussed.

Brain Research

Technology has changed the way scientists are able to understand the brain and how people learn. After conducting a study involving London taxi cab drivers and London bus drivers, scientists were amazed at the results concerning one's learning ability. During the study, it was found that, in order for a person to qualify to be a London taxi cab driver for the Black Cab Company, he or she must learn and memorize over 20,000 streets and landmarks in a two to four year period as well as take and pass a test called, "The Knowledge." During the training portion, it was found that the applicants' brains actually changed. The hippocampus, which is responsible for learning and applying spatial knowledge, did not remain the same, but grew. During the time of their employment with the company, brains remained the same, but once they retired and were no longer using that area of their brains as they had while employed, their hippocampus shrank back to the pre-employment size (Boaler, 2016). In realizing that the brain

actually has the ability to physically change, scientists were able to support the idea that the brain is more like a muscle and using it will actually increase its size.

In another study performed by the National Institute for Mental Health (Boaler, 2016) people were given a 10-minute task to work on every day for three weeks. The researchers compared the brains of the people who performed the task every weekday for three weeks with people who did not perform the task. The findings amazed the researchers. The people who performed the task for only ten minutes a day for three weeks actually experienced brain growth, while the people who did not perform the task did not. Boaler (2016) states, "Such results should prompt educators to abandon the traditional fixed ideas of the brain and learning that currently fill schools—the new evidence from brain research tells us that everyone, with the right teaching and messages, can be successful in math, and everyone can achieve at the highest levels in school." (p. 4)

Common Core State Standards and Standards of Mathematical Practice

In order to improve the mathematics achievement in the United States as compared to other countries, the Common Core State Standards (CCSS) initiative was launched. The CCSS are a set of standards that state what students should be able to do by the end of each grade level in school. While teaching styles and lesson plans are to the discretion of the teacher, the standards give the teacher a guide to go by as he or she is leading his or her students through the school year with respect to mathematics learning. It is the goal of the CCSS to allow students to gain a deeper understanding of mathematics on a more conceptual level (Common Core State Standards, National Governors Association, 2010). The Standards of Mathematical Practice (SMP) are a set of eight best practices to go by when implementing the CCSS in mathematics teaching. The practices as described within the CCSS mirror an earlier set of process standards

developed by the National Council of Teacher of Mathematics (NCTM). The SMP when paired with the CCSS can add deeper understanding and rigor in a mathematics classroom. Even though all eight of the SMP are important, the three focused on in this study are as follows:

Practice #1: Make sense of problems and persevere in solving them.

This standard, as described in the CCSS for Math, holds the expectation that students who are proficient in mathematics will approach a problem without looking straight for a solution, but rather tackle the problem with a strategic approach. A few strategic approaches could be considering similar problems, searching for patterns, and then considering the solution and the reasonableness of it.

Practice #3: Construct viable arguments and critique the reasoning of others.

This standard describes students who are proficient in math as those being able to defend, analyze, and critique other approaches to problem solving. To accomplish this, students observe previous problems and use that in combination with logical progressions and statements to test and prove conjectures of their own or of others.

Practice #8: Look for and express regularity in repeated reasoning.

Students will see repeated calculations and look for generalizations and shortcuts. Even though they think critically about the overall process of the problem, they are still able to attend to the details and consider the reasonableness of their results.

When implementing the CCSS and SMP in a classroom, teachers must remember to center the lesson on the students' inquiry and not lead them too much.

One teacher describes leading students too much as "funneling" (Herbel-Eisenmann, n.d.). Teachers mean no harm when they are scaffolding the students through problem solving, but when he or she basically walks the students through solving the problem the way he or she

would, it leaves no room for the students to explore different strategies or to critically think about the problem for themselves. When using the focusing strategy it requires the teacher to hold back on guiding students to his or her method of solving the problem, and listen to how students are responding to guide them along their own problem-solving journey (Herbel-Eisenmann, n.d.). This method is centering the learning on the students and their thinking rather than on the teacher and his or her thinking. In another teacher's classroom students do not fear mistakes because they have all of the time and access to all of the materials they need to solve problems in their own way (Wenrick, n.d.).

Critical Thinking and Its Relationship to Academic Achievement

What exactly is critical thinking? Critical thinking is "the ability to analyze the way you think and present evidence for your ideas, rather than simply accepting your personal reasoning as sufficient proof" (Islam, 2015, p.1). In school, this looks different from the typical lecture-style classroom that traditionally existed. Teachers no longer sit and feed information to students, but rather act as a facilitator and supporter for students' learning. Teachers can use different questioning techniques that will help them understand where their students thinking is and provide their students with the support they need to become independent learners. By using different questioning techniques, teachers are able to help their students think more critically about the content and curriculum presented. "We intervene when necessary and allow freedom when they are able to function without our assistance" (Walsh, 2005, p. 23). Islam (2015) also suggests critical thinking to be a self-directed, self-disciplined, self-monitored, and self-correcting way of learning. Morgan (2018) says, "Students with critical thinking skills become more independent, self-directed learners rather than relying on teachers and classroom time for instruction and guidance." (p. 1) Once students possess better critical thinking skills, they will

achieve their goals in school and life at a higher level than before. “Students who know how to analyze and critique ideas are able to make connections across disciplines, see knowledge as useful and applicable to daily life and understand content on a deeper, more lasting level” (Morgan, 2018, p. 1). If students are able to understand content on a deeper level, this will not only help them learn at a higher level, but it will also help them possess the thinking required to support a growth mindset. Developing the right kind of environment that will foster students’ critical thinking is of utmost importance. Students need to feel safe to make mistakes and learn from those mistakes to grow their understanding at a deeper level.

One of the first things a teacher needs to know in order to encourage more critical thinking in his or her classroom is how to understand understanding. When suggestions are made about mathematics instruction, there is an emphasis on the importance of learning mathematics with understanding; however, “understanding” is often left undefined (Carpenter, 2015). It is suggested that knowledge needs to be connected in order to make it more meaningful. In a math classroom, this is just as true. In order for students to make meaning out of the mathematics they are doing, they must be able to connect that math to something meaningful. That connection can be to something in the students’ prior knowledge, to something the students will see in real-life situations, or simply connected to another discipline in school such as science. When students are asked to critically think about the mathematics they are doing, it helps them make those necessary connections in order to develop the mathematics in their long-term memories. With the mathematics ingrained in the students in this way, their minds begin to grow, leading them more toward a growth mindset than they might have been before.

When teachers try to support the idea of understanding understanding in their classrooms, students will naturally start questioning themselves and their thinking without the scaffolding of

the teacher. Leinwand (2014) states, “To ensure that students have the opportunity to engage in high-level thinking, teachers must regularly select and implement tasks that promote reasoning and problem solving.” (p. 17) Tasks that will do just that encourage students to reason through the problems using various strategies to tackle the problem instead of running straight toward a solution. It is essential for teachers to foster the growth of students’ critical thinking skills to meet the global changes directly influencing education (Stobaugh, 2013). The evolution of the expectations for workforce skills is requiring students to get a good foundation in critical thinking skills because of the wealth of information they access on a daily basis. That information can consist of true, false, biased, and non-biased information that students need to learn how critically analyzing the information will help them make a decision for themselves about the validity of it.

Growth Mindset and Its Relationship to Academic Achievement

In 2006, Dweck published research that has changed educators’ approach in the classroom, especially when students are interacting with the teachers. Her research is supportive of students developing a growth mindset, which means they believe that the brain can grow and intelligence will grow, too. Characteristics of the 40% of students in the United States who exhibit a growth mindset include not seeing failure as a defining point, they enjoy challenges, and they are more willing to take academic risks. Dweck’s research also shows that another 40% of students work with a fixed mindset. Students who have a fixed mindset exhibit characteristics such as the belief you are born with all of the intelligence you will ever have, you are either smart or you are not, they have a fear of failure which makes them avoid challenges, and when they fail or make mistakes they feel they are just not smart (Dweck, 2006).

Dweck's research also supports the idea that when students undergo an intervention to move from fixed to growth mindset they will start to perform at a higher level immediately. This along with results of research about brain elasticity and response to effort changed how teachers interacted with students and how they grouped students for cooperative learning structures. Dweck's findings prompted other studies to investigate what impacts teaching explicit growth mindset interventions had on different groups of students. One of the results of those studies supported the finding that as students experienced effort instruction new connections were formed in the brain. As more studies replicated existing studies it was found that academic achievement significantly rose for the students who had experienced growth mindset instruction. Conversely, when teachers do not foster a growth mindset by either explicitly instructing students about growth mindset or putting growth mindset ideas into place in their classrooms, a fixed mindset threatens to overtake instead. One way teachers foster a fixed mindset in their classrooms is by ability grouping. However, those schools that do not group based on ability send the message that intelligence is learned through effort (Dweck 2006).

One teacher describes her time as a student as having the label "the smart kid" because she was able to copy algorithms in math and get the answers quickly. She describes herself now as an educator who knows from her own teaching and learning that all students are capable of learning. Just because students learn differently and on different time scales does not mean those students are not as smart as others. She goes on to say simply getting answers does not support conceptual understanding. The shift in schools needs to move toward growth mindset teaching and learning practices in order to reach and support all learners (Nuttall, 2017).

CHAPTER 3
METHODS

Introduction

This chapter will focus on the specific methods used to investigate the research questions

(1) Does incorporating more critical thinking activities into math lessons increase a student's critical thinking ability?

(2) Does incorporating more critical thinking activities into math lessons have an effect on a student's growth mindset?

(3) If students are explicitly taught the research behind growth mindset and critical thinking, will that influence his or her ability to think critically in math thus effecting his or her growth mindset in math?

Specifically, this study focuses on seventh graders and their critical thinking ability over one school quarter.

Setting

This study took place at a K-12 school housing preschool through seniors in high school in a small Midwestern community. The school is a consolidated school that includes students from four small towns, and it is located outside a small town with a population of 300 people. There are approximately 1000 students K-12, with approximately 200 students attending the middle school. Of those middle school students, approximately 75% qualify for free or reduced lunch. The research was performed in a seventh grade math classroom and included students from four different seventh grade math periods. Data was kept in a locked metal cabinet in researcher's classroom.

Participants

The participants were seventh graders from four math periods in the middle school. Only the students whose parents signed a consent form (See Appendix A) allowing them to participate in the study and students who agreed to be in the study by signing an assent form (See Appendix A) were included in the study. There were a total of twenty-two students participating between four classes. Of these, ten were male and twelve were female. All students who participated were Caucasian. Sixteen students were in an advanced seventh grade math class over two class periods, and six students were in a basic math class over two class periods. There were no English Language Learners included because there are no English Language Learners enrolled in the middle school. Students with learning disabilities, students on Individual Educational Plans, and 504 plans were not included in the study because permission was not given from those parents and students to participate. Students were in seventh grade and were 12-13 years old. No data was collected or used in this study unless the parent consented and the child gave assent. Any identifying information included in any part of the study was known only by the researcher.

Measurement Instruments

The study is comprised of two different pre and post surveys. The growth mindset survey combined components including mindset, effort beliefs, and student efficacy (See Appendix B). The critical thinking survey was a self-assessment of critical thinking ability (See Appendix C). The students completed the survey during their normal math class time. The data collection took place using a pencil and paper survey. Once the data was collected from the pencil and paper, it was entered into a spreadsheet program. The growth mindset survey is a modified version of a survey used in a previous study by Wilkins, P.B.B. (2014) to quantify the students' answers in order to measure their mindset in their math class. The only change made to the survey was it did

not include section four. The critical thinking survey is a modified version of a survey used in a previous study by Steffen, C. (2011).

The growth mindset survey contains three sections that focus on student mindset, effort beliefs, and student efficacy. This survey contains the students' thoughts and opinions using subscales to quantify their answers. The critical thinking survey contains only one section that focuses on students analyzing how well they can perform tasks related to critical thinking ability. This survey contains the students' thoughts and opinions using subscales to quantify their answer.

Mindset Assessment Subscale

The first section of the growth mindset survey contained the Student Mindset Assessment – Theory of Intelligence Scale (Wilkins, 2014). The scale was used to measure the students' opinions about intelligence and how those compare to the growth mindset theory. Any of the questions pertaining to intelligence the students answered in which they believed intelligence was a set amount from birth and that amount cannot change, were counted more toward the student possessing a fixed mindset. On the contrary, if the students answered in a way that leaned toward intelligence not being a set amount, then this led to the assumption those students possessed a growth mindset. The subscale was set up in a way that showed 1 meant Agree Strongly and 6 meant Disagree Strongly. The higher the score for the questions indicated more of a growth mindset.

Efforts Belief Subscale

Students answered the questions in this portion of the survey to indicate their beliefs about how much work and effort could affect intelligence and success. The scale on this section of the survey was also set up in a way that 1 meant Agree Strongly and 6 meant Disagree

Strongly. On the first five questions of this section, the lower the student scored the item, the less that student felt like effort had any effect on outcome. However, the higher a student scored the item, the more that student felt like effort had effect on outcome. The remaining four questions in that section were the opposite scoring: a lower score meant higher effort belief and the higher the score the lower effort belief.

Student Efficacy Subscale

This last section of the survey assesses how well a student believes in their capability to complete their math assignments. The scale for this portion was such that a 1 meant Strongly Agree and a 6 meant Strongly Disagree. Therefore, if the student scored the five items higher, that leaned more toward the student believing they could not accomplish success in math class this year, whereas, a lower score meant the opposite.

Critical Thinking Ability Subscale

This survey consisted of six questions intended to measure their belief in how well they could critically think. The scale for this survey was set up on a five-point system in which a 1 meant Not At All and a 5 meant I Can Always Do This. The lower the student scored the item, the less he or she believed in his or her critical thinking ability. On the other hand, the higher the student scored the item, the more he or she believed in his or her critical thinking ability.

Procedures

Consent forms were sent home with every student in the researcher's math classes and parents were asked to allow their child to participate in the study. Students were also asked to fill out the assent form. Four different math classes were involved in this study. Identical growth mindset pre-surveys and critical thinking pre-surveys were given to all participants. Growth mindset discussions were planned with an emphasis on critical thinking, and all critical thinking

strategies and growth mindset discussion was the same in all four classes. All four classes had equal length class periods of fifty minutes, and did the same critical thinking activities. All classes completed identical growth mindset post-surveys and critical thinking post-surveys. All classes were administered the growth mindset and critical thinking pre-surveys as a paper and pencil task, and the responses were recorded in spreadsheet software for analysis. At the end of the semester, all classes took the same growth mindset and critical thinking post-surveys in a computer lab on individual computers through a Google Form, so the results were easily compared with each other. While administering the pre- and post-surveys, the researcher did not give any instruction to the students other than how to access the surveys. When students asked questions, the researcher encouraged each student to answer to the best of his or her ability.

The thinking routines emphasizing critical thinking from the book, *Making Thinking Visible* (Ritchhart, 2011) included See-Think-Wonder, Compass Points, I Used to Think…Now I Think…, and What Makes You Say That? See-Think-Wonder is just what it sounds like. Students are asked what they see, what they think about what they see, and what do they wonder about it now. This structure was used for the purpose of this study at the beginning of a new topic to probe student thinking and curiosity. Compass Points is a structure in which the teacher can modify the north-east-south-west compass points of N-E-S-W to stand for whatever serves the purpose of the structure the best. This structure was used as a reflection for the purpose of this study. At the end of a lesson, students were asked to reflect about what **N**ew connection they could make to something already known, what **E**xcited them the most about the topic, what **S**peculation they have about the topic, and what **W**ow moment they could share. The N-E-S-W can stand for whatever best serves the purpose of the lesson. I Used to Think…Now I Think…is a prediction and a reflection structure built into one. This structure was used with a topic that was

just introduced, and students were asked to use their prior knowledge to develop a prediction about the concept. After the lesson or lessons, students returned to their prediction, reflected about what they thought because of the lesson, and made any connections they could. The last structure used was used the most often of them all, What Makes You Say That? This structure was used daily as students were making assumptions, using problem-solving skills, and thinking through the mathematics. This structure is used to probe deeper thinking from the students so they can make necessary connections or pay attention to any red flags that come up as they are reasoning through problems. The researcher was able to gain much insight into what students were thinking through this process.

Data Analysis

Since this study was to measure growth in critical thinking ability and in growth mindset, the pre survey and the post survey questions were the same questions so the validity of the results would not be compromised. After the post surveys were collected, the data was compared to see if there was any growth in the area of critical thinking ability and growth mindset.

Consideration of Ethical Concerns

The surveys did not include any identifying information as they were taken confidentially. As previously mentioned, consent forms were collected from the parents and assent forms were collected from the participants prior to conducting the study. The students who did not provide informed consent and/or assent to be part of the study were removed from the data pool. In addition, the data that was analyzed was done so anonymously. As these surveys were integrated into part of their normal school day and did not require anything additional of the participants, there was no risk associated in this study. The data that were recorded included the opinions of the students concerning intelligence, beliefs and opinions

about effort, and beliefs and opinions about critical thinking ability all within the context of math class. The consent and data was secured in a locked file cabinet in the researcher's classroom. The destruction of consent and any data included in the study were among the documents that were shredded upon completion of the study.

CHAPTER 4
RESULTS

Introduction

The CCSS (National Governors, 2010) describe the SMP as practices that support and enhance a growth mindset. There has not been much research showing a correlation between critical thinking ability and growth mindset. Because there is limited research on how critical thinking ability affects growth mindset in middle school students, the data was analyzed to try to learn about any connections existing between the two. The focus in this study was to inspect the assumption that as students' critical thinking ability increases their growth mindset will also increase, thus answering the question: *If students are explicitly taught the research behind growth mindset and critical thinking, will that influence his or her ability to think critically in math thus effecting his or her growth mindset in math*?

The results of the research into the relationship between critical thinking ability and a student's growth mindset will be presented in this chapter outlining the specific questions from the pre and post surveys that showed changes. The first part will look at the critical thinking pre and post survey to see if there was any change. The second part will be a comparison between the pre and post surveys for mindset assessment to see if there were any changes. Finally, a comparison between the pre and post surveys about adaptive learning scales will be analyzed for change.

Data Analysis Review

All of the pre surveys and post surveys were reviewed in terms of increase, decrease, or maintaining their value. Furthermore, data analysis software was used to assess the data to test for significant changes for conversation. The research question: *If students are explicitly taught the research behind growth mindset and critical thinking, will that influence his or her ability to*

think critically in math thus effecting his or her growth mindset in math? is concentrated on through the results of all the values from the pre and post surveys.

Survey Results

The results of the critical thinking pre and post survey are shown below. Table 1 shows the data collected from the critical thinking pre survey.

Table 1

Pre-Test Survey Results – Critical Thinking

	Number of Students by Response				
	Not at all	Sometimes but I need help	Yes, but I get stuck in the middle	I can most of the time	I can always do this
Question 1	2	8	3	8	1
Question 2	3	3	3	10	3
Question 3	2	4	2	5	9
Question 4	2	4	7	4	5
Question 5	1	3	9	8	1
Question 6	2	3	6	6	5

Table 2 shows the data collected from the critical thinking post survey.

Table 2

Post-Test Survey Results – Critical Thinking

	Number of Students by Response				
	Not at all	Sometimes but I need help	Yes, but I get stuck in the middle	I can most of the time	I can always do this
Question 1	0	4	4	12	2
Question 2	0	3	5	8	6
Question 3	0	3	4	10	5
Question 4	1	4	1	9	7
Question 5	1	4	5	10	2
Question 6	0	5	4	11	2

Table 3 shows the data comparison between the critical thinking pre and post survey.

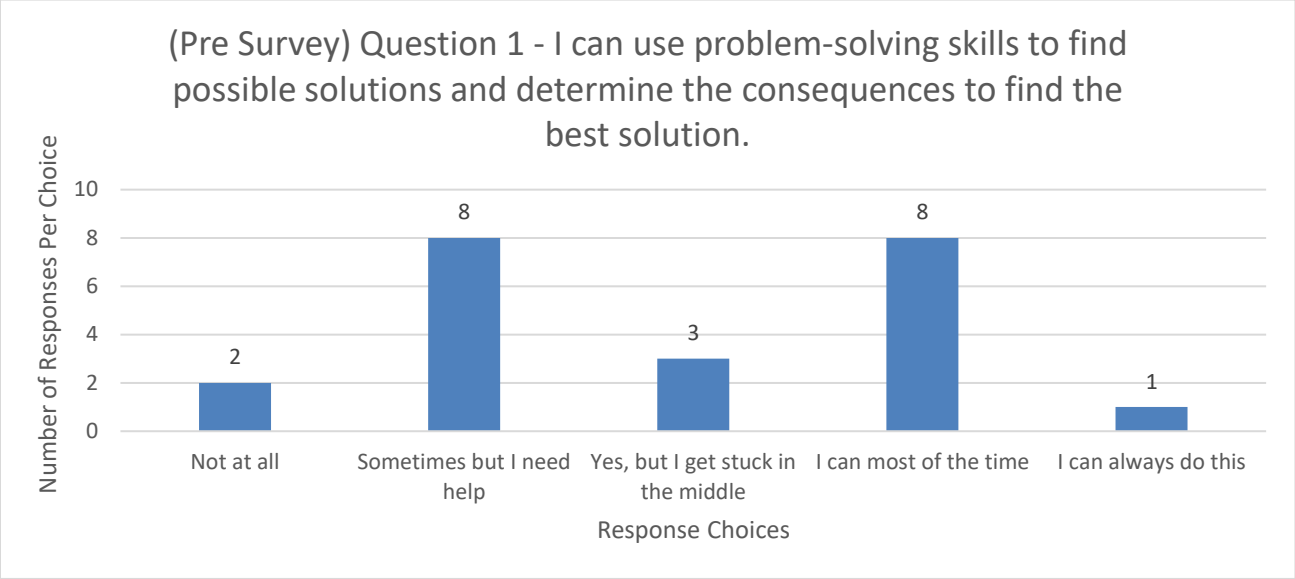
Table 3

Comparison of Pre- and Post-Test Survey Question Mean Scores – Critical Thinking

	Pre-Test Survey	Post-Test Survey	Change
Question 1	2.9	3.5	+0.6
Question 2	3.3	3.8	+0.5
Question 3	3.7	3.8	+0.1
Question 4	3.3	3.8	+0.5
Question 5	3.2	3.4	+0.2
Question 6	3.4	3.5	+0.1

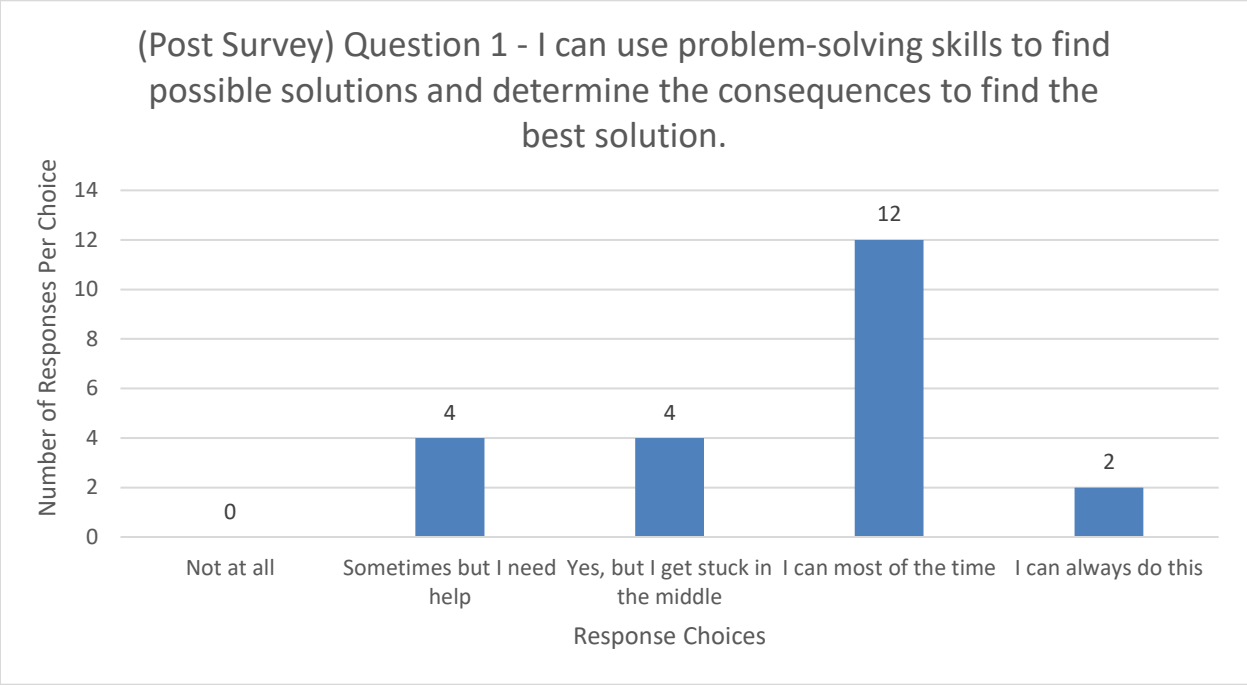
The three questions that showed the most change were questions one, two, and four. Question 1 asked students to rate how often they could use problem-solving skills to find possible solutions and determine the consequences to find the best solution. Figures 1 and 2 show the critical thinking pre and post survey results of question one. Question 2 asked students to rate how well they could use decision-making skills to consider possible options and decide what will happen as the result of the decision. Figures 3 and 4 show the critical thinking pre and post survey results of question two. Question 4 asked students to rate how well they could compare and contrast by considering how things are alike with regard to their differences and any significant patterns. Figures 5 and 6 show the critical thinking pre and post survey results of question four.

Figure 1. Critical Thinking Pre Survey Results for Question 1



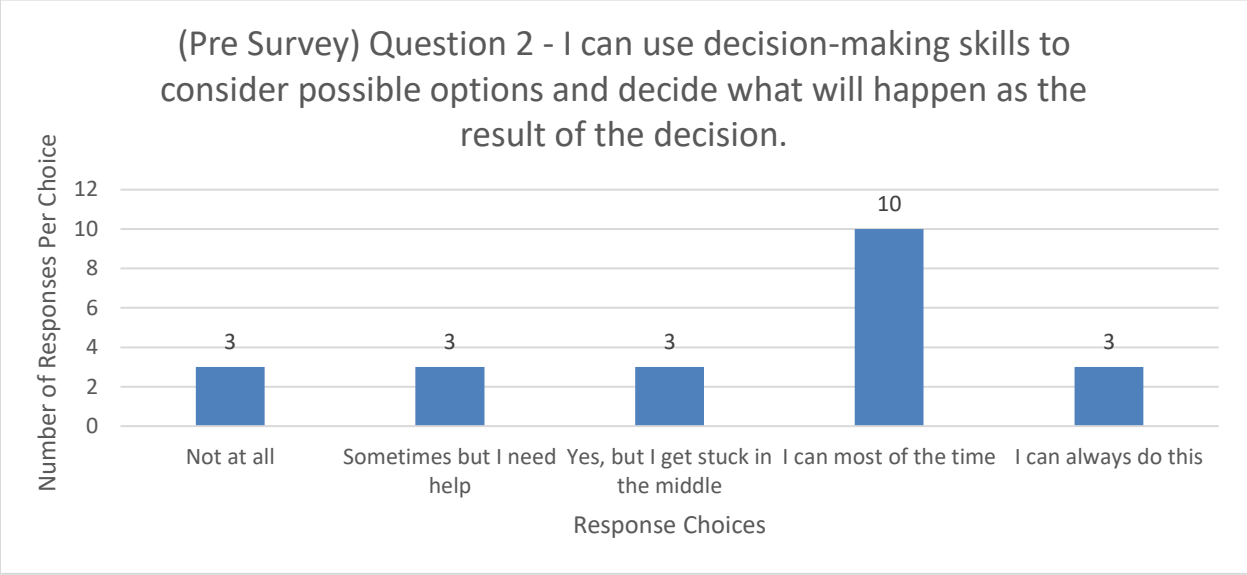
Notes. This figure represents the responses to the pre survey results for question 1 provided to the students before a focus on critical thinking structures.

Figure 2. Critical Thinking Post Survey Results for Question 1



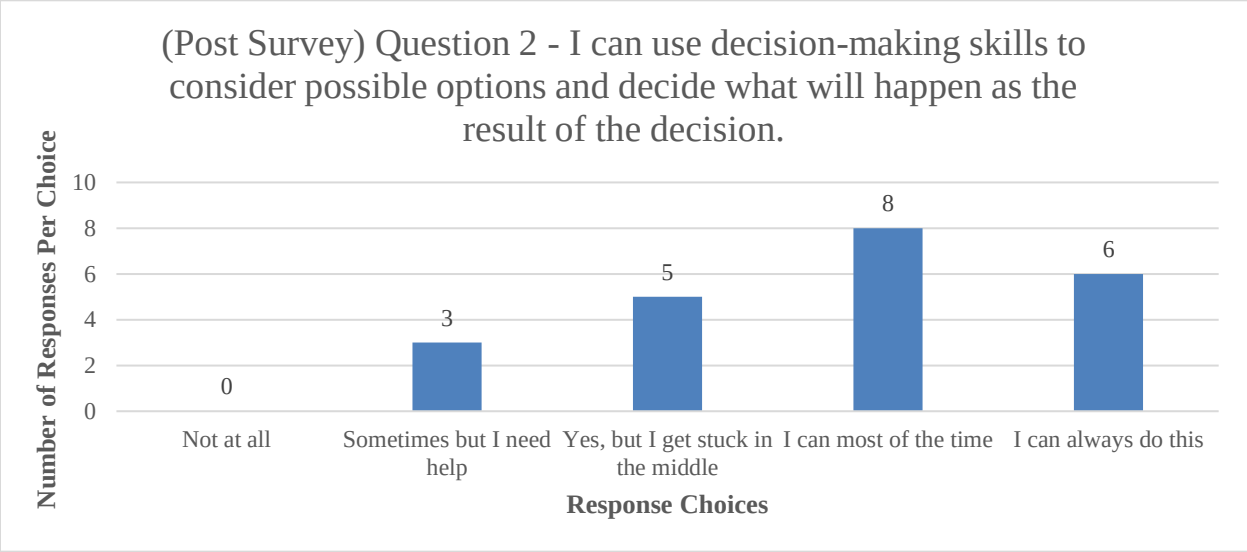
Notes. This figure represents the responses to the post survey results for question 1 provided to the students after a focus on critical thinking structures.

Figure 3. Critical Thinking Pre Survey Results for Question 2



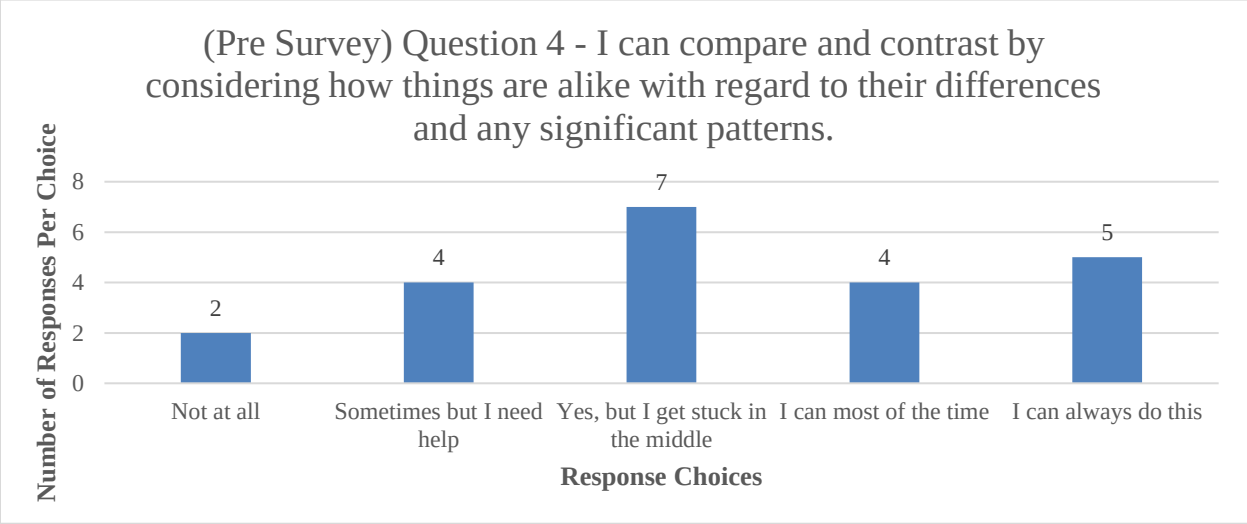
Notes. This figure represents the responses to the pre survey results for question 2 provided to the students before a focus on critical thinking structures.

Figure 4. Critical Thinking Post Survey Results for Question 2



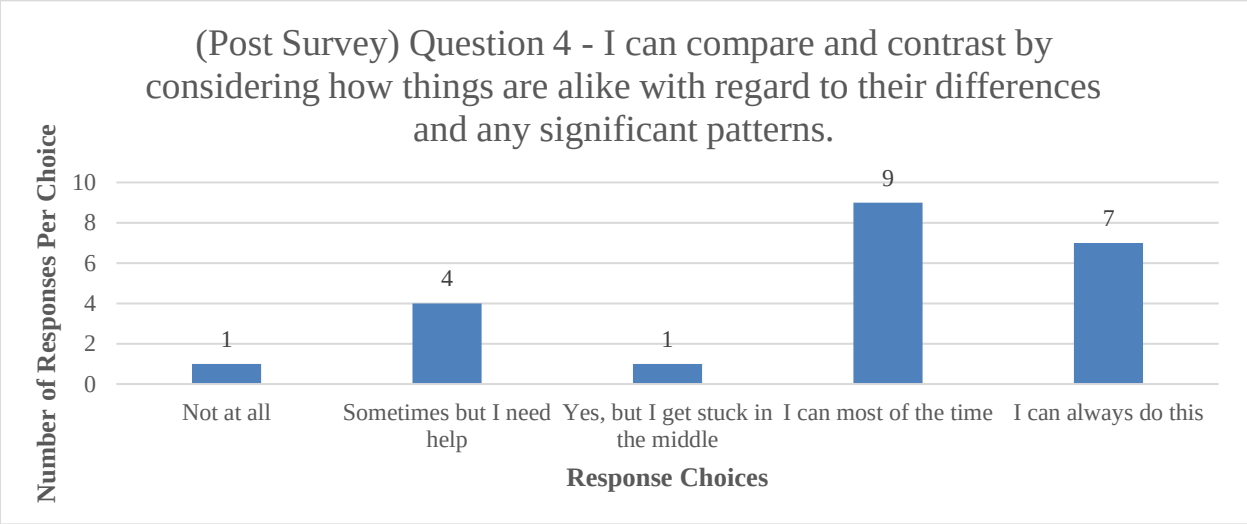
Notes. This figure represents the responses to the post survey results for question 2 provided to the students after a focus on critical thinking structures.

Figure 5. Critical Thinking Pre Survey Results for Question 4



Notes. This figure represents the responses to the pre survey results for question 4 provided to the students before a focus on critical thinking structures.

Figure 6. Critical Thinking Post Survey Results for Question 4



Notes. This figure represents the responses to the post survey results for question 4 provided to the students after a focus on critical thinking structures.

Student Critical Thinking Ability

Questions 1, 2, and 4 are all important qualities to possess if one expects to be successful in a math class. Problem solving is essential for mathematics, so question one is an essential skill to have. As shown in the pre and post survey results the number of students who were confident

when considering the top three rating categories of *yes but I get stuck in the middle, I can most of the time,* and *I can always do this* on question one was at twelve students. After the implementation of the critical thinking strategies, that number rose to sixteen students. When students are problem solving they are using their decision-making skills when deciding on what strategy to use to attack the problem, so question two is also an important aspect of a math class. As shown in the pre and post survey results the number of students who were confident when considering the top three rating categories on question two was at sixteen students. After the implementation of the critical thinking strategies, that number rose to nineteen students. In a mathematics class students are encouraged to pay attention to detail and generalize based on recognized patterns. Since question four had students rate how well they could notice patterns to compare and contrast things, it was an important question to consider. As shown in the pre and post survey results the number of students who were confident when considering the top three rating categories on question four was at sixteen students. After the implementation of the critical thinking strategies, that number rose to seventeen students.

The data results of the student mindset pre and post survey is displayed below. Table 4 shows the data collected from the student mindset pre survey.

Table 4

Pre-Test Survey Results – Student Mindset Assessment

	Number of Students by Score*					
	6	5	4	3	2	1
Question 1	0	3	0	8	5	6
Question 2	2	4	4	3	3	6
Question 3	2	1	3	7	5	4
Question 4	1	2	6	4	5	4
Question 5	0	1	3	2	9	7
Question 6	6	2	2	4	5	3
Question 7	3	2	3	2	5	7
Question 8	3	2	2	2	9	4
Question 9	5	3	3	4	3	4
Question 10	2	2	2	3	7	6
Question 11	0	2	2	3	5	10
Question 12	1	3	2	2	8	6
Question 13	3	10	3	2	2	2
Question 14	4	3	11	2	1	1
Question 15	4	0	5	3	8	2

*A score of 6 indicates the highest growth mindset. A score of 1 indicates the lowest growth mindset.

Table 5 shows the data collected from the student mindset post survey.

Table 5

Post-Test Survey Results – Student Mindset Assessment

	Number of Students by Score*					
	6	5	4	3	2	1
Question 1	8	6	1	5	1	1
Question 2	9	7	5	0	1	0
Question 3	3	11	5	0	2	1
Question 4	6	6	5	3	1	1
Question 5	1	4	9	2	4	2
Question 6	6	10	6	0	0	0
Question 7	5	5	5	6	1	0
Question 8	8	11	3	0	0	0
Question 9	9	9	2	2	0	0
Question 10	1	8	2	9	2	0
Question 11	0	6	7	4	3	2
Question 12	3	7	5	2	3	2
Question 13	6	12	2	0	2	0
Question 14	10	10	2	0	0	0
Question 15	4	8	6	1	3	0

*A score of 6 indicates the highest growth mindset. A score of 1 indicates the lowest growth mindset.

Table 6 shows the data comparison between the student mindset pre and post survey.

Table 6

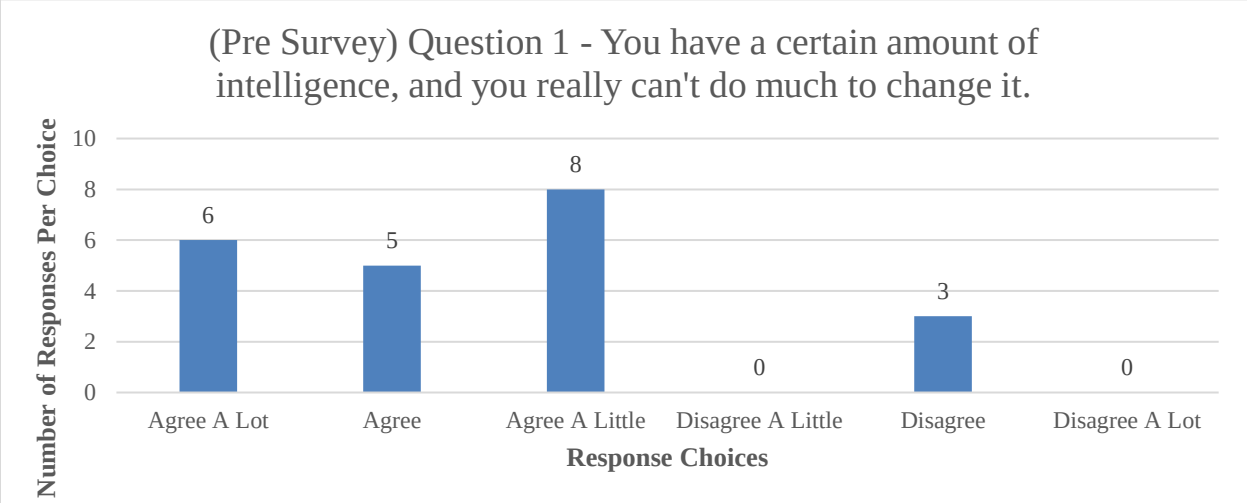
Comparison of Pre- and Post-Test Survey Question Mean Scores – Student Mindset Assessment

	Pre-Test Survey	Post-Test Survey	Change
Question 1	2.5	4.5	+2.0
Question 2	3.1	5.0	+1.9
Question 3	2.9	4.5	+1.6
Question 4	3.0	4.5	+1.5
Question 5	2.2	3.5	+1.3
Question 6	3.6	5.0	+1.4
Question 7	2.9	4.3	+1.4
Question 8	2.9	5.2	+2.3
Question 9	3.6	5.1	+1.5
Question 10	2.7	3.9	+1.2
Question 11	2.1	3.5	+1.4
Question 12	2.6	4.0	+1.4
Question 13	4.2	4.9	+0.7
Question 14	4.2	5.4	+1.2
Question 15	3.2	4.4	+1.2

The three questions that showed more change than any others were questions one, two, and eight. Question 1 asked students how much they agreed with the statement *you have a certain amount of intelligence, and you really cannot do much to change it*. Figures 7 and 8 show the mindset

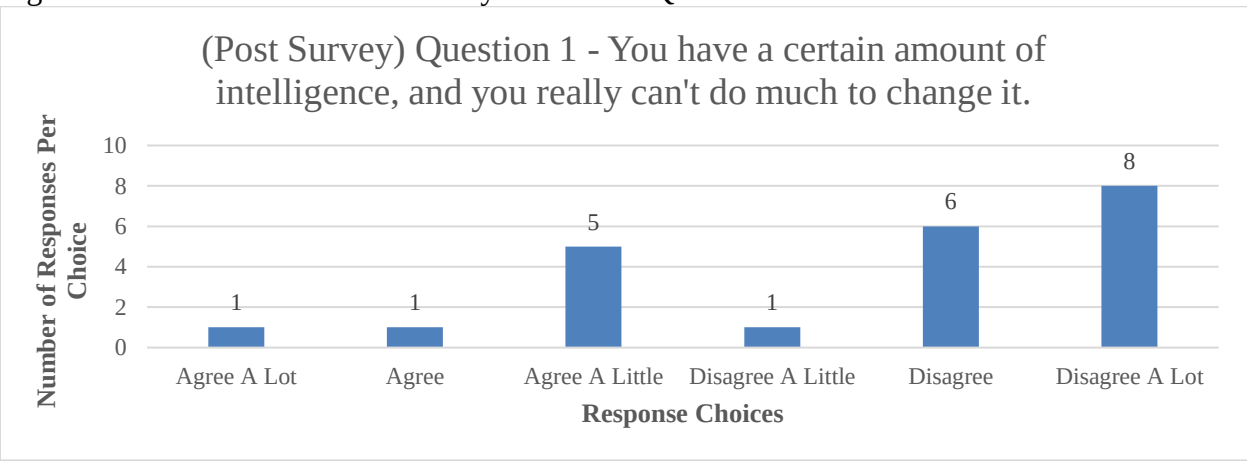
pre and post survey results of question one. Question 2 asked students how much they agreed with the statement *you can always change how intelligent you are*. Figures 9 and 10 show the mindset pre and post survey results of question two. Question 8 was on the mindset survey within the effort beliefs section, and it asked students how much they agreed with the statement *it does not matter how hard you work—if you are not smart, you will not do well*. Figures 11 and 12 show the efforts beliefs pre and post survey results of question eight.

Figure 7. Student Mindset Pre Survey Results for Question 1



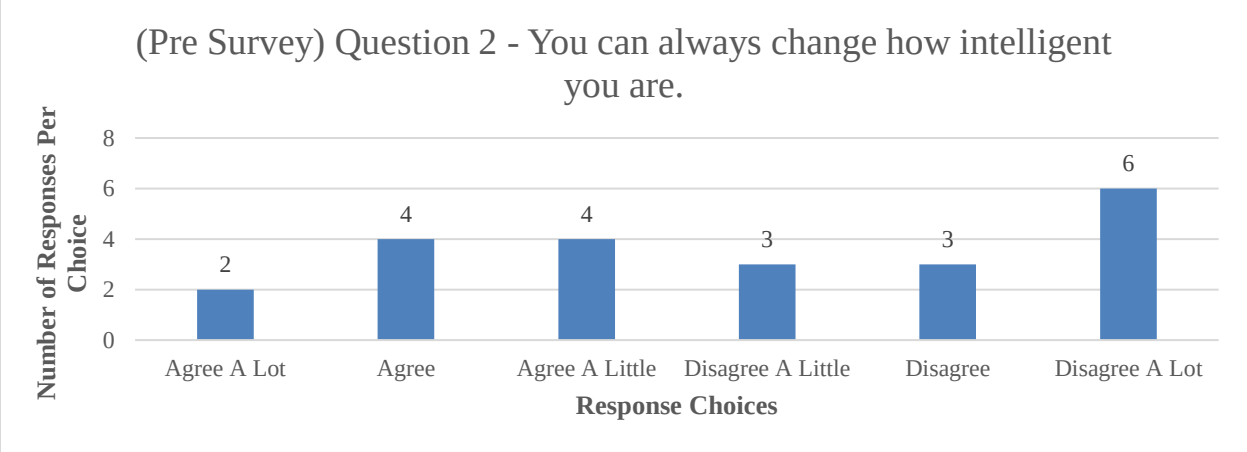
Notes. This figure represents the responses to the pre survey results for question 1 provided to the students before growth mindset instruction.

Figure 8. Student Mindset Post Survey Results for Question 1



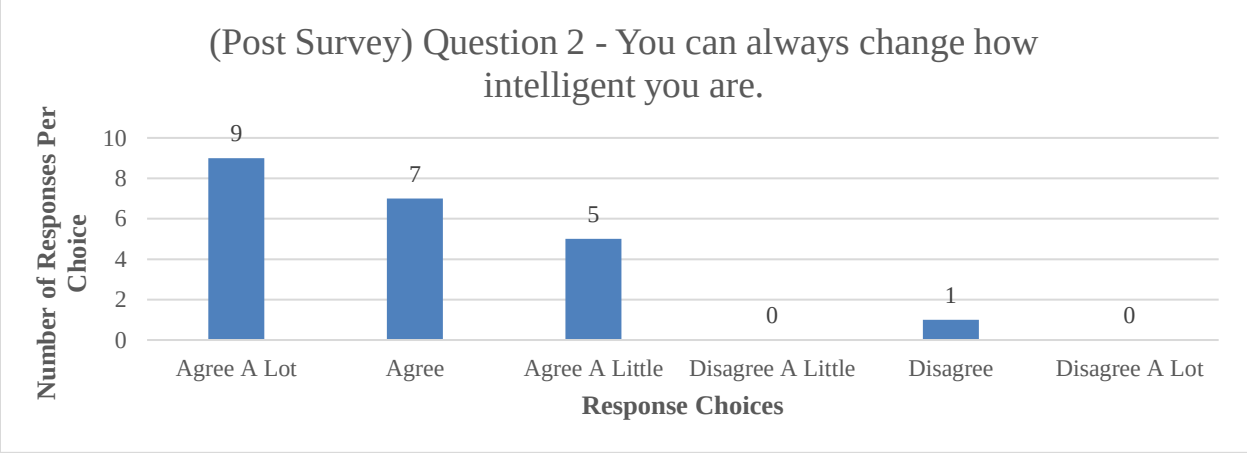
Notes. This figure represents the responses to the post survey results for question 1 provided to the students after growth mindset instruction.

Figure 9. Student Mindset Pre Survey Results for Question 2



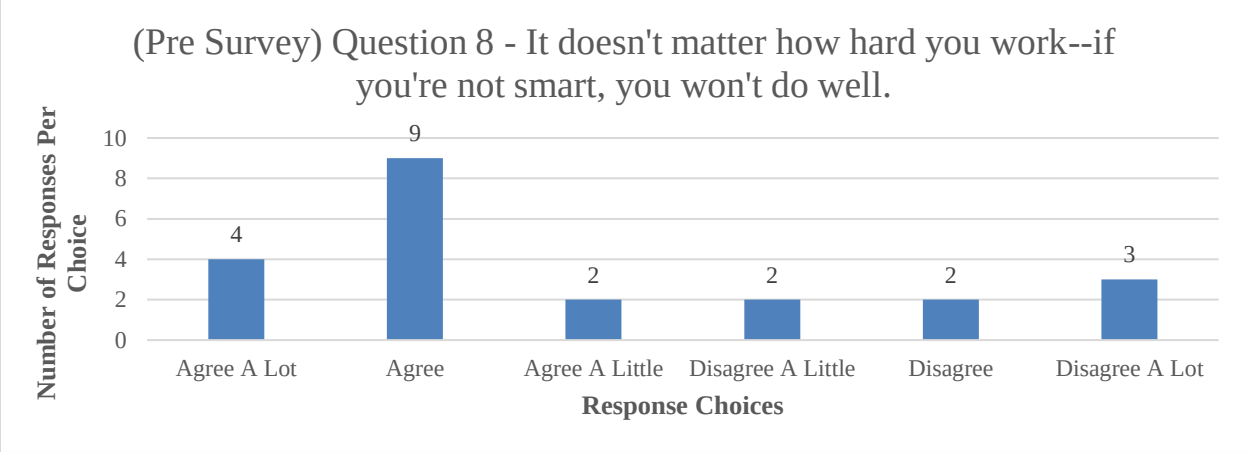
Notes. This figure represents the responses to the pre survey results for question 2 provided to the students before growth mindset instruction.

Figure 10. Student Mindset Post Survey Results for Question 2



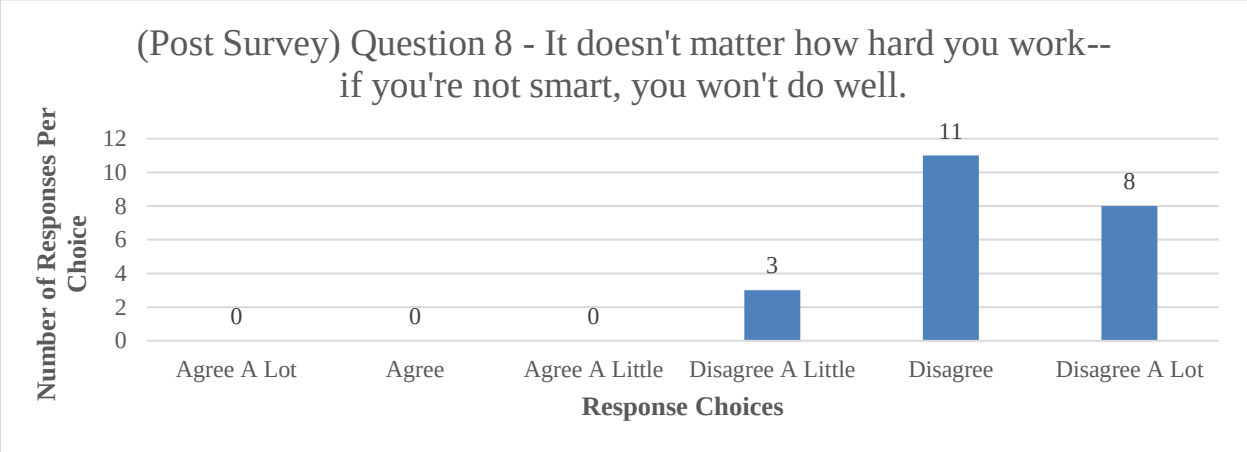
Notes. This figure represents the responses to the post survey results for question 2 provided to the students after growth mindset instruction.

Figure 11. Student Efforts Beliefs Pre Survey Results for Question 8



Notes. This figure represents the responses to the pre survey results for question 8 provided to the students before growth mindset instruction.

Figure 12. Student Efforts Beliefs Post Survey Results for Question 8



Notes. This figure represents the responses to the post survey results for question 8 provided to the students after growth mindset instruction.

Student Mindset

The three questions that showed the most change on the mindset and efforts beliefs portion of the pre and post surveys were questions one, two, and eight. Question 1 asked students to rate how much they agreed with the statement: *you have a certain amount of intelligence, and you really cannot do much to change it*. The number of students out of the twenty-two who participated in the study who agreed in any way with this statement on the pre survey was nineteen. This would lead one to believe they held on to a fixed mindset. However, after

instruction about growth mindset, the number of participants who agreed with the same statement dropped to eight out of the twenty-two. The second question asked students to rate how much they agreed with the statement: *you can always change how intelligent you are*. The number of participating students who disagreed in any way with this statement was twelve, which would lead to the conclusion they held a fixed mindset. However, after growth mindset instruction the number of participants who disagreed in any way dropped to one, which shows their mindsets shifted during the study. Question 8 referred to students' efforts beliefs, and it asked students how much they agreed with the statement: *it does not matter how hard you work—if you are not smart, you will not do well*. On the pre survey, which was before growth mindset instruction, the number of students who agreed in any way with that statement was fifteen. After growth mindset instruction was administered during the study, that number dropped to zero, which showed a great increase in the number of students who believed that effort makes a big impact on success versus failure.

The results of the patterns of adaptive learning scales, student effort beliefs, pre and post survey are shown below. Table 7 shows the data collected from the patterns of adaptive learning scales, student effort beliefs, pre survey.

Table 7

Pre-Test Survey Results – Patterns of Adaptive Learning Scales

	Number of Students by Score*					
	6	5	4	3	2	1
Question 1	4	3	9	4	2	0
Question 2	0	4	9	2	6	0
Question 3	6	4	5	6	1	0
Question 4	4	5	6	6	1	0
Question 5	4	3	7	7	1	0

*A score of 6 indicates the highest growth mindset. A score of 1 indicates the lowest growth mindset.

Table 8 shows the data collected from the patterns of adaptive learning scales, student effort beliefs, post survey.

Table 8

Post-Test Survey Results – Patterns of Adaptive Learning Scales

	Number of Students by Score*					
	6	5	4	3	2	1
Question 1	2	13	6	0	1	0
Question 2	3	8	9	0	1	1
Question 3	4	15	2	1	0	0
Question 4	6	14	2	0	0	0
Question 5	7	11	3	1	0	0

*A score of 6 indicates the highest growth mindset. A score of 1 indicates the lowest growth mindset.

Table 9 shows the data comparison between the patterns of adaptive learning scales, student efforts beliefs, pre and post survey.

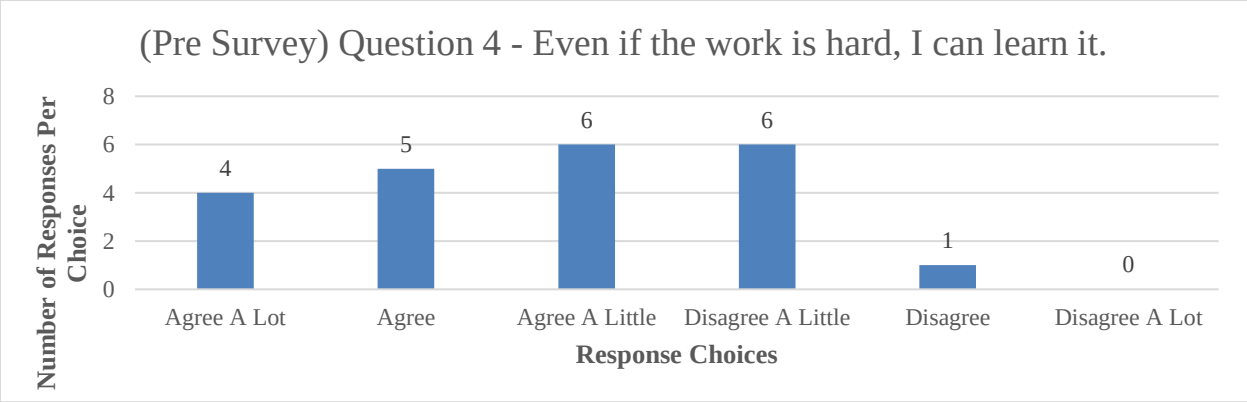
Table 9

Comparison of Pre- and Post-Test Survey Question Mean Scores – Patterns of Adaptive Learning Scales

	Pre-Test Survey	Post-Test Survey	Change
Question 1	4.1	4.7	+0.6
Question 2	3.5	4.4	+0.9
Question 3	4.4	5.0	+0.6
Question 4	4.2	5.2	+1.0
Question 5	4.1	5.1	+1.0

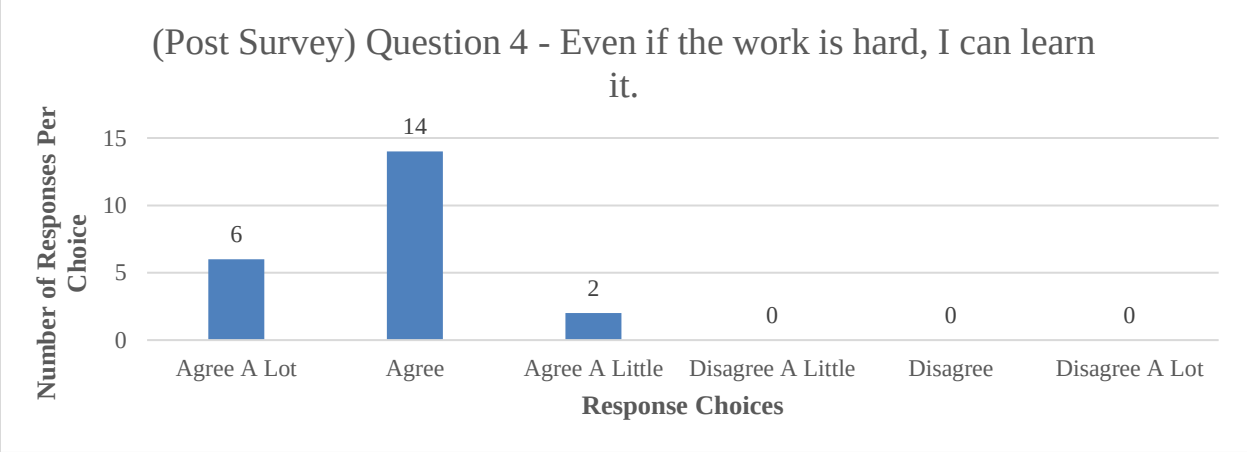
Two questions that showed more change than the others when comparing the pre survey results to the post survey results were questions four and five. The questions asked on this portion of the survey were asked specifically about the students' beliefs about their math class. Question 4 asked students to rate how much they agreed or disagreed with the statement: *even if the work is hard, I can learn it*. Figures 13 and 14 show the student efficacy survey results of question four. Question 5 asked students to rate how much they agreed or disagreed with the statement: *I can do even the hardest work in this class if I try*. Figures 15 and 16 show the student efficacy survey results for question five.

Figure 13. Student Efficacy Beliefs Pre Survey Results for Question 4



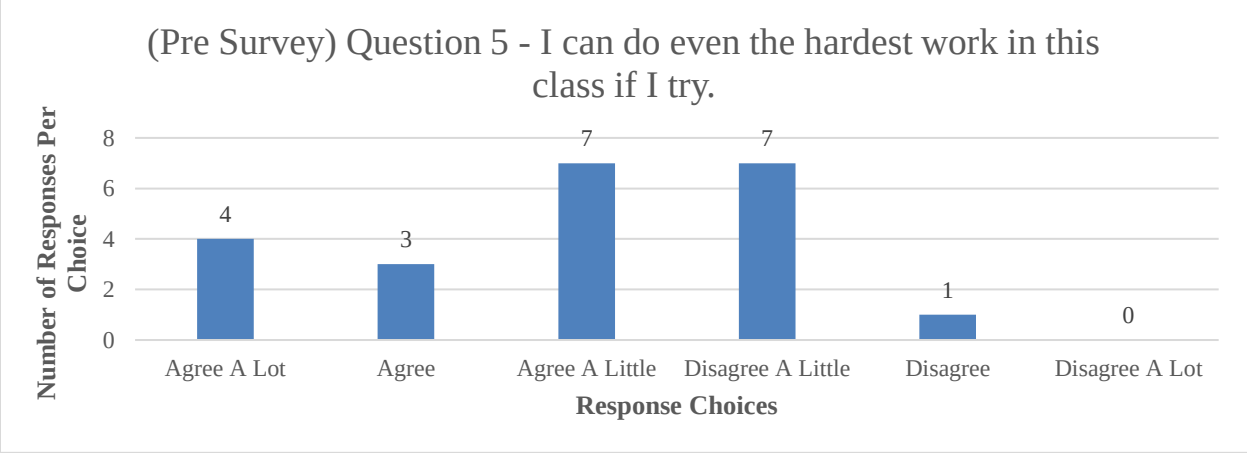
Notes. This figure represents the responses to the pre survey results for question 4 provided to the students after growth mindset instruction.

Figure 14. Student Efficacy Beliefs Post Survey Results for Question 4



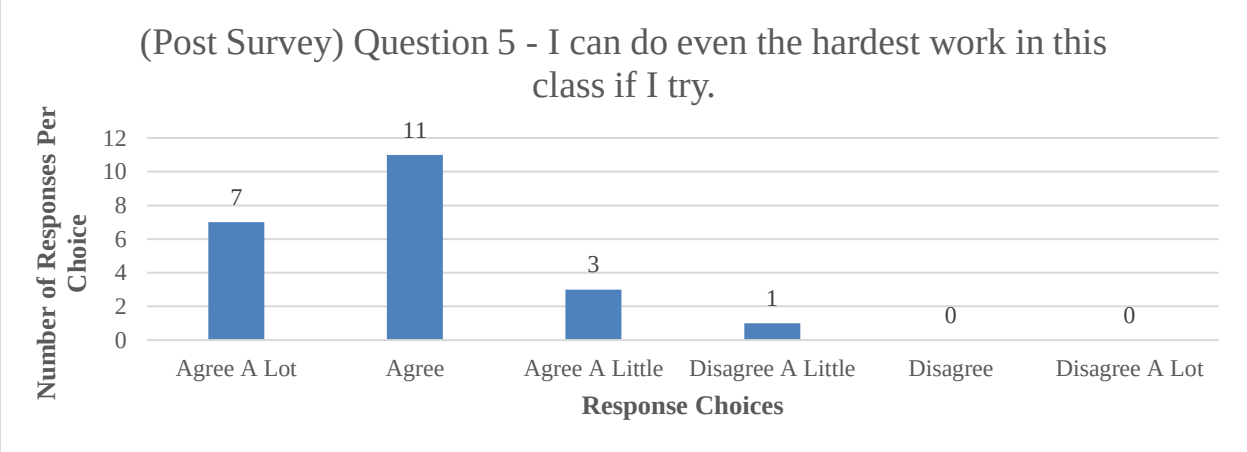
Notes. This figure represents the responses to the post survey results for question 4 provided to the students after growth mindset instruction.

Figure 15. Student Efficacy Beliefs Pre Survey Results for Question 5



Notes. This figure represents the responses to the pre survey results for question 5 provided to the students after growth mindset instruction.

Figure 16. Student Efficacy Beliefs Post Survey Results for Question 5



Notes. This figure represents the responses to the post survey results for question 5 provided to the students after growth mindset instruction.

Student Efforts Beliefs

Believing that effort makes a difference on success or failure is as important to a growth mindset as the belief that intelligence is not fixed. This was a small portion of the surveys, but it showed a lot of shift from less belief in efforts to greater belief in efforts. Question 4 began with fifteen students believing their efforts would make a difference, and on the post survey all twenty-two participants agreed that personal efforts make a big difference. Question 5 on the pre survey showed fourteen students who believed efforts make a difference, and those results shifted to twenty-one participants believing the greater the effort, the more chance for success.

CHAPTER 5
DISCUSSION

Introduction

The main goal of this study was to identify the effect implementing several different critical thinking structures would have on the mindset of seventh grade math students. As mentioned prior to this section, there has not been a lot of research done considering the relationship between critical thinking ability and growth mindset. The hypothesis the researcher made leaned toward a positive correlation between the two. Another goal was to gather research pertaining to a student's critical thinking ability and his or her growth mindset. The following sections will discuss the support that was found in this study that students who underwent critical thinking instruction and growth mindset instruction had an increase in both areas.

Throughout this chapter, there will be discussion that lends itself to supporting how critical thinking ability had a positive effect on growth mindset through this study. Furthermore, there are sections that will discuss the limitations of this study and how it could have been improved, future recommendations and a conclusion.

Student Critical Thinking, Effort Beliefs and Mindset Assessment

The results in the previous chapter support that there appears to be a positive correlation between a student's belief in how well he or she can critically think and that student's growth mindset. When answering questions initially about critical thinking ability and growth mindset, students moved from a more fixed mindset to more of a growth mindset. Statements such as this insinuate participants' beliefs in their brain's ability to grow and get stronger with exercise. Even though the data could not be compared statistically, the results lend themselves to the notion that further research is in order.

Since participants began to shift from the belief that the brain always has been and always will be the size it started out as, to the belief that the brain is able to strengthen and grow through hard work and exercise, there was evidence they were shifting from a fixed mindset to more of a growth mindset. During the critical thinking structures completed in class, the students' dialogue began to shift as well. The researcher was hearing less and less of the, "I am not good at math" or "this is too hard for me" and more of the, "I might not get it right, but I will not ever know if I do not try" and "I wonder how many tries it will take me to get this figured out." Students were beginning to embrace their mistakes as opportunities to learn rather than a sign of failure.

There was not a stray from the typical curriculum that was taught with the exception of adding the critical thinking structures within the lessons and instruction about growth mindset theory. As the students discussed their beliefs about the idea that intelligence is fixed at the beginning of the study, the overall response was that nothing could be done to increase intelligence. Conversely, by the end of the study, students were looking for new ways to challenge themselves to "see if they could do it", as one student challenged. Most of the time, students run the other direction when posed with math problems that look "too hard", but by the end of this study the students were becoming more of strategic problem solvers and less of students looking for a "quick answer."

Limitations

There were several limitations of this study, one being the measurement tools, one having to do with the length of time of the study, and the other pertaining to the size of the sample. People can believe in growth in some areas and not others. The surveys used in this study were general growth mindset and critical thinking surveys, so if those had been more specific to

growth mindset and critical thinking ability in math it might have yielded more accurate results. In fact, a few of the seventh grade students had trouble understanding what the questions were asking based on the complexity of some of the wording. If there were more grade-level appropriate surveys, the students might have comprehended more what each question was asking. The readability of the surveys could have led students to wrong conclusions about what the question was asking. Another limitation to the study was the age of the students and the level of seriousness that was given to the study while answering the questions on the pre- and post-surveys. However, it was easier to measure growth with the critical thinking activities incorporated into the seventh grade math classes during the study. When comparing the quality of the students' visible thinking shown in the early critical thinking activities with the later activities, growth and comprehension were both evident.

The study was set to cover an entire semester of a normal school year, but by the time everything was in place for the study, a quarter had passed. Having the whole semester or more would have given students more exposure to different critical thinking activities and instruction of growth mindset.

With regard to the size of the sample, there were 22 students total. The school district is a small district with 61 students in the seventh grade class, so had more students participated in the study, results could have looked very different. However, with the study consisting of 22 students, one or two outliers could have influenced the results significantly. Finally, since there was no identifying information collected on either of the surveys, statistical analysis comparing a student to himself or herself is not able to be determined. However, overall comparisons from pre and post surveys will be discussed to see if further research would be a relevant endeavor.

Recommendations for Future Research

When considering the size of the participant group this study was completed with, it is clear that the participant group should have been significantly larger. A good suggestion to entertain is the possibility of including several different teachers from different schools. Statistical results are notably more valid the larger the sample size. Another recommendation is to carry out the study over an entire school year or years with the same sample size.

Clearly, there has to be more research comparing critical thinking ability and its effect on the growth mindset of an individual. Since the research was limited, that lends itself to the idea that more studies that are extensive could be done to measure the correlation between critical thinking ability and growth mindset of individuals. Through a more extensive study, there could be more specific instruction about growth mindset, more critical thinking structures implemented, more time for students to self-reflect on their beliefs and how they changed throughout the study, and more time for the researcher to analyze data collected to help decision-making with respect to next steps.

Conclusion

Since growth mindset theory is becoming more and more of a norm implemented in schools, one could only imagine the positive effects this will have on student achievement. If students are taught throughout elementary about growth mindset and their own intelligence, this will only help them that much more through the trying years of middle school. As middle school students are trying to figure out who they are and what their place is in this world, it would be beneficial if one of their concerns, their intelligence, did not have to be a concern to them as much. If educators of all levels would implement growth mindset instruction along with critical thinking structures, they would be arming their students with the resources to embrace

meaningful mistakes, to see failure as an opportunity for growth rather than a finality, and to endure challenges. Students who possess those qualities will be stronger problem-solvers and less likely to solely be solution-seekers.

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APPENDIX A

Consent and Assent Forms

Research Consent Form – 10/4/17

Identification of Researchers: Racheal Watson is conducting this research under advisor, Ann McCoy. We are with the University of Central Missouri.

Purpose of the Study: The purpose of this study is to find out how a focus on critical thinking affects the beliefs and thoughts of students when it comes to math.

Request of Participation: We are inviting your child to participate in a study on growth mindset. It is up to you whether you would like them to participate. If you decide not to allow them to participate, they will not be penalized in any way. Should you decide to let your child participate, they may stop at any time. If they do not wish to answer any of the questions, they may simply skip them. You may withdraw your child's data at the end of the study. If you wish to do this, please tell us before they turn in their materials. Once they turn in their materials, we will not know which survey or test belongs to your child.

Exclusions: Your child must be in Racheal Watson's 7th grade class at Sherwood Middle School to participate in this study.

Description of Research Method: This study involves completing two short surveys. The survey will ask your child about their beliefs and thoughts on several things in the math classroom.

Privacy: All of the information we collect will be confidential. We will not record their name, student number, or any information that could be used to identify them.

Explanation of Risks: The risks associated with participating in this study are similar to the risks of everyday life.

Questions: If you or your child have any questions about this study please contact Racheal Watson. If you have any questions about your rights or your child's rights as a research participant, please contact the UCM Research Compliance Officer at (660) 543-8562.

If your child would like to participate, please sign a copy of this letter and return it to me. The other copy is for you to keep.

I have read this letter and agree to allow my child to participate.

Student Name: _____

Parent Name: _____

Signature: _____

Date: _____ Person Obtaining Consent: _____

Does Critical Thinking Ability Affect the Growth Mindset of 7th Grade Math Students?

Assent Form – 10/4/17

Researcher and Research Topic: My name is Racheal Watson, and I am working under the advisement of Dr. Ann McCoy from the University of Central Missouri. I am trying to learn about students thinking and belief related to math instruction because this will help teachers teach students how to exercise their mind and build confidence in the mathematics classroom. If you would like, you can be in my study.

What will happen in this Research? If you decide you want to be in my study, you will take two surveys.

What are the good and bad things that come from you being in the research study? The good thing that could come from this is that this research could show teachers how they can teach math in a way that will help exercise your mind and make you enjoy challenges and feel better about math in general. Also you will get to participate first hand in a research study. The risks will be the same as those risks you would encounter normally on a daily basis.

We will not share your personal information: Other people will not know if you are in my study. I will put things I learn about you together with things I learn about other teens, so no one can tell what things came from you. When I tell other people about my research, I will not use your name, so no one can identify about whom I am referring.

Parent/Guardian Approval: Your parents or guardian have to say it's OK for you to be in the study. After they decide, you get to choose if you want to do it too. If you don't want to be in the study, no one will be mad or upset with you. If you want to be in the study now and change your mind later, that is OK. You can stop at any time.

Researcher Contact Information: My telephone number is 660-499-2239. You can call me if you have any questions about the study or if you decide you do not want to be in the study anymore. I will give you a copy of this form in case you want to ask questions later.

Agreement: I have decided to be in the study even though I know that I don't have to do it. Racheal Watson has answered all my questions, and I know that I can stop being in the study at any time. If you have any questions about this, please contact the UCM Research Compliance Officer at (660) 543-8562.

_____ _____

Signature of Study Participant Date

_____ _____

Printed Name of Study Participant Printed Name of Parent/Guardian

_____ _____

Signature of Researcher Date

APPENDIX B

Growth Mindset Pre and Post Survey

Your Middle Name: _____ **Your Favorite Animal:** _____

This is NOT a test! It is an opinion survey. We will be asking you for your thoughts and opinions about school and being a student so that we can learn how to help teachers and students do better in school. There are not right or wrong answers—different people have different ideas about all of these things. It is very important that you give your own opinion, not what someone else told you to think.

Your answers will be kept private, and they will not affect your grades in any way. If you have any questions about anything, feel free to ask for help.

Please take a look at the questions on this page, and ask for help if you have any questions about how to do this.

The first set of questions asks about what you think about intelligence. Intelligence is the same thing as smartness. Here are some things people say about intelligence. Tell us how much you agree or disagree. Remember, there is no right or wrong answer—we are interested in what you think.

Section 1: Student Mindset Assessment – Theory of Intelligence Scale (Dweck, 1999; Blackwell, 2002)

Rating Scale

1	2	3	4	5	6
Agree A Lot	Agree	Agree A Little	Disagree A Little	Disagree	Disagree A Lot

1. You have a certain amount of intelligence, and you really can't do much to change it. _____
2. You can always change how intelligent you are. _____
3. Your intelligence is something you can't change very much. _____
4. No matter who you are, you can change your intelligence a lot. _____
5. You can learn new things, but you can't really change your basic intelligence. _____
6. No matter how much intelligence you have, you can always change it a good amount. _____

Section 2: Effort Beliefs (Blackwell, 2002)

Rating Scale

1	2	3	4	5	6
Agree A Lot	Agree	Agree A Little	Disagree A Little	Disagree	Disagree A Lot

7. To tell the truth, when I work hard at my schoolwork, it makes me feel like I'm not very smart. _____
8. It doesn't matter how hard you work—if you're not smart, you won't do well. _____
9. If you're not good at a subject, working hard won't make you good at it. _____
10. If a subject is hard for me, it means I probably won't be able to do really well at it. _____
11. If you're not doing well at something, it's better to try something easier. _____
12. When something is hard, it just makes me want to work more on it, not less. _____
13. If you don't work hard and put in a lot of effort, you probably won't do well. _____
14. The harder you work at something, the better you will be at it. _____
15. If an assignment is hard, it means I'll probably learn a lot doing it. _____

Section 3: **Patterns of Adaptive Learning Scales (PALS) - Student Efficacy**

Here are some questions about you as a student in a math class. Please select the response that describes what you think.

Rating Scale				
1 Strongly Agree	2 Agree	3 Neither Agree or Disagree	4 Disagree	5 Strongly Disagree

16. I'm certain I can master the skills taught in class this year. _____
17. I'm certain I can figure out how to do the most difficult class work. _____
18. I can do almost all the work in class if I don't give up. _____
19. Even if the work is hard, I can learn it. _____
20. I can do even the hardest work in this class if I try. _____

APPENDIX C

Critical Thinking Pre and Post Survey

Instructions: Please answer each question as honestly as you can. Don't think about each statement too hard, just go with your initial thoughts.

For each statement below respond from "Not At All" to "I Can Always Do This" using the scale to the right, and mark an "X" in the appropriate box. Please respond to all items.

Rate How Well You Can…	Not at all	Sometimes but I need help	Yes, but I get stuck in the middle	I can most of the time	I can always do this
1. Use problem-solving skills to find possible solutions and determine the consequences to find the best solution.					
2. Use decision-making skills to consider possible options and decide what will happen as the result of the decision.					
3. Make predictions based on possible and actual evidence.					
4. Compare and contrast by considering how something is alike with regard to their differences and any significant patterns.					
5. Analyze arguments by finding reasons and conclusions and uncover assumptions.					
6. Determine the reliability of sources by considering questions to ask about the information obtained and deciding if it is reliable or unreliable.					

APPENDIX D

IRB Approval Letter

UNIVERSITY OF CENTRAL MISSOURI
LEARNING TO A GREATER DEGREE

Office of Sponsored Programs & Research Integrity
Administration 315
Warrensburg, MO 64093
Office 660-543-4264
Grants/Contracts: osp@ucmo.edu
Compliance: researchreview@ucmo.edu

Full Review
11/16/2018
Protocol Number: 881

Dear Racheal Watson:

Your research project, 'Is There a Correlation Between Critical Thinking Ability and Growth Mindset?', was approved by the University of Central Missouri Human Subjects Review Committee on 10/4/2017. You may collect data for this project until **10/4/2018**. Your informed consent is also approved until **10/4/2018**.

If an adverse event (such as harm to a research participant) occurs during your project, you must IMMEDIATELY stop the research unless stopping the research would cause more harm to the participant. If an adverse event occurs during your project, notify the committee IMMEDIATELY at researchreview@ucmo.edu.

The following will help to guide you. Please refer to this letter often during your project.

- If you wish to make changes to your study, submit an "Amendment" through Blackboard under the "Amendment and Renewals" tab. **You may not implement changes to your study without prior approval of the UCM Human Subjects Review Committee.**
- If the nature or status of the risks of participating in this research project change, submit an "Amendment" through Blackboard under the "Amendment and Renewals" tab. **You may not implement changes to your study without prior approval of the UCM Human Subjects Review Committee**.
- If you are nearing the expiration date for collecting data for this project (10/4/2018) and you have not finished collecting data:
  1. submit your project application via Blackboard under the "Amendment and Renewals" tab (include any revisions and/or amendments approved since you submitted your application initially)

     AND

  2. submit a "Renewal Report" through Blackboard under the "Final/Renewal Report" tab.
- **When you have completed your collection of data, please submit the "Final Report" found on Blackboard under the "Final/Renewal Report" tab.**

If your protocol contained a consent form and the consent form was approved, you will receive an additional e-mail. The e-mail will contain a copy of your consent form with an approval stamp in the top right corner. Do not begin data collection until you receive a copy of your consent form with an approval stamp. Note: One year after your protocol's approval date, a request for renewal OR a final project report is required.

If you have any questions, please feel free to contact me at researchreview@ucmo.edu.

Sincerely,

Office of Sponsored Programs & Research Integrity
Administration 315
Warrensburg, MO 64093
Office 660-543-4264
Grants/Contracts: osp@ucmo.edu
Compliance: researchreview@ucmo.edu

Kathy Schnakenberg
Program Administrator/Research Compliance Officer
Office of Sponsored Programs & Research Integrity
University of Central Missouri

cc: mccoy@ucmo.edu