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The Direct and Indirect Effects of Mathematics Self-Efficacy on Intermediate Students' Mathematics Growth

Susan Sipniewski
Wright State University

THE DIRECT AND INDIRECT EFFECTS OF MATHEMATICS SELF-EFFICACY ON INTERMEDIATE STUDENTS' MATHEMATICS GROWTH

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By

SUSAN SIPNIEWSKI
M.Ed., Wright State University, 2012
B.A., Ohio Northern University, 2009

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I HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER MY SUPERVISION BY Susan Sipniewski ENTITLED The Direct and Indirect Effects of Mathematics Self-Efficacy on Intermediate Students' Mathematics Growth BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Doctor of Education.

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Noah Schroeder, Ph.D.
Dissertation Co-Chair

____

Ann Farrell, Ph.D.
Dissertation Co-Chair

____

Suzanne Franco, Ed.D.
Doctor of Education Program Director

____

Carol Patitu, Ph.D.
Chair, Leadership Studies in Education & Organizations

____

Barry Milligan, Ph.D.
Interim Dean of the Graduate School

Committee on Final Examination:

____

Noah Schroeder, Ph.D.

____

Ann Farrell, Ph.D.

____

William Romine, Ph.D.

____

Brian Boyd, Ph.D.

ABSTRACT

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The Direct and Indirect Effects of Mathematics Self-Efficacy on Intermediate Students' Mathematics Growth

In this study, the investigator sought to determine the extent to which mathematics self-efficacy affects mathematics growth among students in grades four and five. Included in this investigation is a hypothesized structural model that reflects Bandura's (1977a, 1986, 1989) theory of self-efficacy. In part one of the investigation, each variable in the model (mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, attitude toward mathematics, and mathematics growth) was analyzed to determine whether there were significant differences between genders in those specified variables. Findings revealed gender differences in two of the six variables, self-regulation in mathematics and mathematics avoidance. Females reported more self-regulatory behaviors in mathematics and less mathematics avoidance behaviors. In part two of the study, the investigator examined the measurement and structural model. In addition, the direct and indirect effects of mathematics self-efficacy on mathematics growth were analyzed. Results from this investigation showed no significant direct effect of mathematics self-efficacy on mathematics growth. However, there was a significant indirect effect of mathematics self-efficacy on mathematics growth with the following mediating variables: self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics. The indirect effect of mathematics self-efficacy on mathematics growth was small, and 5% of the variance in mathematics growth could be explained by the predictor variables. Though some of the data supported Bandura's (1977a, 1986, 1989) theory of self-efficacy, most of the findings do not support the theoretical framework. The findings from this investigation provide helpful information to the educators at the study's site. Further intervention studies in the areas of mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics are recommended. Another recommendation for the study's site is to continue to strengthen the social and emotional learning environment with lessons centered on the growth mindset or through evidence-based programs.

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CHAPTER 1: INTRODUCTION

The United States is trailing other countries in mathematics achievement, as evidenced by findings from several national datasets. According to the 2013 National Assessment of Educational Progress at Grades Four and Eight, only 41 percent of students in grade four achieved at or above proficient in mathematics, and 34 percent of eighth graders scored at or above proficient (National Center for Education Statistics [NCES], 2013). In the highlights from Trends in International Mathematics and Science Study (TIMSS) and TIMSS Advanced 2015, the United States was still behind several education systems in mathematics, including Singapore, China, and Japan (Stephens, Landeros, Perkins, & Tang, 2016). Kastberg, Chan, and Murray (2016) summarized data from the Program for International Student Assessment (PISA) 2015 and determined the U.S. average in mathematics literacy was lower than half of the other education systems that participated in the assessment: The U.S. average score on the PISA 2015 was 36^{th} out of 69 countries. It is evident the United States is under-achieving in mathematics.

Mathematics achievement gaps have also been an issue within the United States. Gaps are forming due to socioeconomic status (Kalaycıoğlu, 2015), gender (Cheema & Galluzzo, 2013; Meece, Glienke, & Burg, 2006), race, and ethnicity (Lemke et al., 2004). Gender has been the most widely debated demographic factor influencing mathematics performance. Research has shown significant gender differences in mathematics achievement, showing males outperforming females (Cheema & Sheradan, 2015; Choi &

Chang, 2011; Fan & Chen, 1997; Meece et al. 2006; Wei, Liu, & Barnard-Brak, 2015). Blair, Ursache, and Vernon-Feagan (2015) found evidence that boys even grow at a more rapid rate in mathematics than girls. In addition, the gender gap favors males early in education (Cimpian, Lubienski, Timmer, Makowski, & Miller, 2016). However, some researchers have found evidence to disclaim the existence of a gender gap in mathematics (Anis, Krause, & Blum, 2016). Therefore, more research regarding the gender gap is warranted.

To address the gender gap, researchers have shown the importance of examining factors that affect early mathematics growth. Early mathematical growth is critical to future success in mathematics. In the 1960s, Bloom (1965) discussed the impact of early growth, and the advantages associated with early learning. For example, early learning can result in more rapid growth, and have an impact on later learning with regard to habits and hindrances (Bloom, 1965). More recent studies further support Bloom's claims regarding early learning. Students that obtain a strong foundation in mathematics in early elementary grades are more likely to be successful in college (Gonzales et al., 2004; Jordan, Kaplan, & Locuniak, 2009). Analyzing factors that impede early academic growth in mathematics is important to eliminating the gender gap, and to improving student mathematical performance in the United States.

One factor that has been shown to be a factor impeding mathematics performance is mathematics self-efficacy. Self-efficacy is an individual's belief about his/her ability level, and a personal view about whether he/she will be able to complete a task successfully (Bandura, 1977a). Bandura's (1986, 1989) theory on self-efficacy posited that a person's self-efficacy influences his/her behaviors and emotions. Academically, students' self-efficacy levels affect their ability to self-regulate their learning. If a student has low self-efficacy, they tend to avoid the subject/task in which they feel inefficacious (Bandura, 1986). In addition, students who perceive themselves as having a low ability are more prone to have anxious feelings toward the subject (Bandura, 1986). Self-efficacy affects a person's behavior and emotion in the classroom.

Self-efficacy is task specific, so mathematics self-efficacy refers to an individual's personal view about his/her ability to complete math tasks successfully. Research has revealed that students' mathematics self-efficacy influences many aspects of students' education. Furthermore, mathematics self-efficacy has been shown to affect the career paths and aspirations of students (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). In one study, mathematics self-efficacy was shown to moderate the effect of gender and mathematics achievement on college major choices (Hacket, 1985). It is apparent that mathematics self-efficacy affects students' decisions regarding college majors and future careers.

In addition to influencing students' career paths, mathematics self-efficacy has been shown to affect overall academic achievement. An extensive amount of research has been conducted that revealed a positive relationship between mathematics self-efficacy and academic outcomes (Carpenter & Clayton, 2014; Ferla, Valcke, & Cai, 2009; Lee & Stankov, 2018; Mercer, Nellis, Martinez, & Kirk, 2011; Pajares & Graham, 1999; Pajares & Miller, 1994; Zimmerman, Bandura, & Martinez-Pons, 1992). Cheema and Galluzzo (2013) noted the influence mathematics self-efficacy has on the gender gap as well.

Since there is a need to improve mathematics performance in the United States, research in mathematics self-efficacy is necessary. Many research studies have investigated the influence self-efficacy has on mathematics achievement/performance. In the research, mathematics achievement and/or performance have often been discussed using one static test score. One test score would reveal an attained level of success, such as proficient or advanced (Briggs, 2017). However, one score does not consider any patterns, and patterns are essential to identifying factors that affect performance (Holt, 2006). In order to address this gap in literature, this investigation focused on achievement in the area of mathematics growth. Mathematics growth is defined as objective student progress: Growth can be analyzed using ongoing measurement systems (Fuchs, Fuchs, Hamlett, Walz, & Germann, 1993). When analyzing academic performance, Fuchs, Fuchs, Hamlett, Walz, and Germann (1993) and Holt (2006) both cited the benefits to analyzing student growth, rather than one test score. Education policy from the Obama administration also emphasized a shift from examining the achievement levels on test scores to now examining longitudinal student growth (Briggs, 2017). Focusing on student growth patterns can assist in targeting factors that affect achievement (Holt, 2006), and to support instructional planning (Fuchs et al., 1993). Rather than using one standardized test score, standardized growth measures will be used in this investigation. This investigation specifically addressed the extent to which mathematics self-efficacy impedes mathematics growth.

The model in this investigation reflected Bandura's self-efficacy theory. Bandura's (1977a, 1986, 1989) extensive research in self-efficacy explains the impact of a person's self-efficacy on his/her effort, behavior, and emotional response. In the model central to this study, the investigator hypothesized that a person's mathematics self-efficacy level will affect mathematics growth directly as well as indirectly through self-efficacy's impact on a person's self-regulation in mathematics learning, amount of mathematics avoidance, and levels of mathematics anxiety. The model in this study was aligned with Bandura's (1986) claim that a person's self-efficacy will drive their behaviors and choices. Research also supports the idea that mathematics self-efficacy directly affects mathematics growth (Carpenter & Clayton, 2014; Mercer, Nellis, Martinez, & Kirk, 2011; Pajares & Graham, 1999; Stajkovic, Bandura, Locke, Lee, & Sergent, 2018). There is also evidence of an indirect relationship between mathematics self-efficacy and mathematics growth as well (Blair & Razza, 2007; Hembree, 1990; Jameson, 2013; Malpass, O'Neil, & Hocevar, 1999; Pajares & Kranzler, 1995; Turner et al., 2002).

Since mathematics self-efficacy is also a major factor affecting the gender gap, the variables in the model were examined to determine whether there were significant gender differences. Research has shown differences between genders with each of the variables being studied in this investigation (Griggs, Rimm-Kaufman, Merritt, & Patton, 2013; Hoffman, 2010; Midgley & Urdan, 1995; Pajares & Graham, 1994; Wigfield & Meece, 1988). Since gender has been a debated issue among the factors that may affect mathematics growth, gender was examined among each of the variables in the analysis.

Purpose of the Study

The United States is underperforming in mathematics, so it is critical to examine factors that affect mathematics achievement. Since mathematics self-efficacy has been shown to affect mathematics performance and the gender gap, mathematics self-efficacy is an important construct to further research. Though studies have linked mathematics self-efficacy to mathematics achievement, few studies have been conducted linking mathematics self-efficacy to mathematics growth. Early academic growth is critical to future success in mathematics (Jordan et al., 2009), so examining factors that affect mathematics growth is essential. The purpose of this study was to address what variables show gender disparities in mathematics and to examine whether students' mathematics self-efficacy directly and/or indirectly affect their mathematics growth.

Prior research and Bandura's (1986) theory support the hypothesized model in this investigation. Using independent sample *t*-tests, confirmatory factor analysis, and structural equation modeling, the following research questions were investigated: (1) Do the variables that may affect mathematics growth (mathematics self-efficacy, self-regulation in mathematics learning, mathematics avoidance, mathematics anxiety, and attitude toward mathematics) differ between genders? (2) Does mathematics growth differ between genders among students in grades four and five? (3) To what extent do the instruments used to measure mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics learning, mathematics avoidance, and attitude toward mathematics align with the factor structures revealed from previous studies? (4) How do mathematics self-efficacy levels affect mathematics growth? (5) How do mathematics self-efficacy levels indirectly affect mathematics growth?

The next chapters include: (a) a literature review focused on theoretical implications pertaining to mathematics self-efficacy, as well as previous studies that directly and indirectly link mathematics self-efficacy to mathematical performance, (b) a methods section describing the details of a quantitative study, using structural equation analysis to investigate whether academic growth is affected by mathematics self-efficacy,

(c) results from this investigation, (d) as well as a discussion regarding the implications of the results.

Glossary of Terms used Throughout the Literature Review

Mathematics achievement- success on a large-scale assessment or having obtained a test score or grade that indicates a successful status, such as proficient (Briggs, 2017)

Mathematics growth- objective student progress through the use of ongoing measurement systems (Fuchs, 1993)

Self-efficacy- an individual's perception regarding his/her ability to complete a task successfully (Pajares, 1996)

Mathematics self-efficacy- an individual's belief regarding his/her ability level in the area of mathematics

Self-regulation- Self regulation refers to how learners manage their behaviors in their attempt to meet learning goals (Pintrich, 2000).

Mathematics avoidance- deliberately not putting forth effort toward mathematics (Turner, Meyer, Anderman, Midgley, Gheen, Kang, & Patrick, 2002)

Mathematics anxiety- a feeling of stress and nervousness that negatively affects a person's ability to work with numbers and mathematical problem solving (Ashcraft, 2002; Richardson & Suinn, 1972)

Attitude toward mathematics- internal feelings about mathematics that influence certain actions and behaviors (Gagne, 1985)

CHAPTER 2: LITERATURE REVIEW

The Gender Gap

Fennema (1974) was one of the first researchers to describe the gender gap in mathematics. Continued research of the gender gap in mathematics reveals the gap is consistent and not diminishing. For instance, investigations using national datasets have found a gender gap still exists (Liu, Wilson, & Paek, 2008; Robinson-Cimpian, Lubienski, Ganley, & Gencturk, 2014). The investigations have shown that girls are consistently being surpassed by boys on standardized math tests (Liu et al., 2008; McGraw, Lubienski, & Strutchen, 2006; Robinson-Cimpian et al., 2014), and that the gender gap emerges early in education (Robinson-Cimpian et al., 2014).

Furthermore, reasons for the gender gap in mathematics have been investigated. Some researchers credit the gender gap to the perception of mathematics being a male domain (Brandell & Staberg, 2008). Other investigators have found evidence showing the gender gap is affected by girls being underestimated in mathematics achievement. For example, parents and teachers tend to exhibit a gender bias in a child's math abilities (Gunderson, Ramirez, Levine, & Beilock, 2012; Schwarz & Sinicrope, 2013). Consequently, the stereotyping affects children's attitude toward math and achievement, which ultimately widens the gender gap (Hand, Rice, & Greenlee, 2017; Moss-Racusin, Sanzari, Caluori, & Rabasco, 2018; Wang & Degol, 2017).

The relationship between gender and mathematics achievement has been greatly studied, and it is evident the gender gap is still prevalent. Therefore, it is important to determine what factors in mathematics show disparities between genders so the factors can be addressed in the classroom. One factor that has shown to be an issue between genders is mathematics self-efficacy. Jacobs (2005) claimed that a strong self-efficacy could potentially eliminate the gender gap issue.

Self-Efficacy

Bandura (1977a) first defined self-efficacy as a student's belief regarding his/her ability level, and a personal view of whether he/she can complete a task successfully. Bandura (1997) stressed the effect of an individual's self-efficacy on his/her actions. A person's self-efficacy beliefs may differ across all academic areas (Zimmerman & Schunk, 2003). Pajares (1996) further described the difference between self-efficacy and other expectancy theories: Self-efficacy is characterized by an individual's perception regarding the ability to obtain a certain achievement level. Moreover, self-efficacy is context and task specific rather than other general self-belief expectancy theories (Bandura, 1986; Pajares, 1996). Potential sources of self-efficacy levels include performance comparisons to others and previous mastery and success in mathematics (Schunk, 1996; Masten & Motti-Stefanidi, 2009; Usher & Pajares, 2009).

Self-efficacy can also have an emotional impact on individuals. Low self-efficacy can influence an individual's ability to cope in stressful situations. Though people are influenced by their environment, Bandura (1997) believed that they have control over their paths in life. A social supportive structure combined with self-influences can counteract adversity (Zimmerman & Schunk, 2003). Masten and Motti-Stefanidi (2009) emphasized the impact of self-efficacy on resilience and learned helplessness. A person's self-efficacy can positively or negatively affect his/her emotional state, and ultimately influence his/her direction in life.

Furthermore, Bandura (1989) described the impact of self-efficacy on cognitive processes, and how self-efficacy can help or hinder performance. Schunk (1987) and Bandura (1999) further explained self-efficacy in connection to academic performance by discussing the link between self-efficacy and motivation/effort. Tschannen-Moran and Hoy (2001) also found that a person's self-efficacy affects an individual's desire to set goals and the amount of effort put forth in obtaining the goals. Students with a low self-efficacy will be more likely to avoid certain activities (Schunk,1996). It is evident in the research that low mathematics self-efficacy may lead to anxiety and avoidance in mathematics activities and impact a student's level of motivation and effort in mathematics. Consequently, mathematics growth could potentially be impacted by a student's self-efficacy in mathematics.

Gender and self-efficacy. There is evidence to support that differences in mathematics self-efficacy between genders are prevalent in all grade levels, and that females have lower mathematics self-efficacy than males (Hoffman & Dull, 2010; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Schleifer & McMillan, 2015). Other studies support the notion of gender differences in mathematics self-efficacy, with males reporting higher self-efficacy in mathematics (Cheema & Kitsantas, 2014; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Lussier, 1996; Malpass, O'Neil, & Hocevar, 1999; Pintrich & De Groot, 1990; Ryan, Gheen, & Midgley, 1998).

Though some researchers have found evidence that a gender gap exists in levels of mathematics self-efficacy, there is research that refutes their findings. There is research that supports the idea that there is no gender gap in mathematics self-efficacy

(Griggs, Rimm-Kaufman, Merritt, & Patton, 2013; Pajares & Graham, 1999; Wolters & Pintrich, 1998).

Researchers have investigated the antecedents to the gender gap in self-efficacy levels. Some researchers cite the gender gap as being influenced by parents' self-efficacy levels (Bandura, Barbaranelli, Caprara, & Pastorell, 1996) or by social persuasions from teachers, family members, or peers (Zeldin & Pajares, 2000). Negative gender stereotypes could also influence the gender gap (Sullivan, 2009).

Previous research (Cheema & Kitsantas, 2014, Hoffman & Dull, 2010, Jacobs et al., 2002, Schleifer & McMillan, 2015) led the investigator in this current study to hypothesize that there would be a statistically significant difference between genders in mathematics self-efficacy. It was hypothesized that males would report higher levels of mathematics self-efficacy.

Self-efficacy theory and achievement. Bandura's (1977a, 1986, 1989) extensive work in self-efficacy supports the claim that an individual's self-efficacy level affects his/her ability to perform. Self-efficacy theory was initially explained as a person's belief regarding his/her own capabilities that will ultimately affect the person's choices and behaviors (Bandura, 1977a). Bandura's (1986) description of the theory best models the framework for this proposed study, in that self-efficacy has the potential to influence levels of effort, avoidance, and adverse emotional responses. Additionally, an individual's self-efficacy affects his/her intellectual functioning (Bandura, 1989). Students at the same cognitive level will perform differently depending on their perceived self-efficacy (Bandura, 1993). Self-efficacy impacts a person's memory capabilities. Self-doubt interferes with a person's ability to analyze a situation and problem solve.

Therefore, performance levels will be affected (Bandura, 1989). Though self-efficacy seems akin to self-esteem and self-concept, self-efficacy is domain specific. Students may have a high self-concept in athletics but have a low self-efficacy in mathematics. Self-efficacy theory was explained as being an individual's perceptions of ability pertaining to a specific task, subject, and/or situation (Schunk, 1991).

To further explain self-efficacy, Bandura (1999) presents the theory as being a component of social cognitive theory. Social cognitive theory encompasses a triadic reciprocal causation model, also called reciprocal determinism (Bandura, 1977b). Social cognitive theory comprises the influences in a person's interactions with his/her environment: (a) personal factors within cognitive, affect, and biological events, (b) behaviors, as well as (c) environmental factors (Bandura, 1986; Bandura, 1999; Pajares, 1996). Early discussion of the social learning theory was characterized as a reciprocal influence process, and is continuous between the environmental, personal, and behavioral factors (Bandura, 1969). An illustration demonstrating Bandura's (1977b, 1986) reciprocal causation between three influences is shown (Figure 1), and the focus of this investigation is highlighted.

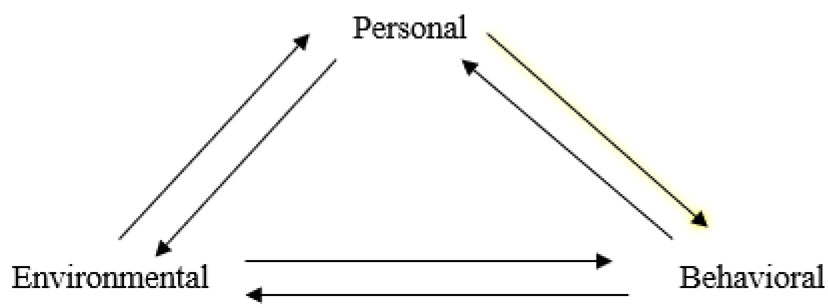

Figure 1. Reciprocal interactions. Adapted from "Social Cognitive Theory and Self-Regulated Learning" by D. H. Schunk (2001). In B. Zimmerman & D. Schunk (Eds.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 125-152). Mahwah, NJ: Lawrence Erlbaum Associates.

Bandura (1999) referred to the concept in Figure 1 as triadic reciprocal causation. Social cognitive theory illustrates a person's interactions and behaviors as being derived from multiple personal, social, and environmental influences. There is a complex network that drives a person's interactions and behaviors. Self-efficacy theory is embedded within social cognitive theory, explaining the personal belief factors that influence a person's behaviors. Self-efficacy is the foundation of a person's actions (Bandura, 1999). This investigation was centered on how a person's self-efficacy level regulates his/her patterns of behavior, specifically in mathematics.

Self-efficacy is developed through mastery experiences, vicarious experiences when observing others, social persuasions/feedback from others, and a person's emotional state (Bandura, 1997; Usher & Pajares, 2009). Prior experiences reinforce a person's confidence and expectations (Bandura, 1971). Grigg, Perera, McIlveen, and Svetleff (2018) also cited prior math achievement and prior interest as predictors of math self-efficacy. Essentially, there is a cyclical pattern of influence. Prior mathematics performance affects a student's self-efficacy level, and the student's self-efficacy level then impacts performance.

In summary, Bandura (1989) stressed the influence of self-efficacy on performance due to its effects on cognitive, affective, and motivational processes. Self-efficacy affects a student's motivation to learn: Students' choices, behaviors, and levels of effort are influenced by their perception of their abilities (Bandura, 1977a, 1986). Inefficacious individuals will not be motivated to improve, will proceed to avoid certain tasks, and are prone to exhibit fear when presented with certain tasks (Bandura, 1986). Subsequently, performance is affected.

Self-Regulation

Mathematics self-efficacy indirectly affects mathematics performance through its effect on self-regulation. Self-regulation refers to how learners manage their behaviors in their attempt to meet learning goals (Pintrich, 2000; Zimmerman & Martinez-Pons, 1988). Students' self-efficacy levels influence whether they set challenging goals and whether they demonstrate persistence and motivation in meeting their goals (Bandura, 1997; Zimmerman, 1989). Self-efficacy affects a person's ability to self-regulate in mathematics learning, and self-regulatory behaviors lead to increased motivation and performance (Bandura, 1977a).

Additionally, Zimmerman (1998, 2008) described the process of self-regulation as self-directive, and that learners use self-regulation to change their mental ability into skills. In this process, the learner is an active participant in his/her environment (McClelland & Cameron, 2011). Malpass, O'Neil, and Hocevar (1999) stated that effort and metacognition are closely aligned with self-regulation and argued only one scale is necessary to describe these constructs.

When explaining the importance of self-regulation, Bandura (1986) mentioned the need to teach three self-management procedures. Zimmerman and Schunk (2003) described the three areas to help students self-regulate as: (a) self-observation (monitoring one's work and performance), (b) judgmental process (evaluating one's personal performance), and (c) self-reaction (personal responses to evaluations). Zimmerman and Schunk (2001) also mentioned the importance of goal setting for students to learn self-regulation. Setting challenging, but attainable goals is recommended.

Gender and self-regulation in mathematics learning. Regarding self-regulatory behaviors and gender differences, Bandura, Caprara, Barbaranelli, Gerbino, and Pastorelli (2003) found differences among perceived academic self-efficacy (perceived capability of successfully controlling learning activities) and resistive self-regulatory efficacy (feelings of capability to resist negative influences), with females having a higher sense of both academic self-efficacy and resistive self-regulatory efficacy. Females displayed a stronger capability to control their learning process.

Several studies have revealed no significant differences in self-regulatory behaviors between genders (Blair, Ursache, Vernon-Feagans, & Greenberg, 2015; Pajares & Graham, 1999; William, White, & MacDonald, 2016; Wolter & Pintrich, 1998; Zimmerman & Kitsantas, 2014). Though researchers found evidence to confirm the connection between self-regulation and achievement, investigators concluded there were no significant differences in self-regulated behaviors based on gender.

Though research has been mixed on whether there are disparities in self-regulatory behaviors between genders, more research suggests there are no differences in self-regulation in mathematics learning based on gender. Self-regulation was further analyzed in this investigation to examine whether there were gender differences in grades four and five. It was hypothesized that there would be no significant differences in self-regulatory behaviors in mathematics between genders.

Self-efficacy theory and self-regulation. In Bandura's (1993) theory of self-efficacy, the author explained that self-efficacy controls an individual's thought processes, which influences the person's ability to engage in self-regulation. Self-regulation has been described as how a learner manages his/her behaviors to set and maintain learning goals. Self-efficacy is critical in motivating a person to set goals and plan how he/she is going to meet those goals (Bandura, 1993). Likewise, students' academic self-efficacy affects their level of motivation to self-regulate, specifically in the classroom (Schunk, 1996). The higher the student's self-efficacy, the more likely the student will be motivated to set challenging goals and engage in behaviors that will be helpful in meeting the goals (Zimmerman et al., 1992). Higher goals have an effect on performance (Locke & Latham, 2002). Pajares (1996) added that self-efficacy beliefs influence a person's level of perseverance and effort to achieve goals. Motivational factors such as self-regulation affect the growth of abilities (Dweck, 1986). A student's self-efficacy level affects whether he/she engages in self-regulatory behaviors, which eventually affects performance levels.

Similar to Bandura (1997), Schunk and Zimmerman (1997) described the social cognitive theoretical model in connection to the development of self-regulation skills.

The authors believed that social influences, such as modeling and feedback, begin the process of self-regulatory skills. However, the next phase of developing self-regulation involves self-influences, such as self-efficacy. Consequently, self-influences impact students' ability to internalize self-regulation habits (Schunk & Zimmerman, 1997). The authors cited self-efficacy beliefs as a source of motivation for self-regulation, which ultimately affects academic outcomes.

Social cognitive theory was again mentioned as a link between self-efficacy and self-regulation (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Shores & Shannon, 2007). Social cognitive theorists see an individual's ability to self-regulate as being affected by his/her personal learning experiences and environment. A student's personal experiences includes his/her self-efficacy level.

More research suggests there is a positive and negative influence of self-efficacy on the development of an individual's self-regulation skills (Bandura, Caprara, Barbaranelli, Gerbino, & Pastorelli, 2003; Dweck, 1986). Whether it is how much a person will persevere or the choices he/she will make in the classroom, an individual's self-efficacy will be a major source of influence. Dweck (1986) stressed the influence of adaptive and maladaptive motivational patterns that students adopt as a result of their self-efficacy levels.

In accordance with Bandura's (1993) theory of self-efficacy, this investigation will continue to examine the influence of self-efficacy on self-regulation. However, this study will focus its efforts on the effect of self-efficacy on self-regulation in the area of mathematics.

Mathematics Avoidance

In another indirect effect of mathematics self-efficacy on mathematics achievement, mathematics self-efficacy influences the extent to which a person avoids mathematics. Since self-efficacy affects a person's choices and behavior (Bandura, 1977a), a student with a low mathematics self-efficacy may not choose to engage in mathematics, leading to mathematics avoidance. Mathematics avoidance is described as a deliberate choice resulting from an individual's own assessment of his/her abilities (Hilton, 1980). Mathematics avoidance is also explained as intentionally not putting forth effort toward mathematics, not seeking help in mathematics, and not trying to learn new mathematical skills and topics (Turner et al., 2002). Disruptive behavior and cheating could also be seen as components of avoidance behavior (Patrick, Turner, Meyer, & Midgley, 2003). However, disruptive behavior and cheating are not included in the current study.

In another definition of mathematics avoidance, Urdan, Ryan, Anderman, and Gheen (2002) explain the construct as the movement away from a task that results in the potential to learn. It is a purposeful inaction or a deliberate action to divert from engaging in a task. A student's low confidence level in their mathematics ability leads them to avoid trying to improve in mathematics. In addition, students' self-confidence influences whether they avoid challenges (Gheen & Midgley, 1999). The aspects of avoidance behavior included in this investigation relate to avoiding the opportunity to improve in mathematics. Avoidance of mathematics will ultimately hinder a student's school career (Peetsma & Van der Veen, 2013). The components of mathematics avoidance being measured in this study include: (a) the use of self-handicapping strategies, (b) the avoidance of help seeking, and (c) the avoidance of novelty and challenge.

Self-handicapping strategies are described as actions individuals take to credit poor performance. For example, purposefully not studying for a test (Urdan, Ryan, Anderman, & Gheen, 2002). Urdan et al. (2002) explained avoidance of help seeking as a situation in which students need help but they intentionally neglect to ask for assistance. Lastly, avoidance of novelty is portrayed as a students' avoidance of a challenge due to their fear of failure (Urdan et al., 2002). Self-handicapping strategies, avoidance of help seeking, and avoidance of novelty can be attributed to a low-self-efficacy, and eventually impact the learning process. In summary, a student's mathematics self-efficacy is the source of student avoidance patterns, and avoidance behaviors have been shown to limit growth (Turner et al., 2002).

Mathematics avoidance and gender. Gender differences among avoidance behaviors have been inconsistent in previous research. From this research, gender differences in the areas of self-handicapping strategies and avoidance of help-seeking have been reported. There is limited research in gender differences among avoidance of novelty and challenge. As discussed earlier, self-handicapping strategies are a type of avoidance behavior that involves deliberately not trying, and avoidance of help seeking occurs when students intentionally avoid seeking help when they need assistance. Researchers have found differences between genders with regard to self-handicapping strategies, with males reporting more self-handicapping strategies (Midgley & Urdan, 1995; Urdan, Midgley, & Anderman, 1998).

Research in the area of avoidance of help-seeking showed contradicting results. There was evidence that supports the idea that boys display more avoidance of help seeking (Butler, 1998; Ryans, Hicks, & Midgley, 1997) but there was also research supporting the notion that females avoid seeking help more often than males (Ames & Lau, 1982; Liew, Lench, Kao, Yeh, & Kwok, 2014). Conversely, Newman (1990) reported there were no significant differences in help-seeking due to gender.

Mixed findings from previous research indicates there is a need for more research. The investigator in this study sought to determine whether there are gender differences among avoidance behaviors in mathematics. This study was different from previous studies because it examined whether there were significant gender differences in three areas of mathematics avoidance: (a) self-handicapping strategies, (b) avoidance of help-seeking, and (c) avoidance of novelty and challenge.

Self-efficacy theory and avoidance. When explaining self-efficacy theory, Bandura (1986) postulated that people who have a low self-efficacy regarding certain skills will be fearful toward situations involving the skill and will be more likely to avoid it. People who feel they are not capable in successfully completing a task may avoid it altogether (Schunk, 1991). Not seeking help is one aspect of mathematics avoidance. Students with low self-efficacy view asking for help as threatening and believe asking for help reflects poorly on their peers' perception of their competence (Ryan, Pintrich, & Midgley, 2001; Karabenick & Knapp, 1991). Dweck and Leggett (1988) referred to avoidance of help seeking as a helpless response and stressed that this behavior limits growth. Students avoid seeking help due to their concern with their peers' judgment, and without seeking to understand the skills, growth is affected.

In addition to not seeking help, another aspect of avoidance includes self-handicapping strategies such as the reduction of effort (Urdan et al., 2002). Bandura (1986) also noted in self-efficacy theory that an individual's effort level is the consequence of his/her self-efficacy level. Avoidance of novelty and challenge is considered another component to avoidance behaviors. Students with a low perception of ability will ultimately choose easier problems, leading to less potential for growth (Urdan et al., 2002).

Other explanations for avoidance behaviors include McClelland's (1951) description of motivation, and the idea of attribution (Weiner, 1985). In McClelland's (1951) and Atkinson's (1957) explanation of achievement motivation, the authors explained that students' motive to avoid failure led to avoidance behaviors. In Weiner's (1985) description of attribution, students attribute their likelihood to fail by their perception of a lack of ability. Resulting from a low perception, students are more likely to avoid engagement in tasks that involve certain abilities, and their academic performance will be impacted.

Mathematics Anxiety

Additionally, mathematics self-efficacy indirectly affects mathematics achievement through its effect on mathematics anxiety. Mathematics anxiety is defined as a feeling of stress and nervousness that negatively affects a person's ability to work with numbers and mathematical problem solving in all settings (Ashcraft, 2002; Richardson & Suinn, 1972). Mathematics anxiety is also described as a feeling of discomfort and panic when approaching a mathematics problem (Tobias & Weissbrod, 1980). Mathematics anxiety has been a studied construct for the past sixty years.

Wigfield and Meece (1988) discussed two domains of mathematics anxiety: cognitive and affective. The cognitive domain is focused on an individual's thoughts. Whereas, the affective domain is centered on the emotional aspect, and feelings of apprehension (McLeod, 1994; Wigfield & Meece, 1988). Similarly, Lang (1968) mentioned three effects of mathematics anxiety including: cognitive and physical effects, as well as avoidance behaviors. Other researchers support the claim that discomfort toward mathematics leads to avoidance of mathematics tasks (Hembree, 1990; Tobias & Weissbrod, 1980). When a person experiences mathematics anxiety, physical reactions such as an increased pulse rate, can occur as well (Faust, 1992). There are also cognitive influences of mathematics anxiety on academic performance: A person's working memory capacity is impacted by the existence of mathematics anxiety (Ashcraft & Kirk, 2001). Therefore, achievement levels will be affected.

In addition, there are wide-ranging levels of mathematics anxiety, and the feeling can be experienced in various settings, such as the classroom or an everyday setting outside of school (Ashcraft & Moore, 2009). Ashcraft (2002) discussed how mathematics anxiety can impact a person's career path as well. Individuals with mathematics anxiety are more likely to avoid careers that involve a greater need for mathematical abilities (Pizzie & Kraemer, 2017).

It was evident from research that mathematics anxiety can influence a student's ability to perform well in mathematics. Therefore, it was an important component to include in this study. Mathematics anxiety is a potential inhibitor of academic growth.

Mathematics anxiety and gender. Research has shown a link between mathematics anxiety and gender in young adolescents (Sepie & Keeling, 1978; Wigfield & Meece, 1988). Investigators concluded that females reported higher levels of mathematics anxiety than males. More evidence supports that mathematics anxiety contributes to the gender gap, showing males displaying less anxiety than females (Cheema & Galluzzo, 2013; Hembree, 1990; Malpass et al., 1999; Meece, Eccles, & Wigfield, 1990; Pintrich & De Groot, 1990). Interestingly, Hembree (1990) revealed that females showed higher levels of math anxiety than males, particularly at the college level. However, though Cheema and Sheridan's (2015) study found a significant correlation between genders and math anxiety ($r = .09$, $p < .001$), the investigators determined the effect size was small. Conversely, some researchers have found no significant gender differences in mathematics anxiety (Anis, Krause, & Blum, 2016; Ma, 1999; Wolters & Pintrich, 1998).

Differences in levels of mathematics anxiety between genders have been studied and conflicting results are evident. However, since there are more studies confirming significant differences between genders in anxiety, this investigation incorporated a prediction that there would be a statistically significant difference between males and females in mathematics anxiety levels, with females reporting higher levels of mathematics anxiety.

Self-efficacy theory and anxiety. Self-efficacy beliefs can influence a person's anxiety level (Pajares & Graham, 1999). Bandura (1986) further explained the connection between self-efficacy and emotional responses: Perceived inefficacy provokes fearful expectations, and an inability to cope with potential threats. Social cognitive theorists believe self-beliefs, such as anxiety, are affected by an individual's personal self-efficacy. In addition, an individual with task-related confidence may be able to overcome anxious feelings toward mathematics (Cemen, 1987). Affect also plays a role in mathematics problem solving, in that beliefs and emotions impact a person's development (McLeod, 1987).

Moreover, Pajares (1996) suggested that low self-efficacy provokes feelings of stress and an inability to exercise control over one's emotional reactions. Bandura (1989, 1993) described this inability to cope with stressors as harmful to a person's memory performance, in that they dwell on their deficiencies. In addition, students who have a low academic self-efficacy are vulnerable to anxiety and even depression (Bandura, 1993).

Eysenck, Derakshan, Santos, and Calvo (2007) have added to the research on the impact of anxiety. Eysenck et al. (2007) claimed attentional control is affected by anxiety. In their discussion, the authors depict anxiety as a disrupter to ones' attentional system. Resulting from the presence of anxiety, there is an increased focus on the stimulus-driven attentional system, rather than the goal-directed attentional system. Individuals with mathematics anxiety would concentrate more on their worrisome thoughts than the mathematics tasks, ultimately impacting performance.

Referring to math anxiety as 'mathophobia', Hilton (1980) suggested that math anxiety leads to math avoidance and added that math avoidance could result from teaching quality, evaluation instruments, and math texts as well. The domination of standardized testing may also play a role in exasperating math anxiety (Hilton, 1980). The author continued to make assumptions that early education sets the tone for students' feelings toward mathematics, and that their social groups will reinforce certain attitudes toward mathematics.

An individual's low self-efficacy affects his/her ability to cope with stressors, leading to anxiety (Bandura, 1993). Anxiety interferes with a person's ability to successfully complete tasks. As a result, avoidance behaviors may be used, negative emotions arise, and performance levels are affected.

Attitude Toward Mathematics

Since mathematics anxiety has been linked to attitude in numerous studies (Perry, Catapano, & Ramon, 2016; Lipnevich, MacCann, Krumm, Burrus, & Roberts, 2011; Choi & Chang, 2011; Schreiber, 2002), attitude toward mathematics has been included in the hypothesized model. Bandura (1986) believed that a person's self-efficacy level is linked to fear arousal and a person's coping ability, resulting in emotional responses to occur. Regarding the hypothesized model, attitude means internal feelings that influence certain actions and behaviors (Gagne, 1985). Students' mathematical confidence impacts their anxiety levels, affecting students' attitude toward mathematics. Ultimately, student behaviors toward mathematics are affected.

Attitude has also been defined as a positive or negative response to an idea, person, or situation (Aiken, 1970). Attitude toward mathematics develops in earlier grade levels, and the prevalence of negative attitudes toward mathematics increases by junior and high school levels (Aiken, 1970). Furthermore, attitude has been characterized as a complex construct that interacts constantly with the individual's vision of mathematics and his/her perceived competence in mathematics (Di Martino & Zan, 2010).

Gender and attitude toward mathematics. Mixed findings have been discussed regarding differences in attitude toward mathematics between genders. Some research has shown women have more negative attitudes toward mathematics, and consequently, performance is impacted (Ai, 2002; Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Odell & Schumacher, 1999; Tocci & Engelhard, 1991). Conversely, some investigators have determined that gender does not have a significant effect on attitude towards mathematics (Ma & Kishor, 1997; Ma & Xu, 2004; Tapia & Marsh, 2003). There is conflicting data on the topic of attitude toward mathematics and gender, so more research in this area is warranted.

Hypothesized Structural Model of Mathematics Self-Efficacy and its Effects on Mathematics Growth

Throughout the next section, the components of the hypothesized structural model (Figure 2) in this investigation will be discussed. Some of the components include the direct relationship between mathematics self-efficacy and mathematics growth, as well as the indirect relationship between mathematics self-efficacy and mathematics growth. Regarding the indirect relationship, research has shown the influence of self-efficacy on self-regulation in mathematics learning, mathematics avoidance, and mathematics anxiety. There is also evidence to support the relationships between the mediators and mathematics achievement. Research about the direct and indirect effects of mathematics self-efficacy on mathematics growth will be further explained.

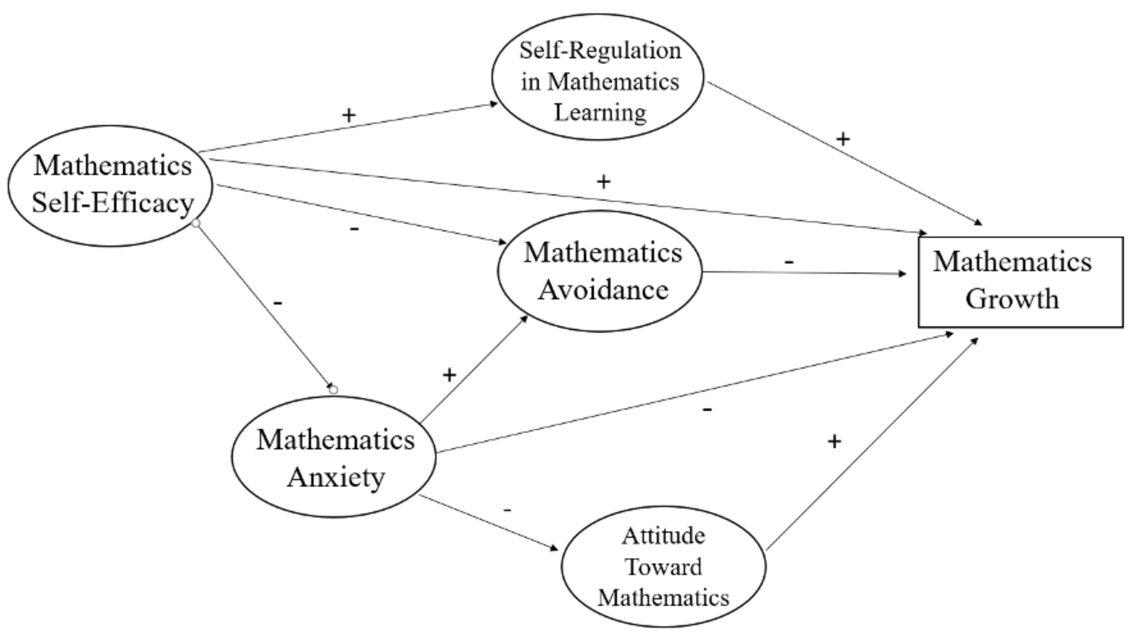

Figure 2. Hypothesized structural model.

The Direct Effect of Self-Efficacy on Mathematics Growth

Mathematics self-efficacy linked to mathematics achievement. Mathematics self-efficacy has been cited as a significant factor affecting mathematics performance of middle school students (Carpenter & Clayton, 2014; Mercer et al., 2011; Pajares & Graham, 1999; Stajkovic et al., 2018). The findings in the research showed that students who reported a high self-efficacy displayed higher levels of mathematics performance or academic growth. In addition, self-efficacy has been shown to be a significant predictor of mathematics problem solving (Pajares & Miller, 1994) and motivational orientation (Stevens, Olivarez, Lan, & Tallent-Runnels, 2004). It is apparent mathematics self-efficacy is an influential factor in middle school students' academic lives. Research has also indicated that mathematics self-efficacy interventions have successfully been implemented to improve students' performance (Katz, 2015; Maier & Curtin, 20015; Ramdass & Zimmerman, 2008; Schunk, 1981).

The effect of self-efficacy on performance has also been found through studies involving international datasets (Lee & Stankov, 2013; Pitsia, Biggart, & Karakolidis, 2017). Out of fifteen psychological constructs, self-efficacy best predicted mathematic achievement, $r = .468$, $p < .01$ (Lee & Stankov, 2013). Results from the international studies show the influence of self-efficacy on mathematics achievement as being a universal issue that needs to be addressed.

Zeldin and Pajares (2000) found evidence connecting self-efficacy and future mathematics success as well. Zeldin and Pajares (2000) analyzed interviews from women who have excelled in math related careers. Several themes included: The women all expressed how their self-efficacy influenced their effort levels in overcoming academic challenges. The women also stressed the influence of their family, peers, and teachers, which supports Bandura's (1997) description of sources of self-efficacy. The connection between self-efficacy and success in mathematics has been shown in research.

The current quantitative study investigated the extent to which mathematics self-efficacy directly affects mathematics growth. Due to extensive research and Bandura's (1977a) theory, it was hypothesized there would be a strong, positive correlation between self-efficacy beliefs in mathematics and mathematics growth. See the hypothesized structural model in this investigation (Figure 3).

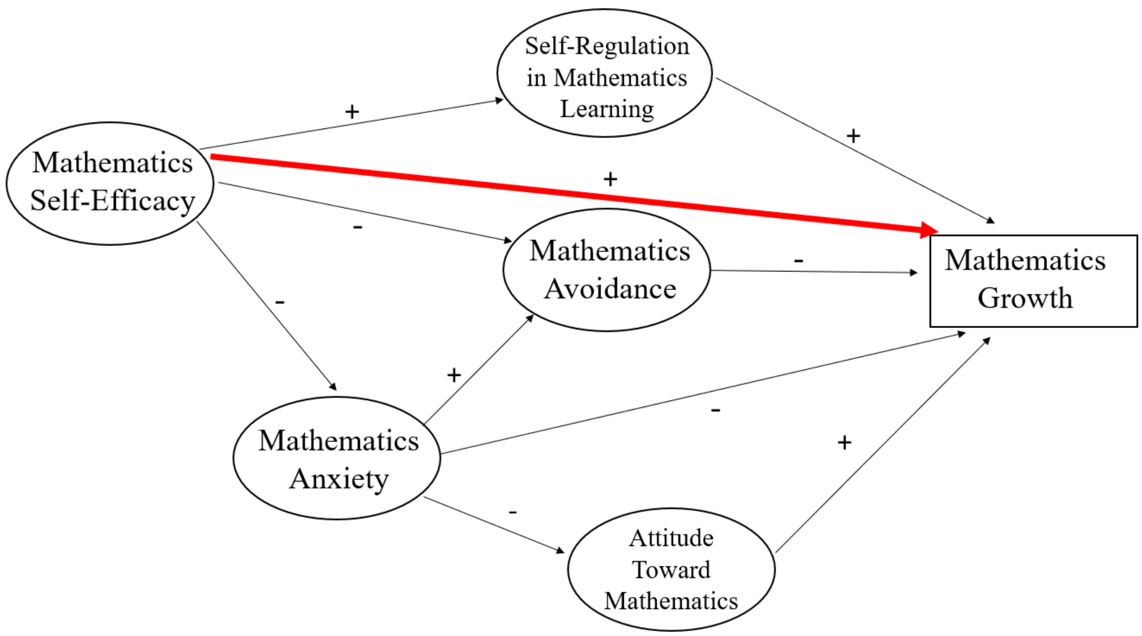

Figure 3. Hypothesized structural model. A strong, positive relationship between mathematics self-efficacy and mathematics growth was hypothesized.

The Indirect Effects of Mathematics Self-Efficacy on Mathematics Growth

Mathematics self-efficacy linked to self-regulation in mathematics. There is evidence to support indirect links between mathematics self-efficacy and mathematics growth. A moderate and positive relationship was found between self-efficacy and self-regulatory behaviors among students (Malpass et al., 1999; Zimmerman, Bandura, &

Martinez-Pons, 1992). Additionally, research indicates there is a connection between self-efficacy and certain types of self-regulatory behaviors, such as setting challenging goals. In one study, students' self-efficacy correlated significantly with grade goals, $r = .41$, $p < .05$ (Zimmerman et al., 1992). Self-efficacy levels have also been shown to influence commitment to learning goals (Seijts & Latham, 2011; Zimmerman et al.,1992). Seijts and Latham (2011) discovered that commitment level to goals acted as a partial mediator between self-efficacy and performance.

In addition, studies involving self-regulatory strategies that are specific to mathematics have been performed among middle school students (Cleary & Kitzantas, 2017; Wolters & Pintrich, 1998). The investigators reported that self-regulated learning behaviors acted as a significant mediator for self-efficacy and mathematics grades among middle school students. Findings revealed that students who reported higher levels of self-efficacy were linked to a greater use of regulatory strategies in mathematics. Research indicates that students' self-efficacy levels affect their acquisition of self-regulatory skills in mathematics.

Due to Bandura's (1989) description of self-efficacy theory and empirical research, it was hypothesized in this investigation that there would be a moderate, positive relationship between mathematics self-efficacy and self-regulatory behaviors in mathematics (Figure 4).

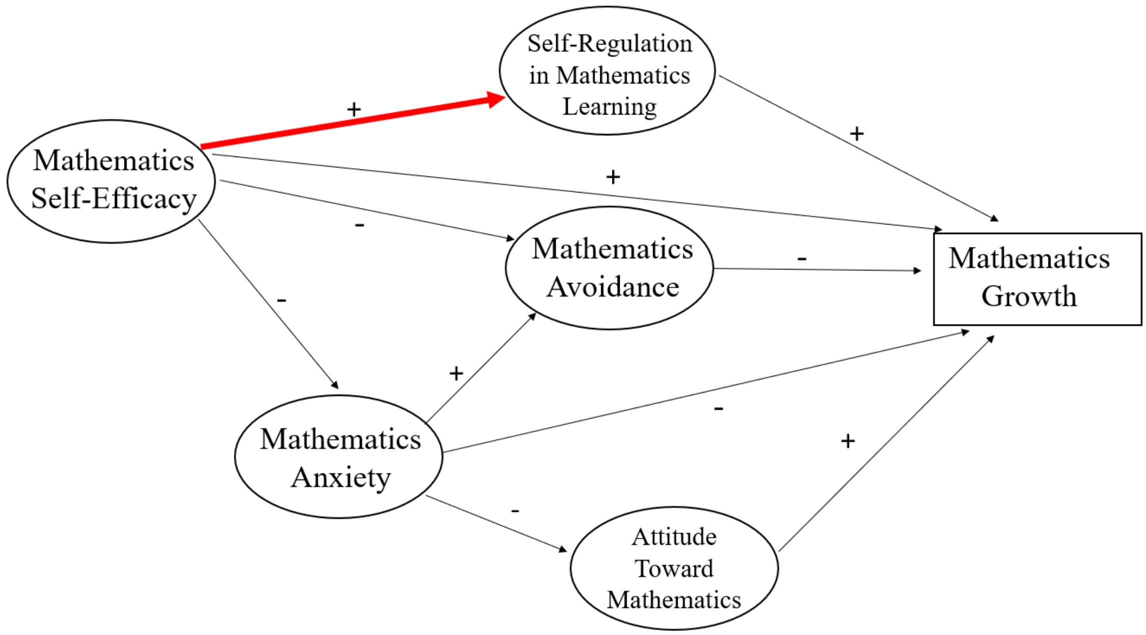

Figure 4: Hypothesized structural model. It was hypothesized there would be a moderate, positive relationship between mathematics self-efficacy and self-regulation in mathematics learning.

Self-regulation in mathematics linked to mathematics achievement. Researchers have uncovered the significant role that self-regulation plays on early academic success in mathematics (Blair & Razza, 2007; Blair, Ursache, Vernon-Feagans, & Greenburg, 2015; McClelland & Cameron, 2011; William, White, & McDonald, 2016). Self-regulation skills have been shown to be beneficial particularly for young students at risk (Blair et al., 2015). Furthermore, evidence indicated the effect of early success in self-regulation skills on later mathematics achievement (William et al., 2016). Development of self-regulatory skills at earlier ages will influence later success in mathematics.

Self-regulatory behaviors were shown to be impactful on performance for middle school students as well (Cleary & Chen, 2009; DiGiacomo & Chen, 2016; Hinnant-Crawford, Faison, & Chang, 2016; McCoach, Newton, Siegle, Baslanti, & Picho, 2016; Pintrich & De Groot, 1990). In some findings, high-achieving students in advanced math classes displayed more self-regulation strategies and less maladaptive regulatory behaviors than students earning a B or lesser grade (Cleary & Chen, 2009). Researchers also found that self-regulatory behaviors are differentiated among high versus low achievers (McCoach et al., 2016). Studies have shown self-regulatory behaviors are most prevalent among high achieving students in middle school.

Studies have revealed the influence of self-regulation on achievement (Day & Connor, 2017; Hinnant-Crawford et al., 2016; Pintrich & De Groot, 1990; Shore & Shannon, 2007; Zimmerman & Kitsantas, 2014). Research shows a positive, significant relationship between self-regulation and mathematics performance. Investigators were able to conclude that self-regulation, $r = .22$, $p < .005$, was significantly correlated with students' average grades (Pintrich & De Groot, 1990). Self-regulation was shown to be a significant predictor of both students' GPA and of the students' scores on a standardized assessment (Zimmerman & Kitsantas, 2014). Likewise, in another study, self-regulation significantly predicted growth from fall to spring in a mathematics problem solving assessment (Day & Connor, 2017). DiGiacomo and Chen (2016) found self-regulatory interventions to affect students' achievement level as well ($\eta^2 = .181$, $p =.024$). Interventions on self-regulation were credited to students achieving higher.

Though most research supports the relationship between self-regulation and academic performance, there is evidence to refute the connection. In a study involving middle school students, self-regulation was not significantly related to academic performance (Shores & Shannon, 2007). However, the majority of research has shown a positive relationship between self-regulation and performance, the prediction in this investigation was a moderate and positive relationship between self-regulation in mathematics learning and mathematics growth (Figure 5).

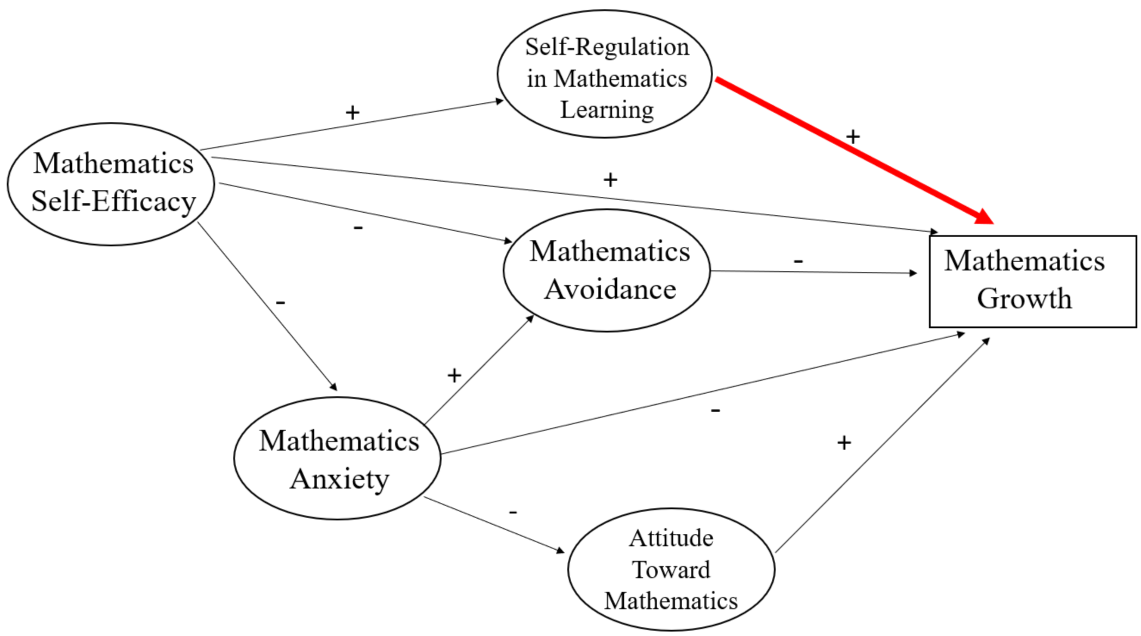

Figure 5. Hypothesized structural model. It was hypothesized that there would be a moderate, positive relationship between self-regulation in mathematics learning and mathematics growth.

Mathematics self-efficacy linked to mathematics avoidance. Students who have a low self-efficacy regarding certain abilities are more likely to develop strategies that will allow them to neglect using those abilities (Turner et al., 2002), and to be disengaged in activities related to those abilities (Karabenick & Knapp, 1991). Research has shown self-efficacy to be linked to avoidance behaviors, including self-handicapping strategies and avoidance of help-seeking.

Self-handicapping strategies, such as deliberately not trying or not studying, have been found to be influenced by self-efficacy (Jagacinski & Nicholl, 1990; Urdan, Midgley, & Anderman, 1998). Researchers have demonstrated how avoidance components are prevalent among students with a lower perception of ability.

Avoiding academic assistance is considered an avoidance behavior and has been a focus in several research studies with middle school students (Newman, 1990; Ryan, Gheen, & Midgley, 1998; Ryan & Pintrich, 1997; Ryan, Shim, & Patrick, 2005). For example, Ryan, Gheen, and Midgley (1998) conducted a study with middle school students and found evidence indicating students' academic self-efficacy was a significant predictor of avoidance of help seeking in mathematics. Research revealed that students with a low self-efficacy were less likely to seek help. It was evident that students' perceptions of their abilities impact whether they are engaged in improving their abilities. However, Newman (1990) also argued that mal-adaptive and adaptive help seeking tendencies may stem from the parents, teachers, and peers' influence rather than primarily a student's self-efficacy.

Miller and Atkinson (2001) provided evidence for the connection between self-efficacy and avoidance of novelty and challenge. Miller and Atkinson (2001) found that when a student displayed a negative perception of his academic abilities, the student avoided participating in classroom discussions and did not engage in activities to help him master new material in class. This study indicated that a student's self-efficacy level may result in the avoidance of new skills.

Research and Bandura's (1986) theory have indicated a negative relationship between self-efficacy and avoidance. The following model (Figure 6) displays the prediction in this investigation that there would be a negative relationship between mathematics self-efficacy and mathematics avoidance.

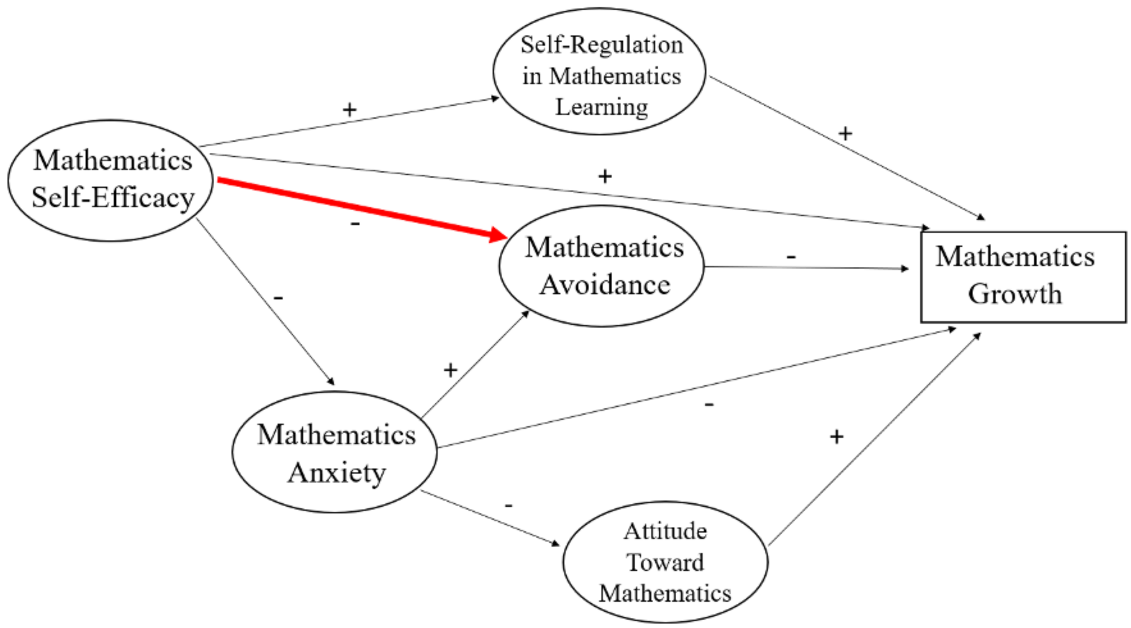

Figure 6. Hypothesized structural model. It was hypothesized that there would be a moderate, negative relationship between mathematics self-efficacy and mathematics avoidance.

Mathematics avoidance linked to mathematics performance. Turner et al. (2002) asserted that students who are lacking confidence in abilities may develop the use of avoidance strategies to evade looking incompetent to peers and teachers. Consequently, students begin to withhold effort, which impacts their success. Avoidance strategies that have been most often included in research studies are self-handicapping strategies and avoidance of seeking help. Midgley and Urdan (1995) described examples of self-handicapping strategies as purposefully not trying as well as procrastinating. Students taking part in self-handicapping strategies are seeking attributions to poor academic outcomes.

Moreover, a negative relationship between self-handicapping strategies and grade point averages was found, $r = -.32$, $p < .05$, (Urdan et al., 1998), and a significant relationship was found between avoidance of help seeking and GPA, $r = .25$, $p \leq .01$, among fifth grade students (Ryan & Hicks, 1997). Ryan and Hicks (1997) explained that students in early adolescence are concerned about displaying a lack of competence. Similarly, Ryan and Shim (2012) discovered there is a decrease in help seeking throughout early adolescence. It is clear that early adolescence is a time when avoidance behaviors increase, and achievement is affected.

Indirect relationships have also been found between avoidance behaviors and achievement. Karabenick and Knapp (1991) found that avoidance indirectly affects achievement through engagement, and Liew et al. (2014) discovered avoidance temperament indirectly impacts mathematics performance, with evaluative threat acting as a mediator.

Thus, a common theme among the studies involves students wanting to avoid being seen as incompetent by their peers. Unfortunately, the avoidance behaviors affect students' performance. Based on previous research, it was hypothesized that there would be a negative relationship between mathematics avoidance and mathematics growth (Figure 7).

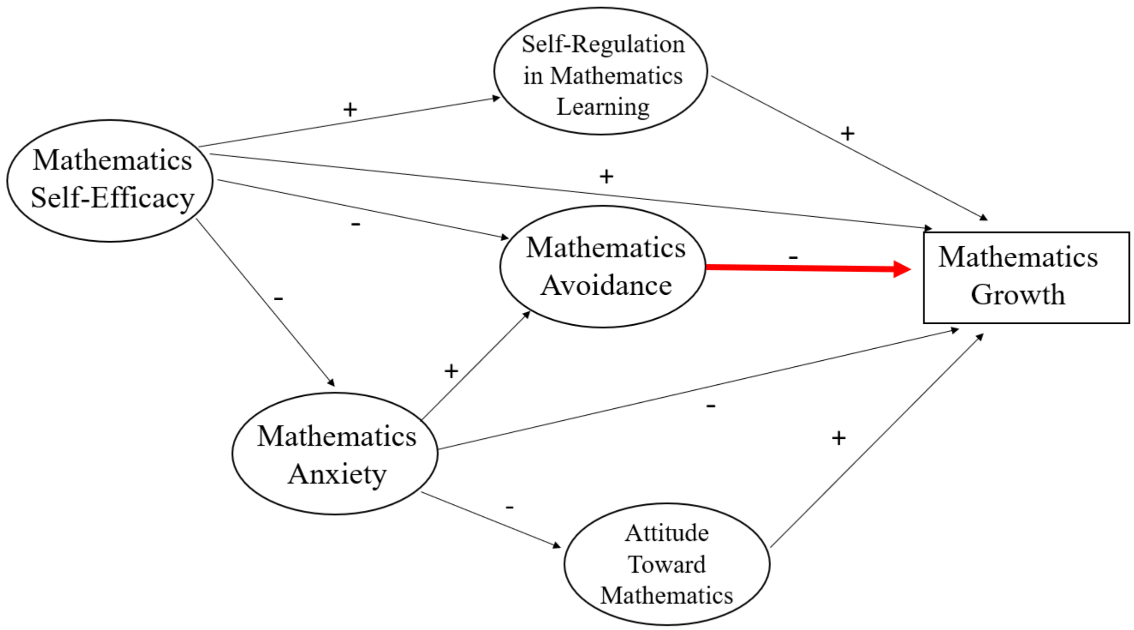

Figure 7: Hypothesized structural model. It was hypothesized that there would be a negative relationship between mathematics avoidance and mathematics growth.

Mathematics self-efficacy linked to mathematics anxiety. Research shows mathematics anxiety levels are influenced by a person's self-efficacy level in mathematics (Cooper & Robinson, 1991; Jameson, 2013; Jameson, 2014; Pajares & Kranzler, 1995). Among elementary grade levels, Jameson (2013, 2014) has linked math self-concept to math anxiety. Self-concept when task specific does align with self-efficacy (Pajares & Miller, 1994). Math self-concept was found to be the strongest predictor of math anxiety, $r = -.606$, $p < .001$ (Jameson, 2014). A conclusion can be made that an individual's belief about his/her ability in mathematics influences the person's level of mathematics anxiety.

Evidence was found that supports the negative relationship between self-efficacy and math anxiety at the middle school level as well (Griggs, Rimm-Kaufman, Merritt, & Patton, 2013; Meece et al., 1990). However, Griggs et al. (2013) questioned the direction of influence between self-efficacy and math anxiety. Investigators demonstrated that greater anxiety in math and science predicted a weaker self-efficacy.

Several investigations sought to determine the moderating effects of mathematics self-efficacy on mathematics anxiety. Researchers found that higher self-efficacy levels help to reduce anxiety effects (Galla & Wood, 2012; Hoffman, 2010). Some research revealed opposing findings that did not support the claim that self-efficacy moderates the effects of anxiety (Barrows, Dunn, & Lloyd, 2015). There are conflicting findings about whether a student's self-efficacy level can moderate the effects of mathematics anxiety.

A significant negative relationship has been shown in previous investigations regarding the link between mathematics self-efficacy and mathematics anxiety. Included in this investigation was a prediction of a negative relationship between mathematics self-efficacy and mathematics anxiety. The hypothesized structural model (Figure 8) reflects this prediction.

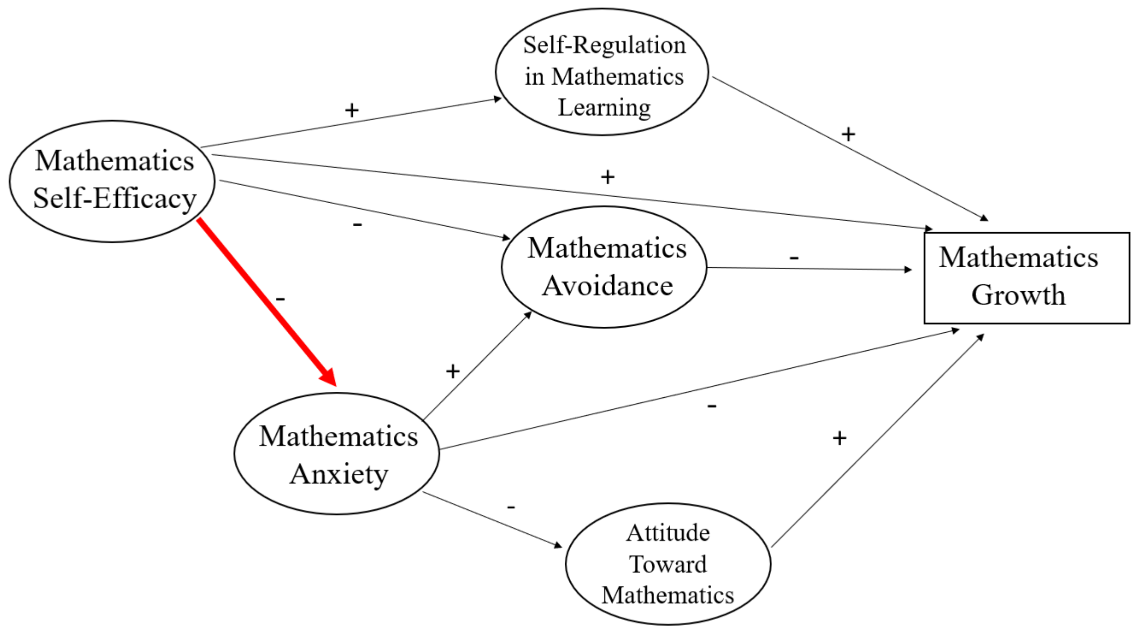

Figure 8. Hypothesized structural model. It was hypothesized that there would be a moderate, negative relationship between mathematics self-efficacy and mathematics anxiety.

Mathematics anxiety linked to mathematics avoidance. Research has also shown a positive relationship between mathematics anxiety and mathematics avoidance. People with mathematics anxiety are more likely to not engage in mathematics and avoid elective math courses as well as careers (Hembree, 1990; Maloney, Schaeffer & Beilock, 2013). In addition, Cemen (1987) contends that long term mathematics anxiety leads to mathematics avoidance, and people developing the belief that mathematics is not important.

Some researchers have tied anxiety to inattention, classifying inattention as a type of avoidance behavior (Grills-Taquechel, Fletcher, Vaugh, Denton, & Taylor, 2013; Pizzie & Kraemer, 2017). When students with mathematics anxiety viewed math stimuli, they viewed it as a threat and sought to avoid it. Moreover, researchers have found the issue of math anxiety and avoidance is most prevalent among pre-service teachers (D'Ailly & Bergering, 1992; Kelly & Tomhave, 1985). Investigators suggested that a teacher's level of mathematics anxiety and avoidance levels will ultimately influence students' perceptions of mathematics. Contrary to previously discussed research, Dew, Galassi, and Galassi (1984) found no significant relationship between math anxiety and avoidance.

Nevertheless, most research supports the positive relationship between mathematics anxiety and avoidance behaviors in mathematics. However, the research conducted has involved young elementary students or students at the undergraduate level. Since this study will focus on the link between mathematics anxiety and avoidance with students in grades four and five, it will address the literature gap in this area. A positive, moderate relationship was predicted between mathematics anxiety and mathematics avoidance. The hypothesized structural model (Figure 9) depicts this relationship.

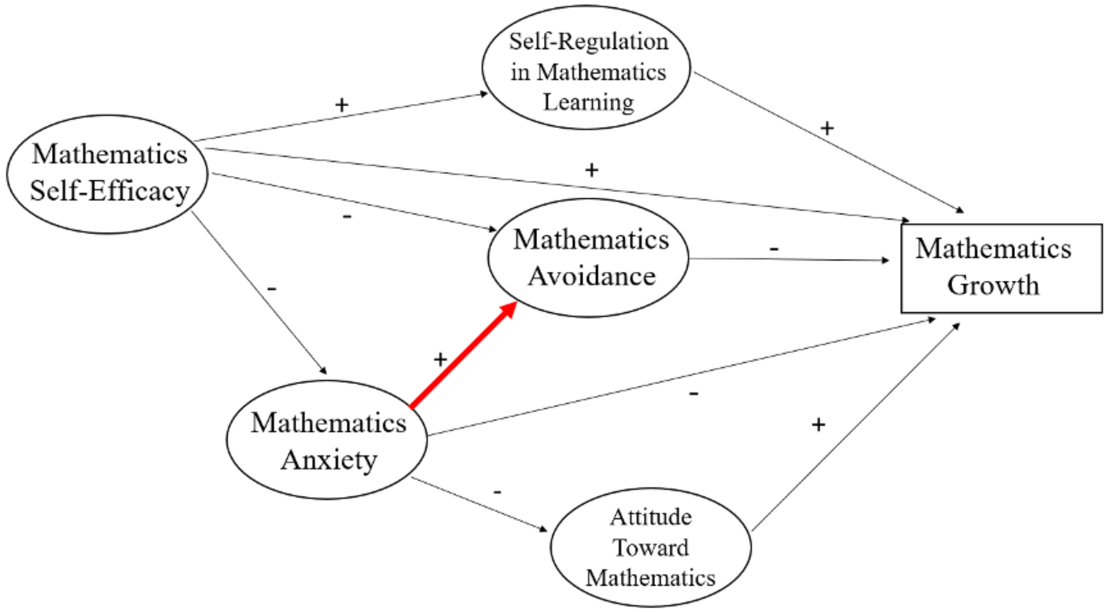

Figure 9. Hypothesized structural model. It was hypothesized there would be a positive, moderate relationship between mathematics anxiety and mathematics avoidance.

Mathematics anxiety linked to performance in mathematics. Studies have identified the negative relationship between mathematics anxiety and performance among elementary grades (Cargnelutti, Tomasetto, & Passolunghi, 2017; Jameson, 2013). In addition, many studies have been conducted that show the negative relationship between mathematics anxiety and mathematics performance among middle and high school students (Cheema & Sheridan, 2015; Hopko, Mahadevan, Bare, & Hunt, 2003; Skaalvik, 2018; Suinn & Edwards, 1982). Grades were negatively related to anxiety, $r = -.43$, $p < .001$ (Skaalvik, 2018). Investigators also claimed that mathematics anxiety may have a cumulative effect and considered the idea that mathematics anxiety may increase throughout schooling (Jameson, 2013). Not only does mathematics anxiety influence course grades, but it also impacts the amount of math courses a student completes. A moderate relationship between mathematics anxiety and number of math courses taken has been found in studies (Hembree, 1990; Hopko et al., 2003).

Some researchers claim the relationship between mathematics anxiety and mathematics performance is significant, however it is a weak relationship (Gierl & Bisanz, 1995; Pajares & Kranzler, 1995). Other researchers have concluded that mathematics anxiety may not always impair cognitive tasks if students' level of motivation is higher (Wang et al., 2015). In addition, interventions in reducing math anxiety have resulted in positive academic outcomes for students (Tobias, 1991).

Furthermore, mathematics anxiety and achievement have been shown to be moderately correlated (Hembree, 1990; Ma, 1999). The question of directionality between mathematics anxiety and performance arose in a couple studies (Cargnelutti, Tomasetto, & Passolunghi, 2017; Hembree, 1990). Although, little evidence was found to support the claim that low performance in mathematics causes anxiety. There was more evidence to support that mathematics anxiety directly affects mathematics performance (Hembree, 1990).

One of the reasons mathematics anxiety interferes with mathematics performance is the effect of mathematics anxiety on the working memory (Ashcraft, 2002; Ashcraft & Krause, 2007; Ashcraft & Kirk, 2001; Ashcraft & Moore, 2009; Hadwin, Brogan, & Stevenson, 2005; Ng & Lee, 2015; Ramirez et al., 2013). Research indicates that students with higher mathematics anxiety complete problems at a slower pace and perform lower on more complex problems (Faust et al., 1996). A student's working memory can be slowed by mathematics anxiety (Ashcraft, 2002). Since the working memory is being disrupted, an individual will not perform to his/her potential ability.

Research in mathematics anxiety has shown that anxiety affects mathematics performance. A negative and significant, weak relationship between mathematics anxiety and mathematics growth was hypothesized in this investigation (Refer to Figure 10).

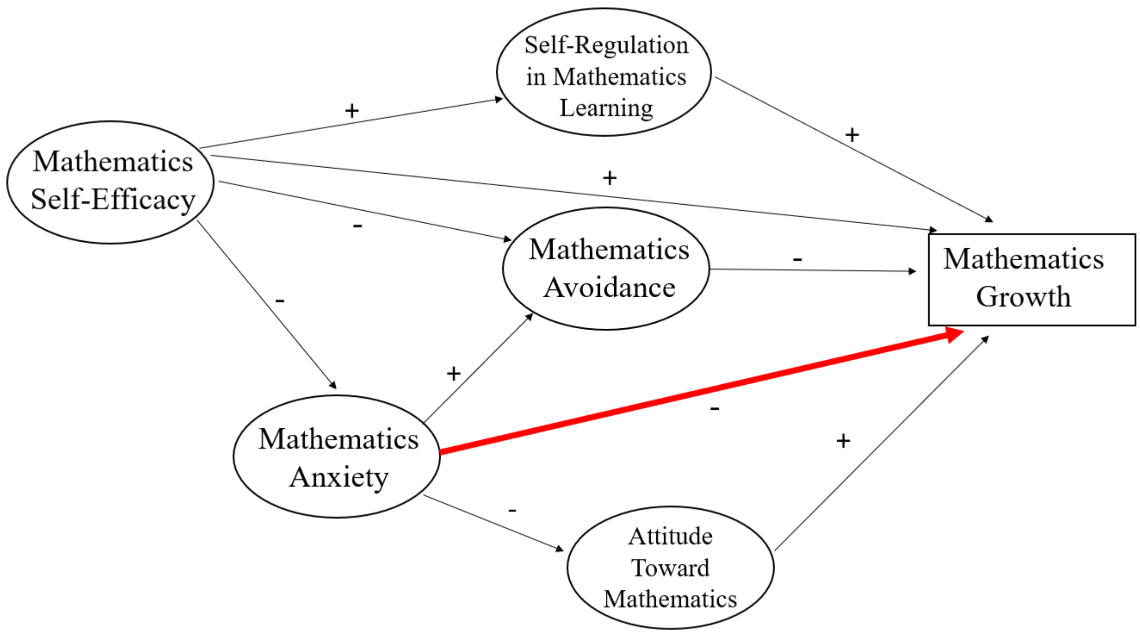

Figure 10. Hypothesized structural model. It was hypothesized that there would be a weak, significant relationship between mathematics anxiety and mathematics growth.

Mathematics anxiety linked to attitude toward mathematics. The relationship between math anxiety and attitudes was initially investigated by Hembree (1990), who found that people with high mathematics anxiety were reporting more negative attitudes toward mathematics. Later, math anxiety and attitude towards math were empirically linked among elementary and middle school students (Gierl & Bisanz, 1995; Young, Wu, & Menon, 2012). Moreover, the influence of mathematics anxiety on attitude is prevalent among people of all ages (Bessant ,1995; Geist, 2015; Soni & Kumari, 2017). Previous research continues to support that anxiety levels have been shown to be associated with attitudes toward mathematics.

Research studies have provided evidence showing the negative relationship between mathematics anxiety and attitude toward mathematics. As mathematics anxiety increases, attitude toward mathematics declines. For the current investigation, the hypothesized structural model (Figure 11) shows an inverse moderate relationship between mathematics anxiety and attitude toward mathematics.

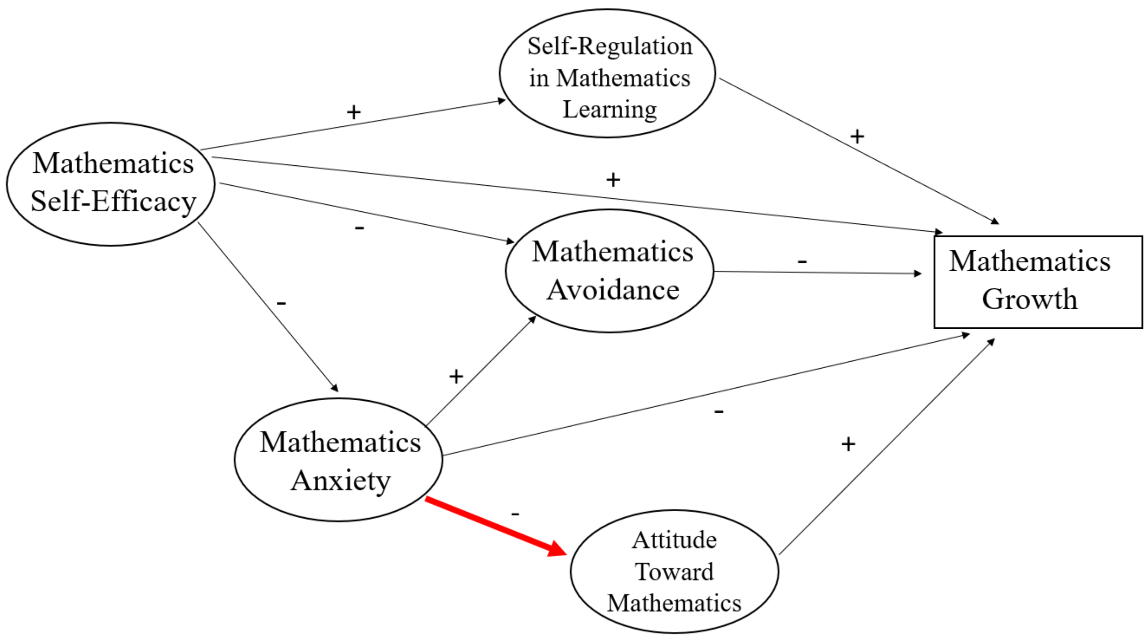

Figure 11. Hypothesized structural model. It was hypothesized that there would be a moderate, negative relationship between mathematics anxiety and attitude toward mathematics.

Attitude toward mathematics linked to academic outcomes. A positive relationship was found between attitude towards mathematics and mathematics performance (Lipnevich, Krumm, MacCann, Burrus, & Roberts, 2011; Perry et al., 2016). Regarding studies with elementary and middle school students, research has shown the positive relationship between attitude toward mathematics and mathematics performance (Chen et al., 2018; Choi & Chang, 2011). Researchers have also found evidence connecting poor mathematical attitudes to low test scores in mathematics (Schreiber, 2002), and lower GPAs (McCoach & Del Siegle, 2003). Previous research shows that attitude in mathematics is related to mathematics performance.

Furthermore, researchers have studied the direction of effect in the constructs of attitude toward mathematics and achievement in mathematics. A significant effect of mathematics achievement on attitude toward mathematics was discovered (Tocci & Engelhard, 1991). In addition, a reciprocal relationship between attitude toward mathematics and achievement toward mathematics was demonstrated in other investigations (Ma, 1997; Ma & Xu, 2004). These findings suggest there could be an additional pathway from mathematics growth to attitude toward mathematics. However, since the majority of research suggests a unidirectional relationship, the model in this investigation will only include the relationship of attitude toward mathematics on mathematics growth. Conclusions in other investigations found the effect of attitudes toward mathematics and mathematics achievement to be weak (Hembree, 1990; Ma & Kishor, 1997). In the current study, the hypothesized structural model (Figure 12) shows the relationship between attitude toward mathematics and mathematics growth to be positive and small.

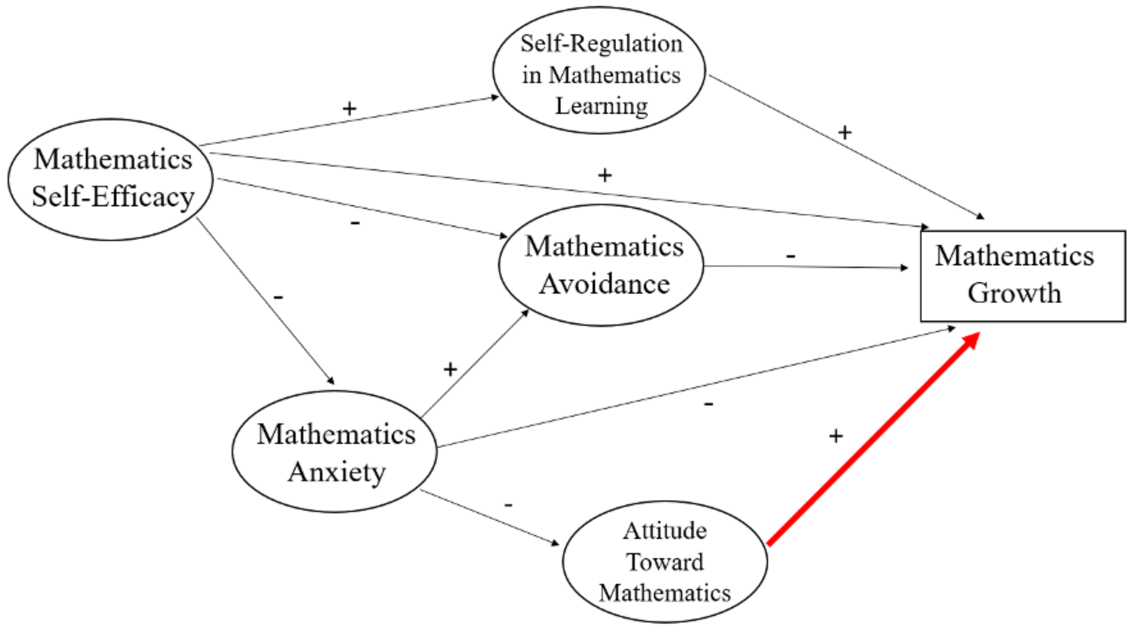

Figure 12. Hypothesized structural model. This investigation included a hypothesis that there would be a positive, small relationship between attitude toward mathematics and mathematics growth.

Summary

Direct and indirect effects on mathematics growth. Bandura's (1977a, 1986) self-efficacy theory and research studies indicate that mathematics self-efficacy affects a person's behavior toward mathematics. Self-efficacy influences a person's motivation and effort. Low self-efficacy could lead to mathematics avoidance and less mathematics growth. Research has shown that mathematics self-efficacy affects an individual's anxiety levels, affecting his/her emotional responses toward mathematics. Math-specific anxiety impacts a person's working memory, and mathematics anxiety also leads to avoidance of mathematics. In effect, mathematics growth is affected. Most research has focused on the effect of self-efficacy on performance levels on standardized assessments or grades. However, not many studies have been conducted to investigate the relationship between math-specific self-efficacy and academic growth targets. This study contributed to the research by examining the extent to which self-efficacy directly and indirectly influenced a student's growth throughout an academic school year.

The direct effect of mathematics self-efficacy on mathematics growth was examined. The indirect effect of mathematics self-efficacy on mathematics growth was investigated as well. Research supported the inclusion of the following mediating variables: self-regulation in mathematics learning, mathematics avoidance, mathematics anxiety, and attitude toward mathematics.

CHAPTER 3: RESEARCH METHODS

Case Study Approach

This investigation was an instrumental case study. A case study involves a single, complex system that is investigated in depth (Stake, 1995; Yin, 2014). Case studies are not bound to certain methods (Stake, 2005). In addition, purposive rather than random sampling is employed in a case study approach (Seawright & Gerring, 2008). When examining a phenomenon of interest, Stake (1995) referred to this technique as an instrumental case study. An instrumental case study is designed to accomplish an objective rather than simply develop an understanding (Stake, 1995). Purposes of case studies include causal analysis and causal inferences from a particular case (Elman, Gerring, & Mahoney, 2016). Furthermore, Langhout (2003) noted that case studies should be holistic and focused on patterns: In an example of a holistic method, Langhout (2003) mentioned structural equation modeling. However, examining a case with multiple forms of data is key to developing a comprehensive understanding of a phenomenon (Guetterman & Fetters, 2018).

Research Questions

Part 1. Since previous literature has indicated a gender gap in the mathematics classroom, one of the focuses of this study was to continue research in this area. The goal of part one was to determine whether there were gender differences among factors that affect mathematics growth. In addition, another purpose was to uncover whether there were differences between genders with regard to mathematics growth.

1. Do the factors that may affect mathematics growth differ between genders?

a. Do mathematics self-efficacy levels differ between genders among students in grades four and five?
b. Does self-regulation in mathematics learning differ between genders among students in grades four and five?
c. Do mathematics avoidance levels differ between genders among students in grades four and five?
d. Do mathematics anxiety levels differ between genders among students in grades four and five?
e. Does attitude toward mathematics differ between genders among students in grades four and five?

2. Does mathematics growth differ between genders among students in grades four and five?

Part 2. The objective of part two included an examination of the measurement and structural model in this study. Part two began with investigating the factor structure of the instrument being administered. Then the main part of the study concentrated on establishing how much of a direct and indirect effect mathematics self-efficacy has on mathematics growth. Specifically, examining whether the theoretical framework described the data in this case was a primary goal. To analyze the measurement model, the following research question was used: To what extent do the instruments used to measure mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics learning, mathematics avoidance, and attitude toward mathematics align with the factor structures revealed from previous studies?

When analyzing the structural model in this investigation, the following research questions were the focus:

1. To what extent does the theoretical framework suggested in Figure 2 describe the data?

2. How do mathematics self-efficacy levels directly affect mathematics growth?

3. How do mathematics self-efficacy levels indirectly affect mathematics growth, with the following acting as mediating variables: self-regulation, mathematics avoidance, mathematics anxiety, and attitude toward mathematics?

a. What is the effect of mathematics self-efficacy on self-regulation in mathematics?
b. What is the effect of mathematics self-efficacy on mathematics avoidance?
c. How does self-regulation in mathematics learning affect mathematics growth?
d. How does mathematics avoidance affect mathematics growth?
e. What is the effect of mathematics self-efficacy on mathematics anxiety?
f. How do mathematics anxiety levels affect mathematics growth?
g. What is the effect of mathematics anxiety levels on attitude toward mathematics?
h. What is the effect of mathematics anxiety levels on mathematics avoidance?
i. How does attitude toward mathematics affect mathematics growth?

Context of the study. The focus of this study was the direct and indirect influence of mathematics self-efficacy on intermediate students' mathematics growth. The participants being studied in the case were the fourth and fifth grade students from a rural school in Ohio. There were less than 1000 students attending the intermediate school, with approximately 90% of the student population being Caucasian, 3% Hispanic, and 2% Multiracial. In addition, 30% of the students were considered disadvantaged, and approximately 20% of the student have disabilities (U.S. Department of Education, 2018).

Participants

In the Fall of 2019, approximately 200 fourth and fifth grade students from a rural school district in Ohio participated in the study. The reason for this setting was convenience sampling. Approximately 80% of fourth and fifth grade students returned their consent form and agreed to participate in the research study. Though 204 students participated, only 197 cases were included in the study due to cases having missing data. There were 100 males and 97 females in the sample.

Measures

Self-efficacy measure. Bandura (1986) advised using self-efficacy measures that are task specific to the corresponding criterion being used in the investigation. Pajares (1996) mentioned the importance of specificity on the self-efficacy assessment and cautioned that assessing self-perceptions of general competence may result in ambiguous findings. Predictions are more accurate if the self-efficacy scale corresponds to the specific task being assessed (Pajares, 1996). The 24-item Middle School Mathematics

Self-Efficacy Scale (Toland & Usher, 2016) contained items from the middle school mathematics learning standards of the National Council of Teachers of Mathematics (NCTM, 2000). The items also reflected skills contained in the Common Core State Standards. Since the growth assessment included the standards from the Common Core State Standards, the self-efficacy scale was specific to the math standards, upholding Bandura's (1986) and Pajares's (1996) criterion for assessing self-efficacy.

Toland and Usher (2016) provided reliability and validity evidence for the four-point Likert scale, and claimed it was the most appropriate scale for middle school students. Toland and Usher's (2016) analysis revealed an individual reliability score (α= .88) and an item reliability (α= .99). A unidimensional scale was detected, and confidence on math topics was the measured factor. Each item contained a mathematics topic, and students were asked to rate their confidence with the topic: 1 (I cannot do this.), 2 (I am not sure that I can do this.), 3 (I am pretty sure I can do this.), and 4 (I can do this.) (Toland & Usher, 2016).

Mathematics anxiety measure. The participants' mathematic anxiety was measured using the Abbreviated Math Anxiety Scale (Hopko et al., 2003). Using exploratory factor analysis, Hopko et al. (2003) discovered a two-factor structure: Learning Math Anxiety (LMA) and Math Evaluation Anxiety (MEA), with factor loadings between .42 and .73. for LMA and between .26 and .88 on the MEA. Hopko et al. (2003) found validity and reliability evidence for the Abbreviated Math Anxiety Scale, with good internal consistency: Abbreviated Math Anxiety Scale (α= .90), Learning Math Anxiety (α= .85), and Math Evaluation Anxiety (α= .88). Test-retest reliability results were sufficient as well, AMAS (r= .85), LMA (r=.78) and MEA (r=.83) (Hopko et al., 2003). The Abbreviated Math Anxiety Scale is a nine-item measure with a five-point Likert scale, ranging from 1 (low anxiety) to 5 (high anxiety).

Self-regulation in mathematics learning. The subscale measuring self-regulated study behavior from the School Attitude Assessment Survey-Revised (McCoach & Del Siegle, 2003) was used to determine student self-regulation levels. The scale was adapted to reflect self-regulated study behavior in mathematics, specifically. Each item included the word mathematics in the statement. McCoach and Del Siegle (2003) found validity evidence for the School Attitude Assessment Survey using confirmatory factor analysis. A five-factor structure was shown: academic self-perceptions, attitudes toward teachers, attitude toward school, goal valuation, and self-regulation. McCoach and Del Siegle (2003) determined internal consistency reliability among the subscales with a coefficient of at least .80 on each of the factors. Students answered ten items regarding self-regulated study behavior in mathematics. Students rated how true statements were for them, with a 1 (not true at all) through a 7 (very true).

Mathematics avoidance measure. Two subscales from the Patterns of Adaptive Learning Survey (PALS) (Midgley et al., 2000; Turner et al., 2002) were used: Avoiding Novelty and Self-Handicapping Strategies. A scale developed by Ryan and Pintrich (1997) was used to measure Avoiding Help Seeking. Turner et al. (2002) found the three-scales to have good internal consistency. Turner et al. (2002) found the three-scales to have good internal consistency, with the scales showing the following alpha coefficients: Avoiding Novelty (α =.84), Avoiding Help Seeking (α =.81), and Self-Handicapping Strategies (α= .82). A five-point Likert-type scale was used on all scales with a 1 (not true at all) to 5 (very true). Ross, Blackburn, and Forbes (2005) conducted a reliability generalization study on the Pattern of Adaptive Learning Survey and discovered coefficients on the scales to range between .60 and .81, except for one coefficient being .42.

Attitude toward mathematics measure. Lim and Chapman (2012) developed the short form of the Attitudes Toward Mathematics Inventory (short ATMI). Strong correlations were confirmed between the short ATMI and the original scale ($r = .96$). Lim and Chapman (2012) reported on the internal consistency of the instrument ($\alpha = .93$) for the short ATMI, and a mean of $\alpha = .87$ for the subscales.

Test re-test reliability was verified as well, $r = .75$ (Lim & Chapman, 2012). The factor structure was determined using confirmatory factor analysis, with factor loadings ranging from .65 to .86: enjoyment of mathematics, motivation to do mathematics, self-confidence in mathematics, and perceived value of mathematics (Lim & Chapman, 2012). A five-point Likert scale was used ranging from a 1 (strongly disagree) to 5 (strongly agree). Five items from the subscale enjoyment of mathematics was used from the short ATMI. Refer to Appendix A for the measures.

Academic growth measure. Benchmark data in mathematics from the Northwest Evaluation Association (NWEA) Measures of Academic Progress were collected in the fall and winter. The NWEA Measures of Academic Progress provide growth targets for the winter and spring benchmark, based on students' previous benchmark scores. The NWEA completes norming studies to continually evaluate the validity evidence of the growth measures (Northwest Evaluation Association, 2015). In the most recent norming study, a data pool of about 6,000 school districts and ten million students in grades K-11 were obtained in a three-year study, in which testing terms ranged from the fall of 2011 through spring 2014 (Thum & Hauser, 2015). Samples between 72,000 to 153,000 student records were randomly selected from approximately 1,000 schools (Northwest Evaluation Association, 2015). The norming study utilized a three-level hierarchical linear model analysis (within students, as well as within and between schools) and employed an additive polynomial growth model to account for such issues as the decline in scores from Spring to Fall. The number of instructional days for each school district were also considered in this study. The norms are based on the bell curve.

The Measure of Academic Progress (MAP) assessment is an adaptive assessment completed online. After students complete the assessment, a RIT (Rausch UnIT) score is given. RIT scores range from 100 to 300. Growth targets are provided to students for the winter according to their baseline score from the fall. Upon completing the winter benchmark, a spring growth target is then provided as well. Students that start at a lower level are expected to grow more (Northwest Evaluation Association, 2015).

Regarding this investigation, the participants' growth measure was their conditional growth index (CGI). The CGI is the normative growth measure. The CGI value shows a standardized measure of a student's growth compared to the 2015 NWEA student growth norms. The growth norms account for the median growth levels of students at the same grade and starting RIT score ("Conditional Growth Index," 2019). Essentially, if a student's CGI score is a 0, it indicates the student showed the same growth as expected for students at that grade level and starting RIT score. Therefore, if a student's CGI score is positive, it means the student grew more than expected compared to the growth norms. A negative CGI score would mean the student grew less than what is expected in comparison to the growth norms.

The CGI can be calculated using the following formula: Growth index divided by the standard deviation for growth. The formula for the growth index is projected growth subtracted from the observed growth ("Conditional Growth Index," 2019). The CGI is useful for comparing students from all ability groups as well as between grade levels ("Conditional Growth Index," 2019; Thum, 2015; Thum & Hauser, 2015). Hegedus (2018) also confirmed that the CGI is best for comparing low and high-achieving students' growth in addition to comparing students at different grade levels. Since low achieving students tend to demonstrate more growth, the CGI will enable the growth results to be compared fairly (Hegedus, 2018). In this investigation, CGI scores in this study ranged from -3.10 to 3.60.

This investigation concentrated on the mathematics growth attained in one semester. Through an extensive longitudinal study with a vast data pool, NWEA demonstrated substantial student growth occurs within one semester (Northwest Evaluation Association, 2015). Specifically, the 2015 NWEA RIT Scale Norms were evidence that supports the inclusion of one semester of data in this current study. Previous norming studies have demonstrated that a student shows growth between their fall and winter benchmark assessments. Since research studies have shown that student growth occurs in one semester, the principal investigator included data from one semester in the present investigation.

Pilot Study

Prior to the primary investigation, a pilot study was conducted to examine the reliability of the instrument that measures all latent variables except mathematics growth. The pilot study was approved by the Institutional Review Board (IRB). Additionally, the principal investigator (PI) assessed participant feedback/responses and evaluated the overall administration of the survey. The survey was administered to 91 fifth grade students from the same location as the primary study. Participants completed the survey in less than 30 minutes. Out of 91 cases one case had missing data, so the PI eliminated this case from the analysis. The PI determined that the instrument had strong internal consistency ($\alpha > .8$) in each measure. Refer to Table 1 for data regarding internal consistency. When evaluating participant responses, the PI determined that on eight of the 24 items on the self-efficacy measure a considerable number of students (greater than seven) reported that they did not know what the topic was. The eight items reflect sixth grade content and would not be appropriate for fourth and fifth grade students. On the other sixteen items, at most two students had not seen these topics. Since more than seven students did not know eight specific items, the eight items will be excluded from the instrument during the primary study.

Table 1

Pilot Study Internal Consistency

Measure	**Cronbach Alpha (α)**
Self-Efficacy Measure	.855
Self-Regulation in Mathematics Measure	.896
Mathematics Anxiety	.893
Mathematics Avoidance	.834
Attitude Toward Mathematics	.869

Procedure for the Primary Study

Preceding the primary study, an IRB application process was completed. Upon approval of the IRB, the procedure for the study initiated. In the Fall of 2019, the data for the primary study was collected from approximately 200 fourth and fifth grade students. Students were given a survey that included the measures for mathematics self-efficacy, self-regulation in mathematics learning, mathematics avoidance, mathematics anxiety, and attitude toward mathematics (Appendix A). The instrument was administered in ten classrooms within the first two weeks of the academic school year. Classroom teachers were provided the instructions for each instrument. Classroom teachers also administered the MAP Assessment for mathematics two times throughout the school year: during the first two weeks of the school year, and during the last two weeks of the second quarter.

Data Analysis

Pre-Analysis. Prior to conducting independent samples *t*-tests, confirmatory factor analysis, and structural equation modeling, assumptions were checked using IBM SPSS Statistics 26. The assumptions included an analysis of missing data, outliers, multivariate normality, linearity, and multicollinearity. Out of 204 cases, there were seven cases with missing data. The missing data were analyzed to confirm the data were missing at random. Since there is less than 5% of missing data at random, the seven cases with missing data were deleted. MacCallum, Widaman, Zhang, and Hong (1999) explained that a sample size of 200 is adequate for CFA if the factors have at least five to seven indicators and communality values are around .5. There were 197 cases included in the analysis, which is approximately the acceptable sample size needed for CFA.

Univariate outliers were checked among the variables. There were zero outliers found in mathematics self-efficacy, mathematics anxiety, and attitude toward mathematics. Three outliers were found in mathematics avoidance and six outliers in self-regulation in mathematics. Eight univariate outliers were detected on the growth measure. Iglewicz and Hoaglin (1993) explained the importance in determining the cause of the outlier, and if no cause can be determined then the outlier should remain in the data. Wiggins (2000) also stated there should be a sufficient reason for eliminating outliers. Since the outliers on the variables were considered valid, there was no sound reasoning to delete those cases. Therefore, the cases remained in the data set. Multivariate outliers were identified by creating the Mahalanobis distance variable, and six multivariate outliers were detected, (df = 56, $p < .001$). Again, there was no sound rationale for deleting those cases, so the cases were still included in the analysis.

Multivariate normality was checked using skewness values of the variables and histograms. Though most skewness values were ranging between -1 and 1, there were fifteen out of 55 that were slightly out of the appropriate range to be able to assume normality. Since the analysis involves a lower sample size and the normality assumption was not met, the analysis was run with bootstrapping, with 10,000 samples and a 95% confidence interval. Hesterberg (2015) recommended 10,000 samples for increased accuracy in the bootstrapping results. Linearity was analyzed visually using scatterplot matrices.

In addition, possible issues with multicollinearity were examined using linear regression. Tolerance values ranged from .59 to .67, which were acceptable values. According to Kline (2011), tolerance values should be greater than .1. Variance inflation factor (VIF) values should also be less than 10 (Kline, 2011), which was also met in this case, since the VIF values were all less than 2. Bivariate correlations showed multicollinearity was not an issue as well.

Part 1. After collecting data from approximately 200 participants in grades four and five, part one of the investigation examined whether there were significant differences in each variable between genders. Cases involving missing data were not included in the analysis, leaving a sample size of 197 participants. Since this part of the study involves a categorical independent variable, continuous dependent variables, and the samples were independent of one another, an independent samples *t*-test was used in this study.

Using SPSS ANALYZE, an independent samples *t*-test was run for each variable. The independent-samples *t*-test output was analyzed. The Levene's Test for Equality of Variances was used to assess the equality of variances between genders. Alpha was set at the .05 level (Frankfort-Nachmias & Leon-Guerrero, 2015). If the Levene's test revealed a *p*-value less than .05, there was a significant difference between the variances. Each *t*-test enabled the investigator to conclude whether there were significant differences between genders in each of the following variables: mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, attitude toward mathematics, and mathematics growth.

If a significant difference between genders was found among any of the variables, an effect size was calculated. Cohen's *d* was calculated by finding the mean difference between the males and females, and then dividing the difference by the pooled standard deviation (Tabachnick & Fidell, 2013). The criteria for evaluating effect size was the following: $d = 0.2$ small, $d = 0.5$ medium, $d = 0.8$ large (Cohen, 1988).

Part 2. A confirmatory factor analysis was conducted on the data of 197 fourth and fifth grade students. Sample sizes between 100 and 200 are acceptable in confirmatory factor analysis (CFA) if the factors are well established, with communalities in the range of .5 and many indicators for each factor (MacCallum, Widaman, Zhang, & Hong, 1999). Refer to the pre-analysis section for the assumptions that were checked prior to conducting the CFA. Using CFA, it was determined whether the instrument measured the following latent variables: mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics learning, mathematics avoidance, and attitude toward mathematics. Results were used to compare the factor structures determined from previous research.

When performing CFA, the χ^2 and fit indices were used to assess the fit of the measurement model. Maximum likelihood estimation was utilized to estimate all models. A non-significant χ^2 indicates a good fitting model (Tabachnick & Fidell, 2013). The Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) were analyzed and should be close to or exceed .9 (Ho, 2014). Furthermore, the PI sought a value below 0.06 for the root mean square error approximation (RMSEA) (Hu & Bentler, 1999). The PI examined residuals as well and analyzed the standardized residual covariances. Larger residuals indicated a modification in the model is necessary. Kline (2011) specified that to determine convergent validity, standardized factor loadings should be greater than .7, but Tabachnick and Fidell (2013) noted that .45 is considered adequate: Discriminant validity can be established if the estimated correlations between factors do not exceed .9.

Modification indices were examined to determine whether the model could be improved. Changes to the model were only made if the modifications were theoretically aligned.

Structural equation modeling (SEM) was the method employed for the primary analysis. Since structural equation modeling was used in the analysis, a large sample size was required (Tabachnick & Fidell, 2013). However, Bentler and Yuan (1999) have found it possible to include a sample as small as 60 participants. In most studies that use structural equation modeling, a suggestion of at least 200 participants has been cited (Kline, 2011; Ullman, 2006), and a typical sample size in SEM is between 200 and 300 participants (Kline, 2011). In another suggestion, Schreiber, Nora, Stage, Barlow, & King (2006) mentioned ten participants per parameter as an acceptable guideline.

Since the analysis involved a complex relationship among variables, SEM was considered the best method (Tabachnick & Fidell, 2013). Adelson (2012) provided other SEM purposes such as (a) looking at patterns of relationships among the variables, (b) analyzing mediation effects, or (c) a comparison of path models for different groups. Since the research questions involved examining direct and indirect influences on the dependent variable, SEM was the most appropriate method for this study.

Tabachnick and Fidell (2013) also mentioned another beneficial component to SEM, which was the relationships will be absent of measurement error. This study investigated the relationships among the factors affecting mathematics growth, specifically examined the direct and indirect influences on mathematics growth. Additionally, Berkout, Gross, and Young (2014) stressed the importance of ensuring the hypothesized model is aligned with a theory. Bandura's (1986) self-efficacy theory framed the foundation for the model in this study.

With SEM, there was flexibility with the levels of measurement for the independent and dependent variables. All variables are considered continuous (mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics learning, mathematics avoidance, attitude toward mathematics, and mathematics growth). The exogenous variable in this investigation was considered: mathematics self-efficacy. The endogenous variables consisted of mathematics anxiety, self-regulation in mathematics, mathematics avoidance, attitude toward mathematics, and mathematics growth. Assumptions were checked prior to testing the model and are described in the pre-analysis section of this paper.

In Figure 2, the hypothesized structural model illustrated the predicted relationships based on Bandura's self-efficacy theory. In the illustrated models used in this investigation, rectangles showed the measured variables and the circles indicated latent variables. In the model, the predictors of mathematics growth were investigated. A direct positive relationship was hypothesized between mathematics self-efficacy and mathematics growth.

The indirect effect of mathematic self-efficacy on mathematics growth was analyzed, with self-regulation in mathematics learning acting as a mediator in one of the indirect relationships. Mathematic avoidance was also examined as being a potential intervening variable between mathematics self-efficacy and mathematics growth. Mathematics self-efficacy was also hypothesized as being a predictor variable to mathematics anxiety, with mathematics anxiety affecting mathematics growth. Lastly, another hypothesized indirect relationship involved mathematics anxiety and attitude toward mathematics as mediating variables between mathematics self-efficacy and mathematics growth.

When evaluating the model, an assessment of fit took place (residuals, model chi-square, and fit indices) and post hoc tests were performed to develop the best fit for the model (Tabachnick & Fidell, 2013). Chi-square values should be non-significant to be a good fit ($p \geq .05$) (Hu & Bentler, 1999). Green (2016) emphasized that reporting on the chi-square, including its *p* value and degrees of freedom, is still not enough evidence to make conclusions about the model fit.

The investigator examined the relative and absolute fit indices as well (Green, 2016). The relative fit indices included the Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI). The absolute indices were comprised of the root-mean-square-error of approximation (RMSEA) and the standardized root-mean-square residual (SRMR). Since the data were being treated as continuous data, a cutoff value of .95 will be used to evaluate the TLI and CFI (Bagozzi, 2010; Iacobucci, 2010; Hu & Bentler, 1999). In addition, the investigator sought a value below 0.06 for the RMSEA, and below 0.08 for the SRMR (Hu & Bentler, 1999).

Tabachnick and Fidell (2013) stressed that the residuals should be centered around zero to be considered a good-fitting model. The chi-square statistic, its degrees of freedom, and *p* value were reported. Larger significant chi-square values indicated a poor fit, whereas non-significant chi-square values provided support for the model and a perfect fit (Berkout et al., 2014). Following any modifications to the model, a correlation was calculated between the initial hypothesized model and final model. The final model will be displayed with the standardized coefficients, and a table with the standardized coefficients will be shown (Tabachnick & Fidell, 2013).

The direct and indirect effects of each variable were examined as well as the significance of certain parameters. The amount of variance in mathematics growth accounted for by each factor and combination of factors was interpreted. In addition, the Lagrange Multiplier (LM) Test was used to determine whether certain parameters should be added to the model (Schreiber et al., 2006). In the LM test, the investigator looked for a significant change with the addition of specific parameters. Model trimming and model building are described as eliminating and adding paths based on theory to create a better fitting model (Kline, 2011). When evaluating effect sizes, the guidelines for effects are from Keith's (1993) criteria: 0.1 - 0.15 small, 0.15 - 0.25 moderate, and greater than 0.25 would be considered large.

In the analysis, mathematics self-efficacy's direct and indirect effects on mathematics growth was determined. Identifying which independent variables were significant predictors of mathematics growth was covered in my analysis.

CHAPTER 4: RESULTS

Part 1

1. **Do the factors that may affect mathematics growth differ between genders?** In the first set of research questions, the investigator sought to determine whether the factors that may affect mathematics growth differ between genders in grades four and five. In addition, the investigator examined whether there was a difference between genders in the amount of mathematics growth. Independent samples *t*-tests were conducted to examine gender differences among the six following variables: mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics, attitude toward mathematics, mathematics avoidance, and mathematics growth. Descriptive statistics by gender are displayed in Table 3 below.

Table 2

Mathematics Self-Efficacy, Self-Regulation in Mathematics, Mathematics Avoidance, Mathematics Anxiety, Attitude Toward Mathematics, and Mathematics Growth-Descriptive Statistics

Variable	Gender	N	Mean	Std. Deviation
Mathematics Self-Efficacy	Male	100	2.65	0.55
	Female	97	2.65	0.61
Self-Regulation	Male	100	5.35	1.17
	Female	97	5.80	0.92
Mathematics Avoidance	Male	100	2.42	0.79
	Female	97	2.12	0.72

Mathematics Anxiety	Male	100	2.79	1.05
	Female	97	2.57	1.01
Attitude Toward Mathematics	Male	100	3.30	1.21
	Female	97	3.34	1.27
Mathematics Growth	Male	100	0.11	1.14
	Female	97	-0.04	1.15

1a. Do mathematics self-efficacy levels differ between genders among students in grades four and five? It was hypothesized there would be a significant difference between genders with regard to mathematics self-efficacy, and it was predicted that males would report a higher mathematics self-efficacy. The assumption of homogeneity of variances was analyzed using the Levene's Test for Equality of Variances, and the assumption was met $F(195) = 0.54$, $p = .46$. However, in this current study, no significant differences were found between genders in the area of mathematics self-efficacy ($t(195) = -0.07$, $p = .94$).

1b. Does self-regulation in mathematics learning differ between genders among students in grades four and five? Since research supported the notion of no gender differences in self-regulation, the investigator posited there would be no differences between genders found in this study. The assumption of homogeneity of variances was assessed using the Levene's Test for Equality of Variances, and the findings showed the assumption was not met, $F(195) = 8.65$, $p = .004$. After applying the Welch's *t*-test for non-equal variances, the results revealed a significant difference between genders in mathematics self-regulation, $t(187) = -3.07$, $p = .003$, $d = 0.43$. There was a small to moderate effect of gender on self-regulation in mathematics, with females reporting more self-regulatory behaviors in mathematics than males (Cohen, 1988).

1c. Do mathematics avoidance levels differ between genders among students in grades four and five? No gender differences in mathematics avoidance levels were predicted. The assumption for equality of variances was met, $F(195) = 0.55$, $p = .46$. A significant difference between genders was found in the area of mathematics avoidance, $t(195) = 2.81$, $p = .005$, $d = 0.40$. There was a small to moderate effect of gender on mathematics avoidance, with female students reporting less avoidance behaviors in mathematics than male students (Cohen, 1988).

Further analysis was conducted with regard to gender differences in mathematics avoidance. Gender differences were examined in three areas of mathematics avoidance: (a) self-handicapping strategies, (b) avoidance of help-seeking, and (c) avoidance of novelty and challenge. It was hypothesized there would be no gender differences in any area of mathematics avoidance. When examining whether gender differences exist in self-handicapping strategies, the assumption for equality of variances was not met. Therefore, the Welch's t-test for non-equal variances was used and findings still indicate a significant difference between genders in self-handicapping strategies, $t(177) = 3.48$, $p = .001$, $d = 0.50$. There was a moderate effect of gender on self-handicapping strategies, and it was determined that male students reported more self-handicapping strategies than females.

Gender differences in avoidance of help-seeking and avoidance of novelty and challenge were examined as well. The assumption for equality of variances was met with avoidance of help-seeking, $F(195) = 0.19$, $p = .66$, and with avoidance of novelty and challenge *F*(195) = 0.72, *p* = .40. Findings revealed no significant difference between gender in avoidance of help-seeking, *t*(195) = 1.08, *p* = .28, or avoidance of novelty and challenge, *t*(195) = 1.97, *p* =.05. It is evident that self-handicapping strategies appear to be the greatest area of concern in mathematics avoidance with regard to gender differences.

1d. Do mathematics anxiety levels differ between genders among students in grades four and five? It was hypothesized there would be a significant difference between genders in mathematics anxiety, with females reporting higher mathematics anxiety levels. The assumption for equality of variances was met, *F*(195) = 0.05, *p* = .83. However, no significant differences were found between genders in mathematics anxiety levels, *t*(195) = 1.49, *p* =.14.

1e. Does attitude toward mathematics differ between genders among students in grades four and five? Previous research led the investigator to hypothesize there would be a significant difference between genders in attitude toward mathematics. The assumption for equality of variances was met, *F*(195) = 0.50, *p* = .48. No significant differences were found between genders in attitude toward mathematics, *t*(195) = -0.19, *p* = .85.

2. Does mathematics growth differ between genders among students in grades four and five? Mathematics growth was another factor examined. Since more studies concluded that males achieve higher in mathematics, the investigator hypothesized that males would display a larger amount of mathematics growth. The assumption for equality of variances was met, *F*(195) = 0.00, *p* = .95. No significant differences between genders were found in mathematics growth (*t*(195) = 0.88, *p* = .38).

Part 2

To what extent do the instruments used align with the factor structures revealed from previous studies? In the next set of research questions, the investigator analyzed the measurement model involved in the study. A five-factor model (mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics) was hypothesized. SPSS AMOS 26 was the program used to conduct confirmatory factor analysis with the fall survey data. Maximum likelihood was the estimation method used to determine the parameters in the model. See Figure 13 for the initial standardized results of the model. The focus of this aspect of the study was: To what extent do the instruments used to measure mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics learning, mathematics avoidance, and attitude toward mathematics align with the factor structures revealed from previous studies?

Like the previous studies, evidence was found that supports the instruments were reliable. See Table 4 for the reliability statistics.

Table 3

Reliability Statistics

	Cronbach Alpha from Previous Research	Cronbach Alpha from Current Study
Mathematics Avoidance	.83 (Turner et al., 2002)	.87
Mathematics Self-Efficacy	.86 (Toland & Usher, 2016)	.86
Mathematics Anxiety	.89 (Hopko et al., 2003)	.87
Attitude toward Mathematics	.87 (Lim & Chapman, 2012)	.92
Self-Regulation in Mathematics	.90 (McCoach & Del Siegle, 2003)	.87

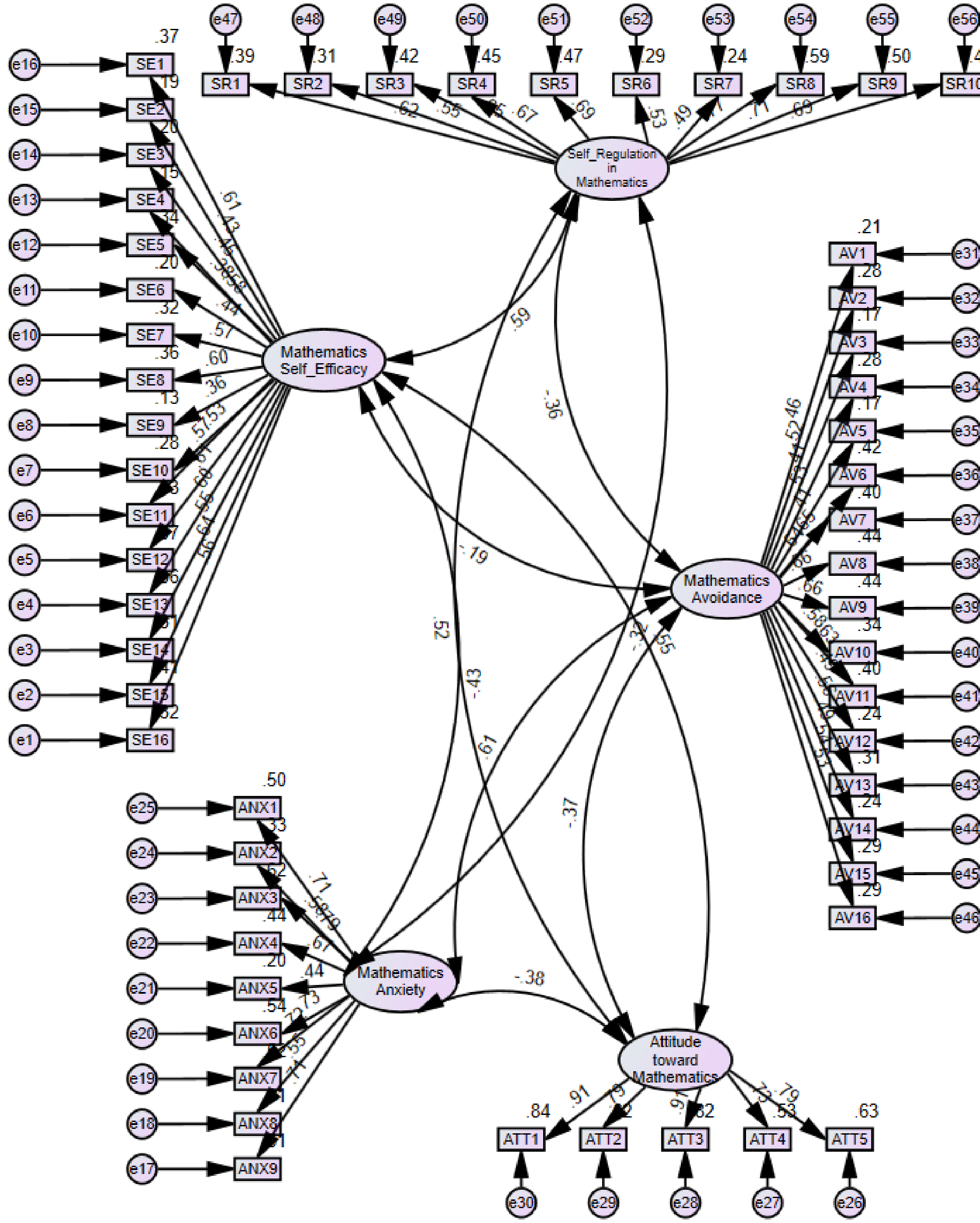

Figure 13. Initial Measurement Model

Model fit. Table 5 shows the goodness and badness of fit indices utilized in the analysis. In addition, chi-square was examined, and findings were significant, χ^2 (1474, N = 197) = 2731.53, p < .001 A non-significant chi-square would be desired in the analysis. Though chi-square was significant, chi-square is a statistic sensitive to sample size, so other indices should be interpreted as well. The null model showed the following results, χ^2 (1540, N = 197) = 6429.72, p < .001. In the initial model, the fit indices also did not meet the criteria for a good fit. Since only one of the fit indices was met, the initial model was not accepted and post-hoc tests were performed.

Table 4

Initial Measurement Model Indices

Model Fit Index	**Fit Criteria**	**Model Result**
Comparative Fit Index (CFI)	> .90	.743
Goodness-of-Fit Index (GFI)	> .90	.662
Tucker Lewis Index (TLI)	> .90	.731
Root Mean Square Error of Approximation (RMSEA)	< .06	.066
Standardized Root Mean Square Residual (SRMR)	< .08	.079

Post-hoc model modifications were conducted to create a better fitting model. Standardized regression weights were considered as well as correlations of the error terms. Tabachnick and Fidell (2013) suggested that factor loadings of at least 0.55 are considered good, 0.45 are fair, and therefore can be interpreted. All changes to the model were theoretically aligned with the study's purpose.

In the first measurement model, the largest modification indices were overall associated with adding covariances to the error terms among the following factors:

mathematics avoidance and mathematics anxiety (e44-e46, e42-e46, e42-e45, e42-e43, e38-e39, e37-e39, e37-e38, e32-e35, e32-e33, e31-e33, e31-e32, e22-e24, e19-e23, e18-e21). Three of the error covariances were from the mathematics anxiety factor and eleven of the error covariances were from mathematics avoidance. In addition, the absolute correlation residuals between these items were greater than 0.1, which could indicate poor local fit (Kline, 2016). Moreover, the standardized residual covariances were around 2 or greater, which also suggests poor local fit. The standardized residual covariances should be less than 2 (Bagozzi & Yi, 1988). After examining the specific items, it was evident the items were similarly worded and therefore could be correlated after accounting for the latent construct (Brown, 2015). Table 6 shows the standardized residual covariances of the items. Table 7 reveals the similarly worded items. Error covariances were added to the model between the listed items.

Table 5

Standardized Residual Covariances of Items

Items	Standardized Residual Covariances
AV14 and AV16	3.875
AV12 and AV13	3.686
AV12 and AV15	3.211
AV12 and AV16	3.174
AV7 and AV8	2.565
AV8 and AV9	2.262
AV7 and AV9	2.455
AV1 and AV2	4.096
AV1 and AV3	4.731
AV2 and AV3	4.447
AV2 and AV5	3.390
ANX2 and ANX4	2.760
ANX3 and ANX7	1.588
ANX5 and ANX8	3.331

Table 6

Items with Error Covariances

Items with Error Covariances	
AV14: Some students purposely get involved in lots of activities. Then if they don't do well in math, they can say it is because they were involved with other things. How true is this for you?	AV16: Some students look for reasons to keep them from studying math (not feeling well, having to help their parents, taking care of a brother or sister, etc.). Then if they don't do well on their math work, they can say this is the reason. How true is this of you?
AV12: Some students purposely don't try hard in math. Then if they don't do well, they can say it's because they didn't try. How true is this of you?	AV13: Some students fool around the night before a math test. Then if they don't do well, they can say that is the reason. How true is this of you?
AV12: Some students purposely don't try hard in math. Then if they don't do well, they can say it's because they didn't try. How true is this of you?	AV15: Some students let their friends keep them from paying attention during math or from doing their math homework. Then if they don't do well, they can say their friend kept them from working. How true is this for you?
AV12: Some students purposely don't try hard in math. Then if they don't do well, they can say it's because they didn't try. How true is this of you?	AV16: Some students look for reasons to keep them from studying math (not feeling well, having to help their parents, taking care of a brother or sister, etc.). Then if they don't do well on their math work, they can say this is the reason. How true is this of you?
AV7: I don't ask questions during math, even if I don't understand the lesson.	AV8: When I don't understand my math work, I often put down my answer rather than ask for help.
AV8: When I don't understand my math work, I often put down my answer rather than ask for help.	AV9: I usually don't ask for help with my math work, even if the work is too hard to do on my own.
AV7: I don't ask questions during math, even if I don't understand the lesson.	AV9: I usually don't ask for help with my math work, even if the work is too hard to do on my own.
AV1: I would choose math problems I knew I could do, rather than those I haven't done before.	AV2: I would prefer to do math problems that are familiar to me, rather than those I would have to learn how to do.

AV1: I would choose math problems I knew I could do, rather than those I haven't done before.	AV3: I like math concepts that are familiar to me, rather than those I haven't thought about before.
AV2: I would prefer to do math problems that are familiar to me, rather than those I would have to learn how to do.	AV3: I like math concepts that are familiar to me, rather than those I haven't thought about before.
AV2: I would prefer to do math problems that are familiar to me, rather than those I would have to learn how to do.	AV5: I prefer to solve math problems as I always solved them, rather than trying something new.
ANX2: Thinking about an upcoming math test 1 day before.	ANX4: Taking a test in a math class.
ANX3: Watching a teacher work a math problem on the board.	ANX7: Listening to another student explain a math problem.
ANX5: Being given a homework assignment of many difficult problems that is due the next class meeting.	ANX8: Being given a "pop" quiz in math class.

The second model was run with a total of 14 covaried error terms. There was a slight improvement in the model. Chi-square was still significant in the second model, χ^2 (1460, N = 197) = 2396.39, $p < .001$ with the following null model, χ^2 (1540, N = 197) = 6429.72, $p < .001$. However, there were two out of the five model fit indices that met cutoff values. An SRMR value less than 0.08 indicates a good fit (Hu & Bentler, 1999) and the RMSEA is less than 0.06 (RMSEA = .057). Standardized regression weights ranged from 0.36 to 0.92. See Table 8 for model indices.

Table 7

Measurement Model 2 Indices

Model Fit Index	**Fit Criteria**	**Model Result**
Comparative Fit Index (CFI)	>.90	.808
Goodness-of-Fit Index (GFI)	>.90	.709
Tucker Lewis Index (TLI)	>.90	.798
Root Mean Square Error of Approximation (RMSEA)	<.06	.057
Standardized Root Mean Square Residual (SRMR)	<.08	.076

A third model was run with the deletion of one variable, the fourth item on the mathematics self-efficacy scale. After analyzing the factor loadings and the variables associated, this variable does not have as much overlapping variance with mathematics self-efficacy. The fourth variable associated with mathematics self-efficacy involved students rating their level of self-efficacy on powers and exponents. Initially, this item was included since it is a standard taught in the intermediate grade levels. However, due to the timing of the survey administration, this math topic had not yet been studied in fourth or fifth grade. During the survey administration many students inquired about this skill. It became evident that students were unclear how to rate their self-efficacy on a topic they had never seen. Feedback during the survey administration as well as a low factor loading of 0.39 contributed to the decision to delete this variable. Item SE4 was eliminated from the model and the CFA was run once more.

After performing the analysis with the modifications to the model, the covariances were examined among the parameters. There were no substantial issues with the standardized residual covariances. Since further changes would not fit theoretically in the model, there were no subsequent changes made to the model.

Model fit with the re-specified model yielded a better fit. Though chi-square was significant, χ^2 (1406, N = 197) = 2303.58, p < .001, the fit indices either met or were close to meeting the cutoff criteria, which is shown in Table 9. Overall, the re-specified model is a better fitting model. The ratio of the chi-square and the degrees of freedom is 1.64, which supports that this model has an acceptable fit (Carmines & McIver, 1981). The null model yielded a significant chi-square test as well, χ^2 (1406, N = 197) = 6309.71, p < .001. It is important to add that the null model has a chi-square/df ratio of 4.25, which suggests the null model is an adequate model. Consequently, the goodness of fit indices (CFI, GFI, and TLI) will not be high since there is less room for improvement in the model. Researchers cautioned interpreting the goodness of fit indices if the null model revealed adequate results and stated that the relative fit indices would not be as informative (Kenny, Kaniskan, & McCoach, 2015). Overall, the RMSEA, SRMR, and χ^2 to *df* ratio show support for the model.

Table 8

Measurement Model 3 Indices

Model Fit Index	**Fit Criteria**	**Model Result**
Comparative Fit Index (CFI)	> .90	.814
Goodness-of-Fit Index (GFI)	> .90	.715
Tucker Lewis Index (TLI)	> .90	.804
Root Mean Square Error of Approximation (RMSEA)	< .06	.057
Standardized Root Mean Square Residual (SRMR)	< .08	.075

The χ^2 difference test was conducted and yielded the following results: χ^2 difference (68) = 427.95, $p < .001$. The standardized regression weights, shown in Table 10, show support for the five factors (Mathematics Self-efficacy, Mathematics Anxiety, Mathematics Avoidance, Self-regulation in Mathematics, and Attitude toward Mathematics). In summary, the RMSEA, SRMR, and χ^2 to *df* ratio provide evidence that the measurement model is sufficient. Figure 14 reveals the final measurement model.

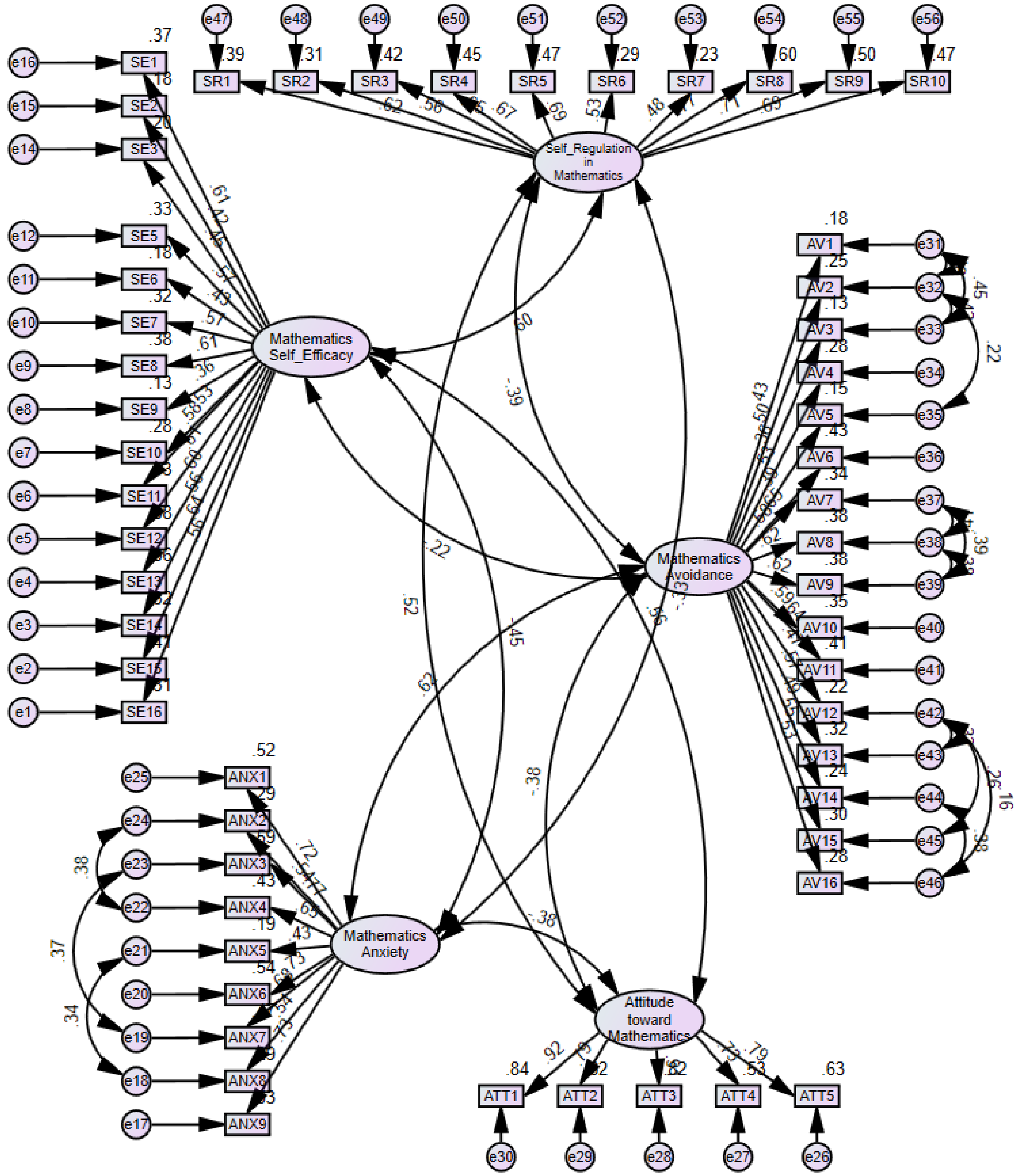

Figure 14. Final Measurement Model

Table 9

Standardized Regression Weights

Item	Mathematics Self-Efficacy	Self-Regulation in Mathematics	Mathematics Avoidance	Mathematics Anxiety	Attitude toward Mathematics
SE1	0.61				
SE2	0.42				
SE3	0.45				
SE5	0.57				
SE6	0.43				
SE7	0.57				
SE8	0.62				
SE9	0.36				
SE10	0.53				
SE11	0.58				
SE12	0.61				
SE13	0.60				
SE14	0.56				
SE15	0.64				
SE16	0.56				
SR1		0.62			
SR2		0.56			
SR3		0.65			
SR4		0.67			
SR5		0.69			
SR6		0.53			
SR7		0.48			
SR8		0.77			
SR9		0.71			
SR10		0.69			
AV1			0.43		
AV2			0.50		
AV3			0.36		
AV4			0.53		
AV5			0.39		
AV6			0.65		
AV7			0.58		
AV8			0.62		
AV9			0.62		
AV10			0.59		
AV11			0.64		
AV12			0.47		

AV13	0.57		
AV14	0.49		
AV15	0.55		
AV16	0.53		
ANX1		0.72	
ANX2		0.54	
ANX3		0.77	
ANX4		0.65	
ANX5		0.43	
ANX6		0.74	
ANX7		0.68	
ANX8		0.54	
ANX9		0.73	
ATT1			0.92
ATT2			0.79
ATT3			0.91
ATT4			0.73
ATT5			0.79

Composite Reliability

Kline (2016) specified that composite reliability (CR) was a dependable coefficient to use for estimating the reliability of factors in CFA. The CR is the comparison of the explained variance with the total variance. Table 11 shows all CR values for each factor, ranging from 0.84 (Mathematics self-efficacy) to 0.92 (Attitude toward mathematics). Since the values meet the criteria (CR > 0.7), the findings support the reliability of the factor measurements.

Table 10

Reliability Findings

	CR	AVE	MSV
Mathematics Avoidance	0.86	0.29	0.39
Mathematics Self-Efficacy	0.84	0.29	0.37
Mathematics Anxiety	0.87	0.43	0.39
Attitude toward Mathematics	0.92	0.69	0.27
Self-Regulation in Mathematics	0.87	0.41	0.37

In addition, construct validity was examined through convergent and discriminant validity. Average variance extracted (AVE) was found to determine convergent validity. AVE is explained as the mean of the squared standardized pattern coefficients for indicators on a factor (Kline, 2016). To establish convergent validity, Hair, Black, Babin, and Anderson (2010) cited an AVE > 0.5 as a threshold. Only one out of the five factors showed an AVE greater than 0.5, attitude toward mathematics (Refer to Table 14). Essentially, more than half of the observed variance in the associated items was accounted for by the factor, attitude toward mathematics. However, less than half of the observed variance in the associated items was explained by the other four factors (mathematics avoidance, mathematics self-efficacy, mathematics anxiety, and self-regulation in mathematics). Though the AVE is not an acceptable value for most of the factors, Malhotra and Dash (2011) claimed that the CR results can provide enough support for the constructs. Regarding factor loadings, 66% of the factor loadings are above 0.55. A factor loading of 0.55 is considered good according to Tabachnick and Fidell (2013).

To investigate the discriminant validity in the model, Hair et al. (2010) stated the Maximum Shared Variance (MSV) needs to be less than the AVE to establish disciminant validity. Shown in Table 17, two out of the five factors did not meet this criteria. In other words, these findings suggest that mathematics avoidance and mathematics self-efficacy may not be sufficiently distinct scales. However, it is important to note that the correlation coefficients between factors ranged from .22 to .62. Discriminant validty can be established if the estimated correlations between the factors do not exceed .85 (Brown, 2015).

1. To What Extent Does the Theoretical Framework Suggested in the Hypothesized Structural Model Describe the Data?

For the primary investigation, one of the goals was to determine whether the theoretical framework in the hypothesized structural model described the data. Furthermore, an analysis of the direct and indirect effect of mathematics self-efficacy on mathematics growth was conducted.

SPSS AMOS 26 was the program used to perform structural equation modeling analyses using survey and MAP data from 197 students. Maximum likelihood was the estimation method used to determine the parameters in the model.

Model fit. The hypothesized structural model was tested, and support was not found, χ^2 (1461, N = 197) = 2420.80, $p < .001$, and the results of the null model were the following: χ^2 (1540, N = 197) = 6366.45, $p < .001$. One of five model fit indices were met, the root mean square error of approximation (RMSEA = .058).

Table 11

Initial Hypothesized Structural Model Indices

Model Fit Index	**Fit Criteria**	**Model Result**
Comparative Fit Index (CFI)	> .90	.801
Goodness-of-Fit Index (GFI)	> .90	.708
Tucker Lewis Index (TLI)	> .90	.790
Root Mean Square Error of Approximation (RMSEA)	< .06	.058
Standardized Root Mean Square Residual (SRMR)	< .08	.093

Post hoc model modifications were employed to develop a better fitting model. Modification indices showed a pathway between mathematics self-efficacy and attitude toward mathematics would improve the model. However, the pathway was only added because it was aligned with Bandura's (1977a, 1986, 1989) theory on self-efficacy. Bandura explained the impact of an individual's self-efficacy on their emotional response, so it makes theoretical sense that a person's level of self-efficacy in mathematics will ultimately affect their attitude toward the subject. A pathway between mathematics self-efficacy and attitude toward mathematics was added, and the structural equation modeling analysis was re-run. The results again revealed a significant chi-square value, which is not a desired result, χ^2 (1460, N = 197) = 2383.65, p < .001, and the null model showed the following results, χ^2 (1540, N = 197) = 6366.45, p < .001. Though there was some improvement in the model, as shown in the indices in Table 13, there was only one index that provided support for the model, RMSEA = .057.

Table 12

2^{nd} Structural Model Indices

Model Fit Index	**Fit Criteria**	**Model Result**
Comparative Fit Index (CFI)	> .90	.809
Goodness-of-Fit Index (GFI)	> .90	.712
Tucker Lewis Index (TLI)	> .90	.798
Root Mean Square Error of Approximation (RMSEA)	< .06	.057
Standardized Root Mean Square Residual (SRMR)	< .08	.081

Continued post hoc model modifications were conducted. Modification indices also revealed that a path between mathematics avoidance and self-regulation in mathematics would result in an improved model. Before making this change, theoretical and practical alignment was considered. As students display more avoidance behaviors in mathematics, they will exhibit less self-regulatory behaviors in mathematics.

The path was added between mathematics avoidance and self-regulation in mathematics, and the analysis was run once more. Findings showed a significant chi-square, χ^2 (1459, N = 197) = 2371.01, p < .001. The third model indicated a better fitting model, with two indices being met, RMSEA = .056 and SRMR = .078. The null model had an RMSEA of .126. See Table 14 for the fit indices of the third structural model.

Like the measurement model, the relative fit indices were not met. However, the ratio of the chi-square and degrees of freedom was 1.63. Carmines and McIver (1981) found that a chi-square and degrees of freedom ratio that is less than 3, is an adequate value. The null model had the following results: χ^2 (1540, N = 197) = 6366.45, p < .001. Further, it is important to note that the null model revealed a chi-square and degrees of freedom ratio of 4.13. Since the null model was an adequate model, the relative fit indices were subsequently lower and the relative fit indices were not as informative. There were three pieces of evidence to support the third model: RMSEA, SRMR, and the chi-square and degrees of freedom ratio. Therefore, there was an acceptable fit in the final structural model.

Table 13

3rd Structural Model Indices

Model Fit Index	**Fit Criteria**	**Model Result**
Comparative Fit Index (CFI)	> .90	.811
Goodness-of-Fit Index (GFI)	> .90	.714
Tucker Lewis Index (TLI)	> .90	.801
Root Mean Square Error of Approximation (RMSEA)	< .06	.056
Standardized Root Mean Square Residual (SRMR)	< .08	.078

Though more changes were suggested by the modification indices, the pathway adjustments were not supported by theory. The third model will remain as the final model of the structural equation analysis. See Figure 15 below for the final hypothesized structural model. The red arrows indicate the pathways that were added.

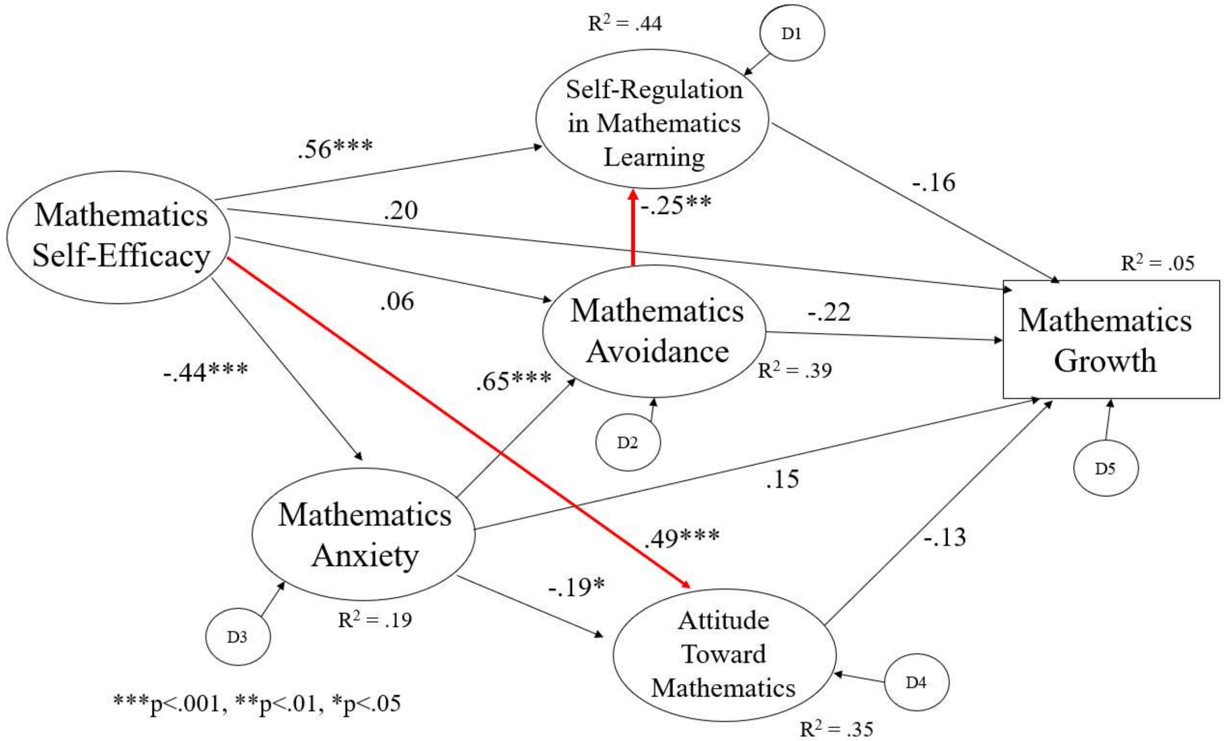

Figure 15. Final Structural Model

2. How Do Mathematics Self-Efficacy Levels Directly Affect Mathematics Growth?

It was hypothesized there would be a positive moderate effect of mathematics self-efficacy on mathematics growth. However, findings revealed that mathematics self-efficacy levels did not have a significant direct effect on mathematics growth ($\beta = 0.20$, $p = .11$, 95% CI [-0.06, 0.48]), contradicting the hypothesis. Furthermore, it was determined that 5% of the variation in mathematics growth can be explained by the predictor variables combined (mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics).

3. How do Mathematics Self-Efficacy Levels Indirectly Affect Mathematics Growth?

3a. What is the effect of mathematics self-efficacy on self-regulation? It was hypothesized that there would be a positive, moderate effect of mathematics self-efficacy on self-regulation. A positive, large effect was found of mathematics self-efficacy on self-regulation, $\beta = 0.56$, $p < .001$, 95% CI [0.39, 0.70]. It is clear mathematics self-efficacy influences self-regulatory behaviors in mathematics at the study's site. Additionally, it can be determined that 44% of the variance in self-regulation in mathematics can be explained by mathematics self-efficacy and mathematics avoidance. Overall, a student with a stronger mathematics self-efficacy will be more likely to put forth more effort in the area of mathematics.

3b. What is the effect of mathematics self-efficacy on mathematics avoidance? A moderate, negative effect was predicted of mathematics self-efficacy on mathematics avoidance. Findings from this study indicate there was not a significant, direct effect of mathematics self-efficacy on mathematics avoidance ($\beta = 0.06$, $p = .51$, 95% CI [-0.16, 0.25]). According to these results, students' mathematics self-efficacy levels do not affect the extent of their mathematics avoidance. Though there was not a significant direct effect, an R^2 value of .39 indicates that 39% of the variation in mathematics avoidance can be explained by mathematics self-efficacy and mathematics anxiety.

3c. How does self-regulation in mathematics learning affect mathematics growth? In the hypothesized structural model, a positive moderate effect was predicted of self-regulation on mathematics growth. This study found evidence that there was not a significant direct effect of self-regulatory behaviors on mathematics growth ($\beta = -0.16$, $p = .14$, 95% CI [-0.41, 0.08]). However, there was evidence in this study of an indirect effect of mathematics self-efficacy on mathematics growth with self-regulation as one of the mediating variables (β = -0.19, p = .039, 95% CI [-0.41, -0.01]). The indirect effect found in this model is considered a moderate effect on mathematics growth. If a student's mathematics self-efficacy is low, self-regulatory behaviors can have a mediating effect and can ultimately influence a student's mathematics growth.

3d. How does mathematics avoidance affect mathematics growth? A moderate negative effect was predicted in the hypothesized structural model, but the final model revealed an effect that was not significant (β = -0.22, p = .07, 95% CI [-0.51, -0.04]). At the study's site, there was not a significant effect of mathematics avoidance on mathematics growth. If students choose to avoid mathematics, this choice is not directly affecting their mathematics growth. Although, mathematics avoidance did act as one of the mediating variables between mathematics self-efficacy and mathematics growth, being that there was a significant indirect effect (β = -0.19, p = .039, 95% CI [-0.41, -0.01]). Ultimately, a student's mathematics growth could be influenced by his/her level of mathematics avoidance.

3e. What is the effect of mathematics self-efficacy on mathematics anxiety? The hypothesis was supported in that there was a large, negative effect of mathematics self-efficacy on mathematics anxiety (β = -0.44, $p < .001$, 95% CI [-0.60, -0.26]). This finding suggests that if students' self-efficacy levels in mathematics are high, their mathematics anxiety levels are low. On the other hand, if a student's mathematics self-efficacy is low, he/she may experience higher levels of mathematics anxiety. In addition, findings showed 19% of the variation in mathematics anxiety was explained by mathematics self-efficacy.

3f. How do mathematics anxiety levels affect mathematics growth? In the hypothesis, a positive, moderate effect was anticipated. Contradictory to the hypothesis, this study found evidence that there was not a significant direct effect of mathematics anxiety on mathematics growth ($\beta = 0.15$, $p = .21$, 95% CI [-0.07, 0.43]). However, there was evidence in this study of an indirect effect of mathematics self-efficacy on mathematics growth with mathematics anxiety as one of the mediating variables ($\beta = -0.19$, $p = .039$, 95% CI [-0.41, -0.01]). Though there was not a direct effect of mathematics anxiety on mathematics growth, mathematics anxiety can still influence a student's growth. For example, students with low mathematics self-efficacy may still exhibit mathematics growth if they have a low anxiety.

3g. What is the effect of mathematics anxiety levels on attitude toward mathematics? A moderate, negative effect was hypothesized based on previous research. A significant, moderate negative effect was found in the final structural model, $\beta = -0.19$, $p = .039$, 95% CI [-0.39, -0.02]. Mathematics anxiety levels had a negative, moderate effect on attitude toward mathematics among students in grades four and five. Mathematics anxiety and mathematics self-efficacy also explained 35% of the variation in attitude toward mathematics. It can be determined that a student with a higher mathematics anxiety may display a more negative attitude toward mathematics.

3h. What is the effect of mathematics anxiety levels on mathematics avoidance? A positive, moderate effect had been predicted. A large effect was revealed of mathematics anxiety levels on mathematics avoidance ($\beta = 0.65$, $p < .001$, 95% CI [0.43, 0.83]). Individuals with higher levels of mathematics anxiety were more likely to report being disengaged in mathematics.

3i. How does attitude toward mathematics affect mathematics growth? A positive, moderate effect was predicted of attitude toward mathematics on mathematics growth. Results of the final structural model does not show a significant direct effect between attitude and growth (β = -0.13, p = .16, 95% CI [-0.33, 0.06]). There may not be a significant direct effect of attitude on mathematics growth, but an indirect effect of mathematics self-efficacy on mathematics growth was found with attitude toward mathematics as one of the mediating variables (β = -0.19, p = .039, 95% CI [-0.41, -0.01]). This finding suggests that even if a student has a low self-efficacy, his/her attitude toward mathematics can mediate the self-efficacy level and still influence mathematics growth.

Additional pathways. Theory and statistical evidence supported the addition of two pathways to the original model. A pathway was added to show an effect of mathematics self-efficacy on attitude toward mathematics. This modification was supported by Bandura's (1986) description of the theory of self-efficacy and its impact on a person's emotional response. Results in the final model demonstrated there was a positive, large effect of mathematics self-efficacy on attitude toward mathematics, β = 0.49, $p < .001$, 95% CI [0.29, 0.64].

The second pathway added shows an effect of mathematics avoidance on self-regulation in mathematics. This addition had practical sense in the pathways of the model. As a student displays more mathematics avoidance behaviors, his/her self-regulatory behaviors will decrease. This pathway was supported in the model. There was a moderate, negative effect of mathematics avoidance on self-regulation in mathematics displayed in the final model, β = -0.25, $p < .01$, 95% CI [-0.44, -0.08]. See Table 15 for the direct and indirect effects on mathematics growth.

Table 14

Direct and Indirect Effects on Mathematics Growth by Research Question from Structural Model

	Direct effects	*p*	Indirect effects	*p*
	β		β	
RQ2: Direct effects of mathematics self-efficacy on mathematics growth				
2a. Mathematics Self-Efficacy →Mathematics Growth	0.20	.11		
RQ3: Indirect effects of mathematics self-efficacy on mathematics growth			-0.19	*
3a. Mathematics Self-Efficacy → Self-Regulation in Mathematics	0.56	***		
3b. Mathematics Self-Efficacy → Mathematics Avoidance	0.06	.51		
3c. Self-Regulation in Mathematics → Mathematics Growth	-0.16	.14		
3d. Mathematics Avoidance → Mathematics Growth	-0.22	.07		
3e. Mathematics Self-Efficacy → Mathematics Anxiety	-0.44	***		
3f. Mathematics Anxiety → Mathematics Growth	0.15	.21		
3g. Mathematics Anxiety → Attitude toward Mathematics	-0.19	*		
3h. Mathematics Anxiety → Mathematics Avoidance	0.65	***		
3i. Attitude toward Mathematics → Mathematics Growth	-0.13	.16		
Additional Pathways:				
Mathematics Self-Efficacy → Attitude toward Mathematics	0.49	***		
Mathematics Avoidance → Self-Regulation in Mathematics Learning	-0.19	**		

Note: *N* = 197
***$p < .001$, **$p<.01$, *$p<.05$

CHAPTER 5: DISCUSSION

With the United States behind other countries in mathematics achievement on national assessments (Kastberg et al., 2016; Stephens et al., 2016), it is critical for researchers to consider why the country is falling short. There are several needs in mathematics education that should be addressed, such as the gender gap (Liu et al., 2008) as well as mathematics self-efficacy (Bandura 1993, Carpenter & Clayton, 2014). This investigation explored what variables in a mathematics classroom may differ between genders including: (a) mathematics self-efficacy, (b) mathematics self-regulation, (c) mathematics avoidance, (d) mathematics anxiety, (e) attitude toward mathematic, and (f) mathematics growth. In addition, the direct and indirect effects of mathematics self-efficacy on mathematics growth were examined. An explanation of whether Bandura's (1977a, 1986, 1989) theory of self-efficacy describes the data will be included. Throughout this chapter, a discussion of the findings regarding each research question will be provided. Next, an explanation of the limitations will be given. Implications for theory and practice will be presented as well. Lastly, conclusions will be drawn regarding the study.

Part 1

1a. Do mathematics self-efficacy levels differ between genders among students in grades four and five? Previous research suggested there are significant differences in mathematics self-efficacy, and that males display a higher mathematics self-efficacy (Cheema & Kitsantas, 2014; Hoffman & Dull, 2010; Jacobs et al., 2002; Schleifer & McMillan, 2015). Results from this study contradicted prior research. This investigation did not find support for the notion that gender differences exist in the area of mathematics self-efficacy in the school in which the investigation occurred. It can be concluded that the school's environment is not causing males and females to adopt different self-efficacy levels in mathematics. A possible explanation is that teachers and other adults in this intermediate school are not displaying a gender bias in mathematics and not presenting it as a male domain, which has been suggested as being one of the causes of the gender gap (Gunderson et al., 2012; Schwarz & Sinicrope, 2013). To examine this notion further, more data could be collected regarding the teachers' perspective on how males and females perform in mathematics. This data would provide the investigator with more insight as to whether a gender bias exists in the school.

1b. Does self-regulation in mathematics learning differ between genders among students in grades four and five? In the current investigation, females reported more self-regulatory behaviors in mathematics than males. Previous research has also found this outcome to be true (Bandura et al., 2003; Zimmerman & Martinez-Pons, 1990). However, there is research that would refute this study's findings and show evidence that there is no difference in self-regulatory behaviors between males and females (Blair et al., 2015; Pajares & Graham, 1999; William et al., 2016; Wolter & Pintrich, 1998; Zimmerman & Kitsantas, 2014). Based on this study's result, males reported less self-regulatory behaviors than females in a mathematics classroom, in this local setting. It is important to establish why females exhibit more self-regulatory behaviors in mathematics through continued research in this context. Qualitative data could perhaps be collected on why females are working harder in this area than males. Females may be more motivated to work harder because of grades (Chumbley, Haynes, & Stofer, 2015) or their motivation may be derived from parental involvement (Benner, Boyle, & Sadler, 2016). Teacher and peer influence have been described as a motivator for students to perform higher as well (Wormeli, 2014).

1c. Do mathematics avoidance levels differ between genders among students in grades four and five? The outcome of this research provided evidence that gender differences in avoidance behaviors, specifically self-handicapping strategies, did exist in grades four and five. In other words, males in this local context are purposefully not trying as well as procrastinating in mathematics. Previous research has been mixed in the area of mathematics avoidance. Some researchers have found males to show more avoidance behaviors (Butler, 1998; Midgley & Urdan, 1995; Ryan et al., 1997; Urdan et al., 1998), while some have found females to display more avoidance (Ames & Lau, 1982; Liew et al., 2014), and others claimed there are no gender differences in mathematics avoidance (Newman, 1990). Since results have been mixed, more research in this area is warranted. Male students at this intermediate school are choosing not to try as hard in the area of mathematics. Determining why males are neglecting mathematics will be an important matter to research going forward at this site.

1d. Do mathematics anxiety levels differ between genders among students in grades four and five? Though most research shows that females have higher levels of mathematics anxiety (Cheema & Galluzzo, 2013; Hembree, 1990; Malpass et al., 1999; Meece et al., 1990; Pintrich & De Groot, 1990), other researchers have found there are no significant differences in mathematics anxiety between genders (Anis, Krause, & Blum, 2016; Ma, 1999; Wolters & Pintrich, 1998). In the local context of this study, gender differences did not exist in mathematics anxiety among fourth and fifth grade students.

Though gender differences in mathematics anxiety did not exist in the intermediate grade levels, evidence has shown a gender gap could form later in schooling (Hembree, 1990).

1e. Does attitude toward mathematics differ between genders among students in grades four and five? Previous research supports the findings from this study that there are no gender differences with regard to attitude toward mathematics (Ma & Kishor, 1997; Ma & Xu, 2004; Tapia & Marsh, 2003). However, some researchers did find gender differences in attitude toward mathematics and found that females display a more negative attitude toward mathematics (Ai, 2002; Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Odell & Schumacher, 1999; Tocci & Engelhard, 1991). In this study, attitude toward mathematics did not differ between genders. Females did not show more negative attitudes toward mathematics in grades four and five in this rural school setting. Researchers have found that a positive classroom environment (Vandecandelaere, Speybroeck, Vanlaar, De Fraine, & Van Damme, 2012) or a teacher's affective support (Sakiz, Pape, & Hoy, 2012) positively relate to student attitudes. The classroom environment and the teacher may possibly play a role in student attitudes at the study's site.

2. Does mathematics growth differ between genders among students in grades four and five? Though there is ample research in the gender gap and mathematics achievement, there have been few studies focused on a possible gender gap in mathematics growth. In a study involving young elementary students, Blair et al. (2015) concluded that boys grow at a more rapid rate than girls. However, in the current study that involved students at the intermediate grade levels, there were no differences between genders in the amount of mathematics growth at the intermediate setting. The findings from this study add to the literature gap in gender differences and mathematics growth at the intermediate level. One possible explanation for this result could be the school environment. Since stereotyping has been a contributing factor to the gender gap (Hand et al., 2017; Moss-Racusin et al., 2018; Wang & Degol, 2017), then perhaps this intermediate school does not exhibit stereotyping. Knowing that there is no gender gap with regard to mathematics growth in grades four and five is a positive discovery for this intermediate school.

Part 2

To what extent do the instruments used to measure mathematics self-efficacy, mathematics anxiety, self-regulation in mathematics learning, mathematics avoidance, and attitude toward mathematics align with the factor structures revealed from previous studies? Reliability evidence provided in the results showed support for the instruments being utilized in this investigation. Like the previous studies (Hopko et al., 2003; Lim & Chapman, 2012; McCoach & Del Siegle, 2003; Toland & Usher, 2016; Turner et al., 2002), evidence was found that supports the instruments to be reliable. The standardized regression coefficients also supported a five-factor structure (mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics) for the instrument being used in this study. An analysis of model fit was performed. With the addition of 14 error covariances and the deletion of the fourth self-efficacy item, the final model was determined. The null model showed an adequate result, so comparative fit indices were not as informative. However, the RMSEA, SRMR, and χ^2 to *df* ratio provide evidence that the model is adequate. In conclusion, the measurement model deemed sufficient for further use in the structural model.

Theoretical Framework and the Hypothesized Structural Model

1. To what extent does the theoretical framework suggested in Figure 2 describe the data? In part two of this investigation, the purpose was to determine whether the theoretical framework of this model describes the data. Overall, the theoretical framework of the hypothesized model does describe a small portion of the data. Bandura's theory of self-efficacy indicates that a person's self-efficacy in an area influences his/her level of effort on tasks in that area, and can lead to avoidance, as well as adverse emotional responses toward the tasks (Bandura, 1977a). Ultimately, performance on tasks will be affected indirectly by an individual's self-efficacy level (Bandura, 1986).

The model in this study illustrates how mathematics self-efficacy directly and indirectly affects mathematics growth. It was hypothesized that mathematics self-efficacy will influence a student's level of self-regulation, mathematics avoidance, mathematics anxiety, and attitude toward mathematics. There were significant effects, ranging from small to large, between mathematics self-efficacy and self-regulation in mathematics, mathematics self-efficacy and mathematics anxiety, as well as mathematics self-efficacy and attitude toward mathematics. Importantly, there was evidence of a significant indirect effect of mathematics self-efficacy on mathematics growth. Essentially, there were mediation effects between mathematics self-efficacy and mathematics growth through self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics. In addition, 5% of the variation in mathematics growth could be explained by the predictor variables, which shows that the variables do have some effect on mathematics growth.

Bandura (1989) had also stated that self-efficacy interferes with a person's intellectual functioning and can impact performance directly. The model did not show evidence of a direct effect between mathematics self-efficacy and mathematics growth, so this aspect of the theory was not supportive in the model.

The next section will focus on the research questions concerning the pathways from the hypothesized structural model.

2. How do mathematics self-efficacy levels directly affect mathematics growth? Results revealed that mathematics self-efficacy levels did not have a significant direct effect on mathematics growth, which contributes to the literature gap in examining the effect of mathematics self-efficacy on growth rather than achievement. Prior research has shown evidence of a link between mathematics self-efficacy and mathematics performance (Carpenter & Clayton, 2014; Mercer et al., 2011; Pajares & Graham, 1999; Pajares & Miller, 1994; Stajkovic et al., 2018). On the other hand, results from this study indicated that mathematics self-efficacy does not have a direct effect on mathematics growth. This study specifically focused on the amount of objective progress a student made, rather than a static test score or grade. This finding also demonstrated the need for more research in this area. Determining whether this outcome would be replicated at other locations is important to uncover. More research would be needed to generalize this result to the population. More research in various contexts is necessary (Pajares & Graham, 1999). Katz (2015) recommended more qualitative research in mathematics self-efficacy as well.

3a. What is the effect of mathematics self-efficacy on self-regulation? There was a positive, large effect of mathematics self-efficacy on self-regulation, which is supported by previous research (Cleary & Kitzantas, 2017; Malpass et al., 1999; Wolters & Pintrich, 1998; Zimmerman, Bandura, & Martinez-Pons, 1992). Therefore, examining ways to improve a students' mathematics self-efficacy will ultimately have an effect on the student's self-regulatory behaviors. For example, if teachers provide students with immediate, specific feedback (Ozdemir & Pape, 2013) in the mathematics classroom, it could lead to an increase in a student's self-efficacy. Consequently, the student's amount of effort in mathematics could possibly increase.

3b. What is the effect of mathematics self-efficacy on mathematics avoidance? Bandura's theory of self-efficacy (Bandura, 1977a) suggests there would be a negative effect of mathematics self-efficacy on mathematics avoidance. Findings from this study indicated there was not a significant, direct effect of mathematics self-efficacy on mathematics avoidance. These results also conflict with some prior research (Jagacinski & Nicholl, 1990; Ryan et al., 1998; Urdan et al., 1998). Since research in mathematics avoidance was more limited, this study provided more information for this field. Based on this study's results, mathematics self-efficacy may not play as big of a role in mathematics avoidance as past research suggests. Mathematics anxiety may have a larger impact on mathematics avoidance (Hembree, 1990).

3c. How does self-regulation in mathematics learning affect mathematics growth? Though most research supports a positive, moderate effect between self-regulation and mathematics performance (Cleary & Chen, 2009; DiGiacomo & Chen, 2016; Hinnant-Crawford et al., 2016; McCoach et al., 2016; Pintrich & De Groot, 1990), evidence from this study showed there was not a significant direct effect of self-regulatory behaviors on mathematics growth. This finding suggests there could be other stronger factors contributing to a student's mathematics growth. For example, the classroom environment (Fraser & Kahle, 2007; Malik & Rizvi, 2018) or parental involvement (Benner et al., 2015) have been shown to be factors affecting student achievement. In addition, indirect pathways on mathematics growth may be more prevalent at this intermediate school.

3d. How does mathematics avoidance affect mathematics growth? The final model showed there was no significant effect of mathematics avoidance on mathematics growth, which differs from previous research (Ryan & Hicks, 1997; Urdan et al. 1998). Mathematics avoidance did not influence the students' mathematics growth at the study's location. It is important to note that there was not as much research available in mathematics avoidance. However, further research is warranted in mathematics avoidance and mathematics growth at other locations. Continued research should also include the following aspects of mathematics avoidance: (a) the use of self-handicapping strategies, (b) the avoidance of help seeking, and (c) the avoidance of novelty and challenge. Specifically, examining these areas of avoidance strategies and achievement has been recommended in previous research (Turner et al., 2002). These avoidance strategies may be impeding students from learning, so determining which aspect of avoidance is prevalent in mathematics classrooms will be critical in helping students to grow.

3e. What is the effect of mathematics self-efficacy on mathematics anxiety? There was a large, negative effect of mathematics self-efficacy on mathematics anxiety, which is aligned to prior research. There has been research gathered at the middle school level that supports the findings from this study (Griggs et al., 2013; Meece et al., 1990). Again, the construct of mathematics self-efficacy has shown to affect another factor in the mathematics classroom. By improving a student's mathematics self-efficacy, his/her mathematics anxiety could be alleviated. Moving forward at this intermediate school, more interventions should be implemented to improve a student's self-efficacy.

3f. How do mathematics anxiety levels directly affect mathematics growth? Previous research demonstrated a moderate, negative effect of mathematics anxiety on mathematics performance (Cheema & Sheridan, 2015; Hopko et al., 2003; Skaalvik, 2018; Suinn & Edwards, 1982). However, this study did not show a significant effect of mathematics anxiety on mathematics growth. These findings differed from the hypothesis and previous studies. A student's mathematics anxiety level may not be the primary issue affecting mathematics growth at the research site. For example, it is possible that students' mathematics anxiety may have also been mediated by teacher affective support (Sakiz, Pape, & Hoy, 2012) or a positive classroom environment (Hughes & Coplan, 2018).

3g. What is the effect of mathematics anxiety levels on attitude toward mathematics? A moderate, negative effect of mathematics anxiety levels on attitude toward mathematics was hypothesized based on previous research (Bessant, 1995; Geist, 2015; Gierl & Bisanz, 1995; Young et al., 2012). A significant, moderate negative effect was found in the final structural model, showing that mathematics anxiety levels can have a slight effect on attitude toward mathematics among students in grade four and five. Since there was a minor effect of mathematics anxiety on attitude toward mathematics, implementing interventions targeted at mathematics anxiety could be beneficial at this intermediate school. In addition, Ramirez, Shaw, and Maloney (2018) found that negative math-related experiences in the elementary grades was a potential cause of math anxiety for students. Particularly, when elementary teachers exhibited math anxiety, it affected the students' feelings about mathematics. Unfortunately, elementary teachers have reported high levels of mathematics anxiety (Hembree, 1990). Professional development focused on math instruction with manipulative has shown to decrease mathematics anxiety among teachers (Barrett, 2013). Targeted professional development for elementary teachers at the study's site may be beneficial.

3h. What is the effect of mathematics anxiety levels on mathematics avoidance? A large effect was revealed of mathematics anxiety levels on mathematics avoidance, which was in accord with the hypothesis and previous research (Grills-Taquechel et al., 2013; Hembree, 1990; Maloney et al., 2013; Pizzie & Kraemer, 2017). This finding indicates a possible need for interventions in mathematics anxiety, as this study has now found mathematics anxiety not only affecting a student's attitude toward mathematics, but his/her avoidance levels as well. Ramirez et al. (2018) recommended interventions that foster growth mindsets to help decrease mathematics anxiety. Being sure to communicate that failing is not a negative thing is important in this process. Showing students examples of famous individuals that have struggled and failed many times was described as one way to demonstrate that understanding (Ramirez, Shaw, & Maloney, 2018).

3i. How does attitude toward mathematics affect mathematics growth? There was not a significant, direct effect of attitude toward mathematics on mathematics growth in the final model. This outcome deviates from past research, which indicates there is a positive, moderate effect of attitude on mathematics performance (Chen et al., 2018; Choi & Chang, 2011). This study's findings suggest attitude toward mathematics does not impact fourth and fifth graders' mathematics growth at the study's site. Perhaps other factors play a more prominent role in affecting mathematics growth such as student engagement (Park, 2005), classroom climate or the teacher (Rockoff, 2004; Rucinski, Brown, & Downer, 2018).

Limitations of Findings

This research fills the literature gap in the area of mathematics growth. However, there are limitations to be considered in this research study. One constraint to this study involves the location. Data were gathered at one rural school district in Ohio, rather than multiple diverse sites. Therefore, the conclusions from this study may not be generalizable to the population. However, the decision to gather data at one location was intentional so the results could be utilized to benefit the intermediate school involved in the study. Furthermore, convenience sampling was used, the data were not from a random sample. Non-random data yields findings that may be biased: Replication of this study at other locations would be recommended (Jaciw, 2011; Napier & Grant, 1984). Laosa (1988) suggested that population generalizability is an ethical issue and would caution generalizing data if it is only representative of one population. It is important to conduct the study using multisite trials. Rather, the findings will be applied to the local context and used to improve the learning environment of the intermediate school that participated in the study.

In addition, not all the observed fit indices were met in the SEM. The results indicated the badness of fit indices (RMSEA, SRMR) were met. Though the goodness of fit statistics did not meet the desired criteria, Kenny, Kaniskan, and McCoach (2015) suggested that researchers should use caution when analyzing the goodness of fit indices when the null model shows adequate results. Essentially, if the null model is adequate, the goodness of fit indices will be subsequently lower. The investigator also recognizes there are confounding variables, such as the classroom environment or the teacher, that could influence mathematics growth as well. Other contextual factors were also not accounted for, such as socioeconomic status. For the purposes of this study, however, the researcher was testing a theory and focused on a limited number of variables as a result.

Though there were limitations in the reported study, results were still advantageous to the site and comparable sites. The research provided valuable information for locations similar to the small rural school district. There will be several opportunities for future research. For example, incorporating a mixed methods design would be beneficial in analyzing mathematics self-efficacy and its effects on students. In another follow-up study, investigators could include additional covariates such as parental support and classroom climate. In conclusion, this study had practical applications for the site and the research contributed to literature gaps.

Implications for Theory

Bandura's (1977a, 1986, 1989) theory of self-efficacy explained some of the data from the structural model. Specifically, the idea that mathematics self-efficacy can influence an individual's effort, behavior, and emotional response in mathematics was supported. It was evident in the results that mathematics self-efficacy impacted a person's self-regulatory behaviors and their emotional responses including anxiety and attitude. Results from this study indicated that as students' mathematics self-efficacy increases, their ability to regulate their behavior in mathematics increases. A stronger self-efficacy in mathematics will also result in a lower anxiety and a better attitude toward mathematics, which is described in Bandura's (1986, 1989) description of the theory of self-efficacy.

Some parts of the model that were not supported by the theory include the direct effect of mathematics self-efficacy on mathematics growth. Bandura (1989, 1996) had also explained self-efficacy as having a direct effect on a person's cognitive processes. This aspect of the theory failed to explain most of the data. Furthermore, a significant effect was not found of mathematics self-efficacy on mathematics avoidance. Bandura (1986) and Schunk (1996) claimed that an individual's self-efficacy can lead to a person avoiding a specific task. Bandura's self-efficacy theory did not describe this portion of the structural model.

Another aspect of Bandura's (1989) theory of self-efficacy did not explain the relationship between mathematics self-efficacy and mathematics avoidance in the model. In Bandura's (1989) theory, the effect of self-efficacy on avoidance levels was described. However, since no significant effect was found between mathematics self-efficacy and mathematics avoidance in the model, this aspect of the theory may be challenged as well. Mathematics self-efficacy may not directly lead to mathematics avoidance, but instead an indirect relationship may exist through mathematics anxiety, which is supported by the structural model.

Though Bandura's (1986, 1989) theory did not support the direct effect of mathematics self-efficacy on mathematics growth or mathematics avoidance in the model, an indirect effect was found from mathematics self-efficacy to mathematics growth with several mediating variables including: self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics. The role of self-efficacy on motivational and affective aspects was shown to be prevalent from the outcome in this study, which is applicable to the theory of self-efficacy (Bandura, 1989, 1993; Zimmerman et al., 1992). Specifically, an individual's self-efficacy affects a person's self-regulatory behaviors, anxiety levels, and attitude toward a subject. Bandura's theory is reflected in only some of the model through this indirect influence.

Mathematics growth was influenced by mathematics self-efficacy indirectly rather than directly through self-regulatory behaviors in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics. However, some of the fit statistics were poor and there was a small indirect effect. This finding indicates that other influences need to be considered in this model. For example, confounding variables such as the classroom environment or a teacher's support may have a greater effect on mathematics growth. Using two grade levels may have influenced the results as well. Since the direct effect of mathematics self-efficacy on mathematics growth was not supported by Bandura's (1996) theory and the indirect effect of mathematics self-efficacy on mathematics growth was small, then these findings suggest there is a more complex relationship between mathematics self-efficacy and mathematics growth.

In addition, it is important to note that 5% of the variance could be explained by the predictor variables. Though 5% seems insignificant, it still indicates that the variables in the model had some effect on mathematics growth. Therefore, Bandura's (1977a, 1986, 1989) theory of self-efficacy included predictor variables that do impact mathematics growth.

Though not every component of Bandura's self-efficacy theory explains the structural model in this study, some of the findings could be described by the theory. In particular, the influence self-efficacy has on a person's affective and motivational processes was displayed (Bandura, 1989). Therefore, it can be concluded from this study that the student's perception of his/her mathematics abilities may have an effect on his/her amount of self-regulatory behaviors and emotions in mathematics (Bandura, 1977a, 1986).

Implications for Practice

Implications for practice in the local context. This study found differences between genders in self-regulation in mathematics learning and mathematics avoidance. Specifically, males reported that they exhibit more avoidance behaviors and less self-regulatory behaviors. This unexpected finding is not supported by previous literature (Ames & Lau, 1982; Blair et al., 2015; Liew et al., 2014; Pajares & Graham, 1999; William et al., 2016; Wolter & Pintrich, 1998; Zimmerman & Kitsantas, 2014). However, there is some evidence showing males reported using self-handicapping strategies more than females (Midgley & Urdan, 1995; Urdan et al., 1998). Self-handicapping strategies are avoidance strategies that were shown to have differences between genders in this study. This finding implies that the fourth and fifth grade males in this local context are purposefully not trying as hard in mathematics and procrastinating.

Unfortunately, there is limited research in intervention research in the area of mathematics avoidance. However, Newman (1990) suggested some avoidance behaviors may stem from parents, teachers, or peers. Determining the source of the mathematics avoidance is important to eliminating this pattern. Developing a survey focused on the source of mathematics avoidance would be beneficial. In addition, Turner et al. (2001) found that teachers who provided ample instructional and motivational support led to a decrease in student's mathematics avoidance. Turner et al. (2001) mentioned that these teachers also stressed that it is okay to make mistakes, be unsure, and ask questions, as this is all a part of the learning process. These messages assisted in preventing students from displaying more avoidance strategies and an increase in motivation (Turner et al., 2001). Another study found that a supportive classroom environment resulted in students reporting less avoidance behaviors (Patrick et al., 2003). The supportive classroom environment involved teachers that were showing students support academically as well as emotionally, and consistently communicating that all students could learn (Patrick et al., 2003). With the findings from this study, fourth and fifth grade teachers at this intermediate school can develop a plan to address this matter. Essentially, developing a strong sense of classroom community and a positive social and emotional learning environment may be a solution.

Other results from this study indicated there are moderate to large effects of mathematics self-efficacy on self-regulation in mathematics learning, mathematics anxiety, and attitude toward mathematics. There are also indirect effects of mathematics self-efficacy on mathematics growth. Consequently, interventions in the area of mathematics self-efficacy would deem beneficial. Some interventions include goal setting, reflections, and targeted skill training in the areas of need (Katz, 2015; Maier & Curtin, 20015; Ramdass & Zimmerman, 2008; Schunk, 1981). Katz (2015) described the goal setting intervention: Students developed a daily goal during a consultation with the teacher. Once the goal was met, another goal was established. The goals must also be manageable for students. Researchers found that students have more success when they are the ones that track their own goals, so they can visually see their progress (Ozdemir & Pape, 2013; Wells, Sheehy, & Sheehy, 2017).

Another self-efficacy intervention that teachers could implement involves providing students with up to 20 open ended writing prompts to explain their thoughts and emotions on learning math (Katz, 2015). It was determined that self-awareness in mathematics was helpful in increasing their mathematics self-efficacy. Therefore, self-evaluations and self-reflections are critical (Ramdass & Zimmerman, 2008). Lastly, providing students with multiple experiences for success with a skill is key. The teacher should model mathematical thinking, utilize peer modeling, provide scaffolded support, followed by immediate specific feedback, which will all contribute to an increase of self-efficacy (Ozdemir & Pape, 2013). Teachers should also monitor student's self-efficacy to ensure the interventions are working (Ramdass & Zimmerman). Siegle and McCoach (2007) demonstrated the benefit to professional development in self-efficacy through teacher trainings in goal setting, teacher feedback, and modeling.

Other researchers recommended incorporating approaches to social and emotional learning such as: emphasizing the process of learning and effort rather than the product, support positive teacher and peer interactions, develop a sense of community in the classroom, and improve the overall classroom social environment (Griggs et al., 2013).

Implementing evidence-based programs to support students' social and emotional development was another suggestion (Becker, Darney, Domitrovich, Keperling, Ialongo, 2013). This includes the Promoting Alternative Thinking Strategies (PATHS) Curriculum (Kusche & Greenberg, 1995) as well the PAX Good Behavior Game (Embry, Staatemeier, Richardson, Lauger, & Mitich, 2003). Both programs promote self-regulation of behaviors and a positive classroom environment. Teachers are supported through a coaching system, in that they will receive ongoing support throughout the implementation process, rather than one session of professional development (Becker et al., 2013). In addition, implementing lessons focused on a growth mindset should be a priority at the study's site. Research has shown that mindset can impact a person's self-efficacy (Dweck, 1999).

Implications for future research. This research can be replicated at various other sites to determine whether the findings can be generalized to the population. Particularly, a larger urban school district would be a necessary district to include. Future studies could collect qualitative data in addition to quantitative. Longitudinal studies are also needed in this area. Research to examine self-efficacy on growth in other subject areas and grade level contexts would deem advantageous. For example, an investigation could be conducted to determine whether reading self-efficacy influences reading growth. MAP reading growth data could be utilized in this research. Looking at how much mathematics self-efficacy affects students in the upper grade levels would be important to examine as well.

In a replication of the current study, an SEM analysis could incorporate a gender analysis as well. The same structural model can be run with solely male data, followed by an analysis with female data. Research has shown that self-efficacy plays a major role in affecting the gender gap (Jacobs, 2005; Schwery, Hulac, & Schweinle, 2016). In one study, when mathematics self-efficacy and anxiety were used as controls, the gender gap in achievement was not detected (Cheema & Galluzzo, 2013). Therefore, determining whether mathematics self-efficacy affects female or male students' mathematics growth would be beneficial in determining whether to focus on mathematics self-efficacy in eliminating the gender gap. In addition, some of the relationships in the model have shown different results by gender in previous studies. For example, Geary et al. (2019) found that mathematical competence was related to more positive attitudes among females, but not in males among sixth grade students. Furthermore, boys and girls process mathematics differently (Geist & King, 2008), so analyzing the model by gender would be an important step in strengthening the research.

When performing an SEM analysis with the inclusion of a gender analysis, sample size needs to be addressed. Unfortunately, sample size was a restraint in the current study, which prevented this further gender analysis to be performed. A sample size of 200 females and 200 males would be needed to carry out the described study (MacCallum et al., 1999). The researcher may also want to focus exclusively on mathematics self-efficacy in a specific math standard, rather than the standards collectively. Using one grade level would be recommended if pursuing a specific math standard since some standards only apply to certain grade levels. Multiple grade levels were involved in the current study, which made the study unable to focus on a single math standard.

Knowing that a person's self-efficacy level indirectly influences their growth implies the need to focus on self-efficacy in the classroom. Since this study found direct effects of mathematics self-efficacy, future work should include intervention research on mathematics self-efficacy and its effect on self-regulation, mathematics anxiety, and attitude toward mathematics.

Continued research on the gender gap is necessary as well. Results from this study suggest that more research in the area of mathematics avoidance as well as self-regulation and gender is necessary. There were conflicting findings from previous research and the current study in mathematics avoidance and self-regulation. The investigator also noted the limited amount of research in mathematics avoidance in general. Conducting more studies in mathematics avoidance in the intermediate grade levels would add to the literature gap in this area. More studies in this field would shed more light on the gender differences debate in mathematics.

Conclusion

Central to this investigation was determining whether a student's mathematics self-efficacy influences his/her mathematics growth or other outcomes in the mathematics classroom. By better understanding the students' behaviors and emotions in the mathematics classroom, more targeted supports can be provided to help students demonstrate more mathematics growth.

In addition, since the gender gap is still a prevalent issue, another focus of this research study was to examine whether there are gender differences in certain areas of mathematics (mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, attitude toward mathematics, mathematics growth). Finally, it was essential to establish whether Bandura's (1977a, 1986, 1989) self-efficacy theory describes the data in the hypothesized structural model.

Findings from this investigation showed two areas in mathematics with differences between genders, self-regulation, and mathematics avoidance. Though the SEM analysis did not reveal a direct effect of mathematics self-efficacy on mathematics growth, an indirect effect was found with the following variables acting as mediators: mathematics self-efficacy, self-regulation in mathematics, mathematics avoidance, mathematics anxiety, and attitude toward mathematics. Overall, the theoretical framework explained a small portion of the data in the hypothesized structural model.

The findings highlight the importance of improving mathematics self-efficacy at the intermediate level, so further intervention studies will be advantageous to conduct. This research also uncovered gender differences in self-regulation and avoidance in mathematics, so these areas will become another focus at the study's site. Similar rural school districts can also utilize the findings from this research to work toward improving mathematics growth among students in grades four and five.

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Appendix A

Measures

Survey. Gender: ☐ **Male** ☐ **Female**

Mathematics Self-Efficacy Scale (Toland & Usher, 2016)

Please rate how much confidence you have that you can succeed at exercises related to the following math topics. Remember that you can choose any number from 1 (not confident at all) to 4 (completely confident), or if you don't know what a specific math topic is, you can mark the box that says, "I don't know what this is".

How confident are you that you can successfully solve math exercises involving….	**Not confident at all**		**Completely confident**		**I don't know what this is**
1. Multiplication and division	1	2	3	4	☐
2. Decimals	1	2	3	4	☐
3. Fractions	1	2	3	4	☐
4. Ratios and Proportions	1	2	3	4	☐
5. Percents	1	2	3	4	☐
6. Powers and Exponents	1	2	3	4	☐
7. Factors and multiples	1	2	3	4	☐
8. Inequalities ($>, <, \geq, \leq, \neq$)	1	2	3	4	☐
9. Order of Operations	1	2	3	4	☐

10. Rounding and estimating	1	2	3	4	☐
11. Word problems	1	2	3	4	☐
12. Equations with one variable	1	2	3	4	☐
13. Equations with two or more variables	1	2	3	4	☐
14. Graphing	1	2	3	4	☐
15. Tables, charts, diagrams, and coordinate grids	1	2	3	4	☐
16. Angles perimeter, area, volume	1	2	3	4	☐
17. Multi-step problems	1	2	3	4	☐
18. Measurement	1	2	3	4	☐
19. Mean, median, range, and mode	1	2	3	4	☐
20. Chance and probability	1	2	3	4	☐
21. Negative numbers	1	2	3	4	☐
22. Explaining in words how you solved a math problem	1	2	3	4	☐
23. Using math in other subjects	1	2	3	4	☐
24. Doing quick calculations in your head	1	2	3	4	☐

Self-Regulation in Mathematics Learning Scale (McCoach & Siegle, 2003)

Please rate how true the following statements are for you, 1 (not true at all) to 7 (very true).

Please rate how true the following statements are for you	**Not true at all**						**Very true**
1. I check my math assignments before I turn them in.	1	2	3	4	5	6	7
2. I work hard in math at school.	1	2	3	4	5	6	7
3. I am self-motivated to do my math schoolwork.	1	2	3	4	5	6	7
4. I complete my math schoolwork regularly.	1	2	3	4	5	6	7
5. I am organized about my math schoolwork.	1	2	3	4	5	6	7
6. I use a variety of strategies to learn new material in math class.	1	2	3	4	5	6	7
7. I spend a lot of time on my math schoolwork.	1	2	3	4	5	6	7
8. I am a responsible student in math class.	1	2	3	4	5	6	7
9. I put a lot of effort into my math schoolwork.	1	2	3	4	5	6	7
10. I concentrate on my math schoolwork.	1	2	3	4	5	6	7

Mathematics Avoidance Scale (Midgley, Maehr, Hruda, Anderman, Anderman, Gheen, 2000)

Please rate how true the following statements are for you, 1 (not true at all) to 5 (very true).

How true are the following statements for you?	**Not true at all**				**Very true**
I would choose math problems I knew I could do, rather than those I haven't done before.	1	2	3	4	5
I would prefer to do math problems that are familiar to me, rather than those I would have to learn how to do.	1	2	3	4	5
I like math concepts that are familiar to me, rather than those I haven't thought about before.	1	2	3	4	5
I don't like to learn a lot of new concepts in math.	1	2	3	4	5
I prefer to solve math problems as I have always solved them, rather than trying something new.	1	2	3	4	5
When I don't understand my math work, I often guess instead of asking someone for help.	1	2	3	4	5
I don't ask questions during math, even if I don't understand the lesson.	1	2	3	4	5
When I don't understand my math work, I often put down my answer rather than ask for help.	1	2	3	4	5
I usually don't ask for help with my math work, even if the work is too hard to do on my own.	1	2	3	4	5
If my math work is too hard for me, I just don't do it rather than ask for help.	1	2	3	4	5
Some students put off doing their math work until the last minute. Then if they don't do well, they can say that is the reason. How true is this for you?	1	2	3	4	5
Some students purposely don't try hard in math. Then if they don't do well, they can say it's because they didn't try. How true is this of you?	1	2	3	4	5

	Not true at all				Very true
Some students fool around the night before a math test. Then if they don't do well, they can say that is the reason. How true is this of you?	1	2	3	4	5
Some students purposely get involved in lots of activities. Then if they don't do well in math, they can say it is because they were involved with other things. How true is this for you?	1	2	3	4	5
Some students let their friends keep them from paying attention during math or from doing their math homework. Then if they don't do well, they can say their friend kept them from working. How true is this for you?	1	2	3	4	5
Some students look for reasons to keep them from studying math (not feeling well, having to help their parents, taking care of a brother or sister, etc.). Then if they don't do well on their math work, they can say this is the reason. How true is this of you?	1	2	3	4	5

Mathematics Anxiety Scale (Hopko, Mahadevan, Bare, & Hunt, 2003)

Please rate your level of anxiety with the following items, 1 (low anxiety) to 5 (high anxiety).

Rate your level of anxiety with the following items.	**Low Anxiety**				**High Anxiety**
1. Having to use the math book.	1	2	3	4	5
2. Thinking about an upcoming math test 1 day before.	1	2	3	4	5
3. Watching a teacher work a math problem on the board.	1	2	3	4	5
4. Taking a test in a math class.	1	2	3	4	5
5. Being given a homework assignment of many difficult problems that is due the next class meeting.	1	2	3	4	5
6. Listening to the teacher's lesson in math class.	1	2	3	4	5
7. Listening to another student explain a math problem.	1	2	3	4	5
8. Being given a "pop" quiz in math class.	1	2	3	4	5
9. Starting a new chapter in a math book.	1	2	3	4	5

Attitudes Toward Mathematics Scale (Lim & Chapman, 2013)

Please rate how much you agree with the following items, 1 (strongly disagree) to 5 (strongly agree).

Rate how much you agree with the following items.	**Strongly disagree**				**Strongly agree**
1. I have usually enjoyed studying mathematics in school.	1	2	3	4	5
2. I like to solve new problems in mathematics.	1	2	3	4	5
3. I really like mathematics.	1	2	3	4	5
4. I am happier in a mathematics class than in any other class.	1	2	3	4	5
5. Mathematics is a very interesting subject.	1	2	3	4	5