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Interpreting Differences of Self-Efficacy of Gifted or Talented Students with Grouping
Practices in Middle School Mathematics

A dissertation

presented to

the faculty of the Department of Educational Policy and Leadership Analysis

East Tennessee State University

in partial fulfillment

of the requirements for the degree

Doctor of Education in Educational Leadership

by

Amanda Waits

August 2016

Dr. James Lampley, Chair

Dr. Cecil Blankenship

Dr. Don Good

Dr. Pamela Scott

Keywords: Grouping, Acceleration, Gifted Education, Mathematics Self-Efficacy,

Classroom Environment

ABSTRACT

Interpreting Differences of Self-Efficacy of Gifted or Talented Students with Grouping Practices in Middle School Mathematics

by

Amanda Waits

The purpose of this study was to determine if there was a significant difference in total scores on the *Mathematical Self-Efficacy Scale*, the mathematics task self-efficacy portion of the scale, and the math-related school subjects self-efficacy portion of the scale for middle school students between students assigned to a homogeneously grouped accelerated math class and students assigned to a heterogeneously grouped math class.

The instrument used to gather information for this study on student self-efficacy was the *Mathematics Self-Efficacy Scale* (MSES). The MSES measures 2 domains of mathematics-related behaviors and capabilities. The *Mathematics Task Self-Efficacy* scale is designed to measure the level of confidence the student would have when successfully completing the given task. The *Math-Related School Subjects Self-Efficacy* scale is designed to measure the level of confidence the student would have when successfully completing a college level course with a final grade of an A or B. The 2 parts of the MSES may be individually scored or holistically scored to obtain a total score representing overall mathematical self-efficacy.

Descriptive and inferential statistics were used to analyze the data for the 9 research questions. Participants in the study were randomly assigned to the heterogeneous or homogeneous groups by their schools and were not controlled by the researcher. Students within the groups were chosen as participants based on their math ability and scores on the seventh grade TCAP test. At

the time of the survey these students attended either a K-8 elementary school or a middle school in Northeast Tennessee. The population consisted of 357 gifted or talented eighth grade math students in 6 school districts in Northeast Tennessee.

The results of this study does not support or discourage the practice of acceleration by retaining 7 of the 9 null hypotheses that there are no significant difference in self-efficacy scores between homogeneous grouped eighth grade math students who were placed in accelerated coursework by taking Algebra I and those students who were heterogeneously grouped in a regular eighth grade math class.

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DEDICATION

I dedicate this project to my son Owen. I waited so long and had given up hope for such a joy to enter my life. I never truly understood God's unconditional love until I held you.

I dedicate this work to my students. I believe that being an educator is a calling just like being in the mission field or a call to preach. It is the dedication of one's life to service for the betterment of society and the future. I am thankful that none of my teachers ever looked at me and said I would never be anything because I was just a poor farm girl. To each of the students I have taught or will be blessed to teach in the future my message and my model is to go after life at full speed. Dream and achieve what you desire. Self-efficacy is your belief that you can accomplish a complex task and I can think of no greater task than life itself.

Finally, I dedicate this work to my friends and family. You have all stuck by me for many years through the complaints, frustrations, and often hopelessness that this would ever happen for me. You have carried me, laughed with me, and helped me keep pushing forward with calls, text messages, and e-mail messages. You even cleaned my house. I did not want to get to the top of the mountain and discover that I was there alone. I am blessed to have a network of family and friends all across Tennessee. My parents instilled in me an ethic of hard work and love. These are priceless to me and are the sole reason that I have been able to fulfill God's plan for my life. Each person I have met in life has been part of my work and my success.

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I would like to acknowledge my parents and coworkers for helping me stuff and mail the envelopes for the surveys used to collect my data. You have endured my craziness and taken on part of my workload so that I can succeed. I have always said that we are smarter together than we are alone and they have proved to me that we can work faster that way as well.

I would like to acknowledge the help of the teachers in six school districts for distributing and collecting surveys from students. Even in a time where standardized tests and new curriculum provide extra pressure, you still took your time to help me. My research would not be possible without your support.

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CHAPTER 1

INTRODUCTION

Public and private educational institutions in the United States are as diverse as the population of students served. Furthermore, the pedagogy implemented complicates the divergent nature of theoretical and practical education. It should be important to any institution engaged in the act of providing a solid educational foundation to a student to examine research-based best practices that are established as having a positive effect on student achievement, development of conceptual understanding, and support student self-efficacy. Mathematics achievement is often viewed as a measurement of the success, or status, of a nation. Results from the National Assessment of Educational Progress (NAEP) and the Trends in International Mathematics and Science Study (TIMSS) are both used by legislators to make decisions regarding the progress made in United States schools. These results directly influence policy and programming decisions made at the federal, state, and district levels. The National Assessment of Educational Progress (NAEP) began in 1990 and is given nationally to represent a common assessment of what students in the United States know and can do in various subject areas (National Center for Education Statistics, 2014). Administered every 2 years, comparisons of achievement can be made between years to determine if growth is significant. Results of the 2013 NAEP Assessment of fourth grade mathematics showed that 42% of students in the United States performed at or above *proficient* as compared to the 40% performing at or above *proficient* in 2011. Similarly, on the 2013 NAEP Assessment for eighth grade mathematics, 35% of students in the United States performed at or above *proficient*, which remains unchanged since the administration of the assessment in 2011 (National Center for Education Statistics, 2014). The NAEP results presented a case for increased rigor and importance of mathematics

instruction. The data from NAEP also included performance of the highest achieving students in mathematics. The student performance in mathematics at the *advanced* level is evidence of a need to provide students who are gifted or talented in mathematics with access to higher levels of mathematics and problem solving opportunities. On the 2013 NAEP Assessment 8% of fourth grade students and 9% of eighth grade students performed at the *advanced* level.

In our globalized society where students will be seeking job opportunities and experience high levels of career competition with other nations, it is important that they have been prepared with the skills and thinking abilities in mathematics that will enable them to be successful. While the NAEP measures student performance on a national scale, the United States is also compared internationally on the Trends in International Mathematics and Science Study (TIMSS). The TIMSS study provides data on the mathematics and science achievement of students in the United States compared to that of students in other countries (National Center for Education Statistics, 2011).

The TIMSS study was administered five times since 1995 at grades 4, 8, and 12 and included over 20,000 students attending public schools in the United States and 500,000 worldwide. In grade 4, student scores were 12 points higher than when administered in 2011; in grade 8, student scores were 17 points higher than when administered in 2011. In a comparison of the average scores of participating countries, the United States ranked ninth in fourth and eighth grade mathematics. Students in Singapore, Republic of Korea, and China achieved average scores above 600, as compared to students in the United States whose average score was 541 for fourth grade and 509 for eighth grade mathematics (National Center for Education Statistics, 2011).

The data for students reaching the international benchmark for *advanced* on the TIMSS study compares top performing students to their peers in other countries with what skills and knowledge a student should demonstrate at the *advanced* level. In fourth grade only 13% of United States students met the international benchmark for the *advanced* level indicating a rank of ninth internationally. In comparison, Singapore, Republic of Korea, Hong Kong, Chinese Taipei, and Japan had 30% or more of their students meet the international benchmark for the *advanced* level. Similarly in eighth grade, 7% of students in the United States met the international benchmark for the *advanced* level, indicating a ranking of twelfth internationally, whereas Singapore, Chinese Taipei, Republic of Korea, and Hong Kong had 30% or more of their eighth grade students meet the international benchmark for the *advanced* level, with the highest being Chinese Taipei at 49% (National Center for Education Statistics, 2011).

The Templeton National Report on Acceleration included an in-depth examination of educational practices that directly impacted the educational success of gifted or talented students (Colangelo, Assouline, & Gross, 2004). Ten years after this report was first published the research it contains and the questions it presents to the field of education were still relevant. According to the NAEP and TIMSS studies, students in the United States do not perform at high levels of achievement when compared to other industrialized countries. It is important to examine practices that inhibit or enhance student achievement in mathematics, specifically for students identified as gifted or talented. Mathematics instruction has received varying levels of attention over the past century.

As one-room school houses were being phased out because of the standardization of the educational system, students were gradually offered minimal opportunities for advancement at their own pace. Schools became institutions of equity and fairness, although this was not always

exhibited between various ethnic and socioeconomic groups. The Rehabilitation Act of 1973 began an examination of practices in United States schools for students with disabilities. Section 504 regulations required school districts “to provide a ‘free appropriate public education’ (FAPE) to each qualified person with a disability who is in the school district’s jurisdiction, regardless of the nature or severity of the person’s disability” (US Department of Education, 2010, para. 3). Over the 40+ years since this Act was implemented it has been updated and reissued periodically and is now titled the Individuals with Disabilities Education Act of 2004. In examining what constitutes a free and appropriate public education, the question of what is appropriate must be answered through substantial research and effective best practices, which can lead to generalizable and practical implementation for the populations found in an educational setting. Several national publications have created an awareness of the need for quality mathematics instruction (Colangelo et al., 2004; No Child Left Behind Act of 2001 (NCLB), 2002; O’Connell-Ross, 1993). Individuals in the gifted education networks advocate for high quality math instruction for the brightest students. A wealth of research, information, theoretical constructs, and applicable models for gifted education exist and the body of research is continually growing to support these students.

Theorists offer the most prominent and empirical work in the field (Feldman, 1994, 2003, 2008; Gagné, 1985, 1999, 2004; Gardner, 1983, 1999, 2006, 2011; Renzulli, 1978, 2002, 2011; Tomlinson et al., 2002). Regarding mathematics instruction, it is important to examine issues such as practices that lead to advanced levels of achievement, what systems and structures should be in place to ensure student success, and how students view themselves as mathematicians in the various constructs. Acceleration is a grouping practice that is backed by decades of empirical evidence regarding its effectiveness to meet the needs of gifted and talented

students (Brody & Reis, 2004; Chval & Davis, 2008; Colangelo et al., 2004; Feldman, 2008; Hoogeveen, van Hell, & Verhoeven, 2009; Miller, 2008; Neihart, 2007; Sowell, 1993). Many forms of acceleration are present in public and private education. Colangelo et al. (2004) reported that more than 18 types of acceleration are currently in practice. A memo from the Tennessee Department of Education (TN DOE, 2014a) states,

Students who are capable of rigorous mathematical coursework must be provided access to accelerated courses of study fully accompanied by a variety of proper supports to ensure their success. Decisions regarding appropriate placement should be made in the best interest of each individual student using appropriate data. (p. 1)

The TN DOE also acknowledges that each district retains the authority to set local policy and procedures regarding acceleration practices offered to students. The memo offered six models for acceleration of students in mathematics.

Statement of Purpose

Self-efficacy is defined as a person's perception of his or her ability to do a defined task or fill a specific role. Burke and Stets (2009) examined what gives individuals their specific perception of self in a variety of roles found in life. They defined self-efficacy as an individual's belief in the ability to accomplish a task. Individuals with a higher self-efficacy participated in tasks or behaviors that were unfamiliar, challenging, or difficult due to their perceived ability of accomplishment (Burke & Stets, 2009). Mindset toward a certain subject, field, or situation has had a great effect on outcomes produced by the individual.

There are several empirical studies showing how high self-efficacy in math is positively correlated with other domains in mathematics such as achievement, college success, degree attainment in Science, Technology, Engineering, and Mathematics (STEM) careers, and overall problem solving abilities (Fast et al., 2010; Hoogeveen et al., 2009; Louis & Mistele, 2012; Neihart, 2007; Schunk, 1991). Liu and Koirala (2009) presented research findings at the

Northeastern Educational Research Association (NERA) Annual Conference that examined the relationship between mathematics achievement and self-efficacy. A correlation between mathematical self-efficacy and mathematical achievement prediction was examined among 10th grade students to determine that mathematics self-efficacy substantially predicted mathematics achievement (Liu & Koirala, 2009).

The purpose of this study was to determine if there was a significant difference in the total mathematical self-efficacy scale scores, the mathematical task self-efficacy scale score, and the math-related school subjects self-efficacy scale score for middle school students between students assigned to a homogeneously grouped accelerated math class and students assigned to a heterogeneously grouped regular math class.

Research Questions

Nine research questions were used to guide this quantitative study.

- RQ1. Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ2. Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ3. Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

- RQ4. Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ5. Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ6. Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ7. Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ8. Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?
- RQ9. Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Significance of the Study

Educational research serves the purpose of providing practitioners with empirical evidence to validate programs, determine factors of success or failure, provide explicit empirical evidence to support implicit theories, and to guide the professional body of educators to a mindset of continuous improvement. The National Research Council's (NRC) report, *Scientific Research in Education* (Lauer, 2004), contends that quality educational research follows the same principles of scientific inquiry in any field. The principles guide researchers and readers in determining if educational research is of high quality and has a significant contribution to the field of education. These recommended principles have been considered in the design of this study as well as in determining the significance of examining what impacts the grouping practice of acceleration has on a student's mathematical self-efficacy and if it differs from the student's peers who are heterogeneously grouped.

This study will help fill a gap in research and knowledge about the relationship between mathematical self-efficacy and acceleration practices in general and examine if gender is a contributing factor. Current research on the relationship between self-efficacy and mathematics achievement in general examines the gender factor but rarely examines same gender differences between groups.

Theorists in the field of gifted education contend that being classified as gifted or talented is not determined solely by Intelligence Quotient (IQ) and general achievement. Motivation, creativity, task commitment, and possessing a type of intelligence outside the normal curve are all components of a gifted or talented individual. There exists no delineated definition of giftedness. Rather, giftedness theory is distinguished by a weaving of common characteristics or traits that describe an individual with high aptitude. Several cocognitive factors have been

identified to describe gifted individuals, including optimism, courage, passion for a discipline, empathy, physical and mental endurance, and visionary leadership. These factors work in tandem with environmental influences and opportunities presented to an individual to work on the development of gifted characteristics (Renzulli, 2009).

Definition of Terms

The terms below signify those found frequently in this study and in the review of literature.

Ability Grouping – The grouping of students in an academic setting with same age peers that are of the same relative academic ability (Brody & Reis, 2004).

Acceleration – The practice of students in an academic setting with unlike aged peers so that students have access to an advanced level curriculum (Brody & Reis, 2004).

Differentiated Instruction – A pedagogical theory that addresses the needs of students with a variety of backgrounds, knowledge, cultural influences, and interests. In mathematics the specific forms of differentiated instruction are *assessing and advancing questions, using a model, bridging, contextualizing, developing metacognition skills, and building schema* (Institute for Learning, 2014).

Gender Bias in Education – A known or subconsciously hidden prejudice toward males or females causing a deterioration of accuracy in the research being explored (Skelton, Francis, & Smulyan, 2006).

Gifted or Talented – A designation given to a student who exhibits superior performance or talent in a particular area. The term is generally applied in academic and nonacademic settings such as sports, music, and artistic endeavors. For this study a gifted or talented

student is one who performs at or above the 90th percentile in mathematics as compared to his or her same aged peers (NAGC, 2010).

Heterogeneous Grouping – The grouping of students with peers of mixed intellect, interest, or talent. This form of grouping is most often used to include students of various instructional levels within a classroom (Marzano, Pickering, & Pollock, 2001).

Homogeneous Grouping – The grouping of students with peers of similar intellect, interest, or talent. This form of grouping is most often used to group students of a like instructional level and provide them with an appropriate curriculum to meet their needs (Marzano et al., 2001).

Mathematical Self-Efficacy – The perception of one’s ability to perform a specific mathematical task that is dependent on the difficulty of the task (Bandura, 1997).

Mathematics Self-Efficacy Scale – A 52-item survey instrument designed to measure a student’s level of mathematics self-efficacy (Pajares & Miller, 1997).

Self-Efficacy – The perception of one’s ability to demonstrate the behavior necessary to obtain a desired outcome that is directly dependent on willingness, persistence, and motivation (Bandura, 1997).

Tennessee Comprehensive Achievement Program (TCAP) – a test that,

...uses multiple choice questions that provide a measure of knowledge and application of skills in various subject areas for grades Kindergarten (K) – 8. The results of the TCAP Achievement Test provide valuable information regarding student’s progress in Tennessee based on TN curriculum standards. (Tennessee Education Association, 2014, para. 4)

Tracking – A form of homogeneous grouping that is not flexible. Students are placed in groups based on ability and remain there for an entire year or more often for every year they are in school with the same group (Hallinan, 1994).

Limitations and Delimitations

The delimiting restrictions placed on this study by the researcher limit the extent of the study. Participants were selected using a criterion-based, convenience sample. Generalizability was limited because of the lack of a randomized experimental design. Students chosen for the study were delimited to eighth grade students during the 2015-2016 academic school year in more than one school system in Northeast Tennessee. Students chosen took the TCAP test as seventh graders during the 2014-2015 year and scored at or above the 90th percentile in all RCPI categories for mathematics.

Limitations to this study address weaknesses or problems within the study that may restrict the methodology and results. There were five limitations in this study.

1. It was not possible to establish if classroom grouping or climate were the only variables influencing mathematics self-efficacy. Most notably are other confounding variables that were not controlled for such as tutoring outside the normal classroom, participation in a mathematics enrichment program outside the normal classroom, self-esteem counseling, mathematics anxiety, and the socioeconomic status of the student.
2. Given that the Mathematics Self-Efficacy Scale is administered to students identified as gifted or talented, it may include students who have a naturally high mathematics self-efficacy due to high mathematics achievement.
3. The survey instruments provide a limitation of the study because of using a 10-value Lickert-type scale for participants to respond. The survey has been tested for validity; however, the reliability of self-reporting surveys using a Lickert-type scale is limited by the authenticity of the respondent, labeling of the gradation, and participant perception of the question (Betz & Hackett, 1993).

4. The region of Northeast Tennessee where the surveys were administered contains both rural and urban areas. Because of greater resources, it is typical in urban districts in this area to offer more pathways for gifted or talented students. This restricts the available sample size of eighth grader students grouped in an accelerated Algebra I class.
5. Teacher effectiveness in the classrooms of students sampled presented the possibility for influencing the classroom environment and quality of teaching and the participant's mathematical self-efficacy.

Efforts made to mitigate method limitations are presented in Chapter 3. These were designed to strengthen the research design and findings of the study.

Overview of the Study

This quantitative study is organized into five chapters. Chapter 1 contains the introduction to the study, statement of purpose, research questions, significance of the study, definition of terms, limitations and delimitations, and an overview of the study. Chapter 2 presents a review of relevant literature to explore the foundations of gifted education, investigates types of grouping practices, and broadly explores self-efficacy with an emphasis on mathematics self-efficacy as observed with gifted or talented students. Chapter 3 includes the research methodology and presents the research design, presentation of the population and rationale behind the groups chosen, instrumentation, data collection procedures, and the methods used to analyze data. Chapter 4 details the analysis of data and reports results of the study. Chapter 5 includes an interpretation of the results, conclusion of the study, a summary of the findings, implications for current grouping practices, and recommendations for further investigation.

CHAPTER 2

REVIEW OF THE LITERATURE

A variety of definitions and conceptions exist on what qualifies a student to be considered gifted or talented. The terms are frequently used interchangeably in the literature and research, presenting an ambiguity that can be problematic when examining research in gifted education (Gagné, 1985). It is therefore necessary to establish the working definition of a student identified as gifted or talented for the purpose of this research. A review of the literature indicated that a consensus among leading theorists does not exist and a continuum from conservative to liberal definitions and concepts of giftedness are influenced by implicit and explicit theories (Gardner, 2011; Renzulli, 2011; Sternberg & Zhang, 1995). These theories directly impact identification of gifted or talented students by their guidance on the definition of giftedness at the federal, state, and district level for the development of criteria of admission to special programs or services.

Theories of Giftedness and Talent

The concept of intelligence has been closely examined and valued by society since theories of education became important to the sustenance of a civilization. Grinder (1985) examined the historical aspect of gifted education as being in three time periods influenced by scientific research, views, and values of society at the time, including giftedness as identified by divinity from a theological perspective, neuroses as a metaphysical aspect, and mental tests as supported by an empirical approach. Mental tests and concepts of giftedness based on an identifiable intelligence quotient (IQ) have greatly influenced the past century of theoretical and practical studies of giftedness (Weber, 1999). One of the earliest tests of intelligence in children – the Binet-Simon – was developed in France as a means of identifying students who would experience difficulty learning in school (Binet & Simon, 1916). This measure of intelligence was

soon modified and used by Terman, a Stanford University psychologist. Terman was highly interested in intelligence and the factors that contribute to the success of some individuals in society. Terman and his associates adapted the test developed by Binet and modified it to better determine general intelligence. Their redesign included translation, adaptation to school content in the United States, determining sets of age norms, and most importantly developing a standardized distribution of scores that set the mean or average intelligence at 100 (Leslie, 2000). Terman's modification of the test became known as the Stanford-Binet test for intelligence, which is the most widely used cognitive ability assessment for identification of exceptional individuals, and is currently in its fifth edition (Roid, 2003). The adaptation and standardization of the test by Terman was through a longitudinal study of 1,500 high-IQ participants in California in the early 1920s (Robinson & Clickenbeard, 2008). It was Terman's desire to psychometrically measure general intelligence that prompted the study that led to his use of the term intelligence quotient and the widespread use of intelligence testing in the 20th century educational system.

It is generally accepted in the cognitive psychology and education fields that IQ is not the most relevant indicator of giftedness. Although it is accepted that giftedness does include factors of IQ, a multifaceted approach that includes personality, environment, and cocognitive aspects of intelligence that are used to describe many of the current theories and approaches to defining giftedness (Gagné, 1985, 1999, 2004; Gallagher, 1964; Gardner, 1983, 1999, 2006, 2011; Renzulli, 2011; Sternberg, 2004; Subotnik, Olszewski-Kubilius, & Worrell, 2011; VanTassel-Baska & Stambaugh, 2005; Wallace, 2008). The societal and philosophical definition of giftedness directly affects research in the field for the time being examined. Neuroscience and

cognitive psychology developments continue to mold and change the models and practices in place to better serve the brightest individuals.

The concept and study of giftedness has bifurcated into implicit and explicit theories to provide empirical research. In examining the concepts regarding giftedness, Miller (2008) differentiated explicit and implicit theories of giftedness. Explicit theories are, “directed mainly toward questions to provide empirical validation of the theory” (Miller, 2008, p. 109), whereas implicit theories, “deals mainly with description and comparisons in order to look for patterns within and among groups” (Miller, 2008, p. 110). Implicit theoretical research is still a moderately new area and sparse research exists to support group belief differences. While recognizing the continued need for implicit research to provide the structure of concepts of giftedness, theories and beliefs must be validated explicitly to provide content embedded in the concepts. In examining the empirical support for both theories, five major scholars in the fields of giftedness, intelligence, and creativity have extensively shaped the leadership, research, and practices in gifted education. In reviewing the work of several researchers, similarities and generalizations can be established in the identification, cognitive characteristics, and appropriate services offered to students identified as gifted or talented (Feldman, 1994, 2008; Gagné, 1985, 1999, 2004; Gardner, 1983, 1999, 2006, 2011; Plucker & Callahan, 2008; Renzulli, 2002, 2009, 2011; Sternberg, 1986; Sternberg, 2004; Sternberg & Davidson, 2005; Sternberg & Zhang, 1995).

Regarding implicit theories, Sternberg and Zhang (1995) approached the definition of giftedness as having the five fundamental characteristics of excellence, rarity, productivity, demonstrability, and value attached to the skills and products of the individual. Sternberg and Zhang (1995) presented explicit data to support the implicit theory and its implications for gifted

education. Sternberg and Zhang's (1995) *Pentagonal Implicit Theory of Giftedness* does not examine or attempt to define giftedness, but rather examines perceptions and beliefs about giftedness in general as having five interconnected yet independent characteristics. The judgment by society of seeing one as a gifted individual is based on five criteria: excellence, rarity, productivity, demonstrability, and value. An implicit interpretation of various definitions of gifted and talented groups them together. However, the authors point out that all implicit theories are shaped by place, time, and culture. Existing implicit theories may hold no value or relativity in other cultures or eras in which context is different from the present. It is implicit theories of society and individuals that provide a means for explicit theories to be formed and provide a framework for empirical evidence to be gathered.

Explicit theories provide a content given description of giftedness. Theorists agree that creativity has its established part as a component of giftedness. However, there are several explicit theories on what creativity is, how it functions in an individual's life, and the types and depths of creativity that exist. Feldman (2003) examined the progression of development in the theory of multiple intelligences, the role creativity plays, and how it is dynamic in relation to an individual's development. Feldman related creativity and its importance to the identification and development of gifted individuals when he wrote about creativity having its own linear progression as compared to other cognitive developmental transitions as set forth by Piaget (Feldman, 2003). Feldman's theory of creativity involved a process in which individuals undergo a reorganization of creativity within domains like language, arts, mathematics, and physics (Miller, 2008). Creativity can be characterized as a fluid or static quality of an individual. While Feldman's theory supported the fluidity of creativity, other theorists only addressed its role and importance as a component of giftedness (Gagné, 1999; Sternberg & Zhang, 1995). Viewing

creativity with a growth mindset influences many aspects of empirical research in the field such as the type of measurement instrument used to collect levels of creativity, the types that exist, norm scales to determine growth, and how creativity may influence general intelligence and overall intellectual ability.

Gardner (1983) is distinguished in the field of education and gifted research as being the originator of the theory of Multiple Intelligences (MI). The MI theory has influenced educational pedagogy and provided a lens into differentiated instruction. Gardner has defined eight types of intelligence that exist including linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist. The MI theory does not explicitly contain a creativity domain but rather imbeds creativity within each of the eight intelligences. Each individual possesses different aspects of the eight intelligences and these differences account for learning styles, preferences in career choice, and how we view the world in general. According to MI theory children can be seen as intellectually gifted because they possess a high level of precociousness in one of the eight domains. Gardner (1995) pointed out that,

Those individuals who combine high psychometric intelligence in childhood with diligent practice in (and out of) school are more likely to become expert thinkers or scholars than those who can only practice (so-called overachievers) or those who do not practice at all (so-called underachievers). (p. 802)

Similarly, Sternberg (1986), Renzulli (1978, 2002, 2009, 2011), and Gardner (1983, 1995, 1999, 2006, 2011) took a liberal approach to the definition of giftedness with attention to the inclusion of other factors that contribute to the giftedness of an individual beyond just IQ. The literature is increasing in the research that personal commitment, motivation, and ethics play in eminence and the success of gifted individuals who produce social capital.

Throughout his career Renzulli theorized key components that were essential to the appraisal of prodigious intellectual ability including testing sequential, judgmental, and logical

task functionality in stress-inducing environments and quantifying motivational rationality. These factors encompassed the exceptional student's ability and separated it from that of talent. Motivation must be considered as a factor for there is a distinct difference between consumers of information who retain and recapitulate gained knowledge as compared to producers of creativity who innovate, invent, challenge philosophy, and engage in divergent thinking to contribute in socially productive ways (Renzulli, 1978). This type of motivation requires persistent concentration of cocognitive factors such as optimism, courage, passion for a discipline, empathy, physical and mental endurance, and visionary leadership to enhance personality and interact with environmental factors that help fully develop human talent (Renzulli & Reis, 1997; Renzulli & Systema-Reed, 2008).

Conversely, Gagné (1985) asserted that there was a difference between giftedness and talent and engendered a difference between the effects research, identification, and services offered to gifted or talented students. Gagné's (1999) theory for giftedness contained a separation of the domains of ability, giftedness, performance, and talent. He referred to giftedness as being that of human ability while talents were human accomplishments (Gagné, 1985). Gagné (2004) put the terms and their definitions under further scrutiny by postulating that giftedness was based largely in part on genetic endowment and that it directly affected talent development in the form of systematically developed abilities. Genetic predispositions are certainly influenced by one's environment while also guiding factors that contribute to greatness in life – specifically that of perspicacity for learning and establishing a maximum and minimum development within a domain. Gifted abilities are those that are natural abilities of behavior including empathy, leadership, reasoning, judgment, originality, endurance, and concentration, whereas talent can be described in relation to an occupation or noncognitive aspect (Gardner, 1999). This was a more

conservative view of giftedness and talent as normative concepts; it was not as prominent in the field as the multifaceted view necessary to be examined in order to explore implications to this research both theoretically and practically (Borthwick, Dow, Lévesque, & Banks, 1980; Fleming & Hollinger, 1981; Gagné, 1999).

Policy and Program Decisions

Definitions and concepts of giftedness indirectly affect gifted students through policy and program decisions. Federal and state definitions of giftedness vary based on the philosophy the state has chosen to characterize a student as being intellectually gifted or talented. The federal definition of giftedness stated:

Pursuant to section 9101(22) of the Elementary and Secondary Education Act of 1965, as amended by the No Child Left Behind Act of 2001 (ESEA), for purposes of the Jacob K. Javits Gifted and Talented Students Education Program, gifted and talented students are students who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services or activities not ordinarily provided by the school in order to fully develop those capabilities. (US Department of Education, 2008, p. 21330)

The federal definition included intellectually gifted or talented students in a specific area and was very broad in allowing state and local education agencies to develop and refine a definition for their own purposes. Allowing such open interpretation by agencies permits them to narrow a definition of giftedness to one that often addresses only academic performance. The National Society for the Gifted and Talented pointed out the comparative nature of the definition where achievement is at or above that of a student's peers. Additionally, the National Association for Gifted Children (NAGC) provided a much more specific definition of giftedness.

Gifted individuals are those who demonstrate outstanding levels of aptitude (defined as an exceptional ability to reason and learn) or competence (documented performance or achievement in top 10% or rarer) in one or more domains. Domains include any structured area of activity with its own symbol system (e.g., mathematics, music, language) and/or set of sensorimotor skills (e.g., painting, dance, sports). (NAGC, 2010, para. 1)

The education of students is a power reserved to the states and is not directly controlled by the federal government, allowing each state to have autonomy in developing policy and mandates that best fit the needs of the students in the state. There exists no mandate at the federal level on the specific educational needs of gifted students. It is the choice of the leadership and legislative bodies in a state to determine a mandate, set forth policy, and identify structures and supports for gifted programs.

Functions and accountability aspects of each institution of education have changed in the past 20 years. States, districts, and building level administrators face more pressure from the public and private sector to graduate high school students who are college or career ready. The No Child Left Behind Act of 2001 (NCLB, 2002) called for state accountability with federal funding to strive in creating support for effective teaching that ensured the achievement of each child receiving a public education. This accountability takes the form of high stakes testing as a means to determine if achievement gaps between various subgroups are addressed in an appropriate manner with steps in place to support students. NCLB, through the Access to Higher Standards Act, supported high achieving students by encouraging them to take an Advanced Placement Exam when taking higher level courses by offering district grants to cover the student's testing fees (NCLB, 2002). However, the small grant that covered testing fees was never adequate to support the needs of the gifted or talented students often left out of programs or classes designed to increase student achievement.

The purpose of this title is to ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments. (NCLB, 2002, SEC. 1001. Statement of Purpose, p. 1439)

It is clear that the primary function of NCLB was to hold states to accountability measures that required all students to reach proficiency. However, it left out the brightest and

highest achieving students. Without grants, federal funds, or other sources of monetary support, districts often cut programs designed to serve gifted or talented students to a minimum, if services are even offered. It is necessary to examine alternative, low cost ways to implement systems and models that are proven to continue to grow high achieving students. Evidence-based studies are one method of determining the success and validity of a program or process designed to serve the needs of gifted and talented students. The results of the NAEP and TIMSS study are evidence that as a country students in the United States are underperforming in mathematics (National Center for Education Statistics, 2011, 2014).

Researchers in the Center for Gifted Education at the College of William and Mary conducted a five-state analysis of how educational policy affects identification, programming decisions, and services offered to gifted students. Results of the study revealed,

[U]nevenness in gifted-education policy at the present time, emphasizing identification procedures over program development and personnel preparation concerns. The study also revealed an absence of connectivity to related state education policies affecting gifted learners and the field such as content standards, *No Child Left Behind*, and secondary programming options, such as AP, IB, and dual enrollment. (Brown, Avery, VanTassel-Baska, Worley, & Stambaugh, 2006, p. 22)

This was not just true for the five states in the study; across the 50 states no two state policies on gifted education look the same. While individual state autonomy with educational policy decisions is required, a complex and unsupported policy for gifted education services exists after filtering the state level policies or mandates down to the district and school level. In a United States Department of Education report (1993), gifted students were in a heterogeneously grouped classroom the bulk of their day without receiving accommodations to the curriculum such as modifications, compacting, acceleration, or differentiated instruction despite having already mastered up to 50% of the material presented in the classroom. Regardless of the broad or narrow state level definition of giftedness, rarely do state and local district policies recognize

grouping practices supported by research in order to meet the educational needs of gifted and talented students and provide them a *Free and Appropriate Public Education* (FAPE). According to Wright and Wright (2007) FAPE requires an education designed to meet the needs of a student with disabilities so the student can access instruction without barriers to learning. Seldom do districts offer instruction specifically designed for the gifted student, which allows him or her to benefit from the instruction while emphasizing that equity does not equate to sameness in the general student population. Servicing gifted education students under the state's definition of giftedness falls to the district and schools to determine whether or not special education services will be offered that support students in their public education and of what form and delivery method is most appropriate to meet those needs.

The Tennessee Department of Education (2014b) follows the guidelines and procedures set forth in the *Special Education Framework* and contains the definition, services, and programs available for gifted and talented students.

Intellectually Gifted means a child whose intellectual abilities and potential for achievement are so outstanding the child's educational performance is adversely affected. Adverse affect means the general curriculum alone is inadequate to appropriately meet the student's educational needs. (Tennessee Department of Education, 2014b, p. 48)

Similarly to many states, Tennessee has a conservative definition of giftedness as compared to that of the Federal Government in that they specifically address the intellectual abilities as associated with achievement. All students in Tennessee are universally screened in grades 1 through 4, as required by the *Special Education Framework* (Tennessee Department of Education, 2014b). Many districts choose to complete this screening in fourth grade based on achievement data from a standardized group criterion-referenced test such as the Tennessee Comprehensive Assessment Program (TCAP). Although several referral paths exist, the most common one involves students identified with a minimum of one academic area at or above the

95% percentile or two academic areas at or above the 90% percentile on the TCAP test; students meeting these requirements are then recommended to be reviewed by a school screening team to determine if the student should be recommended for an individual screening. Further documentation and observations are conducted and the school screening team may consent to recommend the student for a comprehensive evaluation. The *Gifted Assessment Flowchart of referral screening* (see Appendix A) and evaluation process options are defined by the *Tennessee State Plan for the Education of Intellectually Gifted Students*. This model provides several pathways for students to be identified as intellectually gifted through an individual screening and a comprehensive evaluation; however it focuses on an inclusive definition of academic and general ability.

The first step in the gifted assessment process is called Child Find. The Child Find mandate is part of the Individuals with Disabilities Education Act (IDEA) and calls for states to implement a process for locating, identifying, and servicing children with disabilities from birth through age 21 (Wright & Wright, 2007). The Child Find program is a collaborative effort between state and local agencies, professional, and special interest groups to provide information to the public on the availability of service for intellectually gifted students. The Tennessee state plan (Tennessee Department of Education, 2001) states:

Child Find is an extensive effort to locate all children who are potentially gifted by informing all stakeholders (parents, students, teachers, community) of the characteristics of children who are gifted and the availability of services for children identified as gifted. (p. 9)

In searching for students who may qualify for special education services, local agencies are encouraged to be especially diligent in seeking out students who are from culturally diverse backgrounds, economically disadvantaged, or have a disability in addition to being intellectually gifted. Students identified through Child Find are given a referral that can take three different

pathways. Two of the pathways involve screening the individual for gifted behaviors and traits and the other pathway is a direct comprehensive evaluation to determine if an individual qualifies to be identified as intellectually gifted.

State policy and procedures for the identification of gifted students directly affects the program decisions that are made in servicing the student's needs to meet the federal requirements of FAPE. Colangelo and Assouline, (2009) conducted extensive research that directly supported acceleration as an appropriate academic intervention to accommodate a variety of gifted traits and needs. Despite the depth of research to show that acceleration is the most effective curriculum intervention, Colangelo and Assouline found that, "the degree of disparity between the research-based evidence for acceleration and the application of the intervention is unparalleled" (2009, p. 1085). Further support for the use of acceleration with gifted students is found in *A Nation Deceived: How Schools Hold Back America's Brightest Students* (Colangelo et al., 2004), a meta-analysis on acceleration practices that determined the quantitative effect on student achievement. The meta-analysis showed a statistically significant difference in the academic achievement of students who were offered some form of acceleration and the median effect size was .80, signifying a statistically significant growth rate compared to nonaccelerate. This longitudinal research, spanning more than 50 years, supported the position that no other form of intervention for gifted students works as well as acceleration.

A district or school level decision to accelerate students can take a variety of forms service levels based on availability of resources, teacher training, and student readiness. Distinguishing which types of programs are appropriate for students showed that there are at least five dimensions to acceleration that must be considered. Southern and Jones (2004) identified the five dimensions as pacing, salience, peers, access, and timing. In using the

dimensions to determine the best type of educational services for a student, it is important that policy and program decisions not be limited to a few types of acceleration. Constraining the types of acceleration offered in a district prevents the five dimensions from being examined in depth to truly provide an appropriate educational environment for the student.

Development of a state or district policy that supports acceleration as a best practice should be developed based on current research from development to operational implementation. The Institute for Research and Policy on Acceleration (IRPA), the National Association for Gifted Children (NAGC), and the Council of State Directors of Programs for the Gifted (CSDPG) coauthored a set of guidelines for the development of an acceleration policy at the state and district level. According to a survey in the guidelines, only eight states have a comprehensive acceleration policy that addresses the needs, structure, and nature of acceleration practices. Ohio and Minnesota have exemplar acceleration policies that also require districts to submit detailed policies on how students will be assessed, the types of services offered through acceleration, and curriculum modifications within the different forms of acceleration (National Association for Gifted Children, 2009). Tennessee's position on acceleration of gifted or talented students in mathematics was established in the memorandum *Making Decisions about Mathematical Course Sequences and Accelerating Students* (Tennessee Department of Education, 2014a). This document serves as a support guide for discussion on local decisions made for acceleration options available in the Common Core State Standards. Model pathways for compacting in the middle school and accelerated high school are included that allow a student to take a higher level mathematics course such as precalculus or calculus. Tennessee's position on acceleration options is that students who have demonstrated the ability to succeed in rigorous mathematical coursework must be provided with the opportunity for accelerated

coursework in addition to appropriate structures of support for them to be successful (Tennessee Department of Education, 2014a). This document is a tool for districts to foster rich discussions about a myriad of considerations that guide the development of a quality district level acceleration policy. As well as providing sound recommendations for accelerative options, it cautions districts about accelerating students who are truly not ready for engaging in rigorous mathematics. Cooney and Bottoms (2002) offered research that played a critical role in deciding to offer accelerative options to middle school students. The research followed 3,100 ninth grade students with similar demographics and mathematical ability. Approximately half of the students were enrolled in a higher level math course considered a college preparatory pathway. The remaining students were enrolled in a lower level math course that was a part of the normal high school curriculum but did not encourage rigorous mathematics. The results showed that for ninth grade students those who completed the higher level college preparatory mathematics had a higher success rate than those enrolled in lower level mathematics (Cooney & Bottoms, 2002). This is important to emphasize for districts considering mathematics acceleration as an option in the middle grades. Rigorous mathematical learning with accelerative options should be available for students who excel in the subject to ensure success in high school and secondary settings.

While policy and programming decisions for acceleration in mathematics vary across countries, states, and districts, options available to students are further impacted by the multifaceted decisions that must be made in the student's best interest. Although each state is required by the federal government to actively seek out students with high potential through Child Find, there are no federal mandates on how those students are to be provided with an appropriate education nor is it specified as to the nature of the delivery of services deemed appropriate. Tennessee's broad definition and concept of giftedness allows for individual district

interpretation of how students identified as gifted or talented are to be served in the general education setting. When identified, the student must rely on a district to have a documented and operationalized plan of programming to meet the needs even though acceleration may not be one of the options. Research supports the use of acceleration in mathematics as a best practice to meet the needs of students identified as gifted or talented (Colangelo & Assouline, 2009; Cooney & Bottoms, 2002; Kulik, 2004; Southern & Jones, 2004).

Opposition to Grouping Practices

The theories and philosophies in education are as varied as the classrooms that exist and the instructors delivering the curriculum. Grouping practices regarding academic ability is not the exception. It is therefore necessary to examine different viewpoints in order to form robust background knowledge of research and practice for making policy and programming decisions at the district, school, and classroom level. The most prevalent argument discounting the practice of grouping is that it widens the achievement gap between high and low performing students and increases educational inequality in terms of services offered, academic expectations, and opportunities given to students in lower tracks or groups (Chmielewski, Dumont, & Trautwein, 2013).

Oakes (1986) explored ability grouping tracking in regards to secondary students and presented two underlying assumptions that guided most administrators and teachers to track students. The first assumption is that by tracking students, equality and excellence are delivered in a way that meets the academic needs of all students and enhances student achievement. Placing students in groups with peers of a similar background, ability, and level of achievement is seen as a way to provide differentiated instruction to best meet the needs of students. The second assumption claimed that the self-efficacy of lower-achieving students would be adversely

affected when in constant interaction and competition with high-achieving students. It is assumed that students in lower tracks will be taught with the same high expectations, levels of rigor, and highly effective teachers available to students placed in higher tracks. This is not the reality that students in lower tracks face (Oakes, 1986). In examining the main factors that lead to inequalities in education, studies have found that a difference in the effectiveness of a teacher represents the most influential variance in student achievement as much as socioeconomic status (Hanushek, Kain, O'Brien, & Rivkin, 2005; Kahlenberg, 2000; Ramirez, Schofield, & Black, 2009; Walsh, 2007). Coupled with the fact that students in lower tracks are not typically placed with the highest quality teachers; students who have an ineffective teacher for 3 years in a row can be negatively affected in their achievement by up to 50 percentile points and students are not likely to recover the educational loss associated with this deficit (Ramirez et al., 2009). This dilemma is exacerbated by a lack of highly effective teachers and the data that support the likelihood of a student receiving a highly effective teacher 5 years in a row is 1 in 17,000 (Walsh, 2007). In examining the practice of tracking students according to academic ability, while being placed with ineffective teachers, low expectations, lack of a rigorous curriculum, and in-flexible means of advancing to higher tracks show that opponents to tracking have valid claims.

Slavin (1990) presented a best-evidence synthesis of the literature on ability grouping in secondary schools. Many forms of ability grouping were examined with concerns regarding all tracking types that were similar to those cited by Oakes (1986). Slavin's (1990) synthesis revealed little positive academic affect for high or low achieving students when ability grouped. However, in the criteria for study inclusion, Slavin (1990) does not compare ability grouped and heterogeneously grouped classes with highly effective teachers. It is noted that the groups were

comparable without giving exact parameters on what the comparative means were. Slavin (1990) presented conclusions to the research that different forms of ability grouping including between-class ability grouping and grouping by subject or course are equally ineffective as measured by standardized tests. Slavin (1990) made a very poignant recommendation to schools and districts regarding the practice of grouping. The most important factors for accelerating student achievement are a viable curriculum, high quality instruction, and improvement in teaching pedagogy. Kulik (1992) pointed out that a meta-analysis on curricular tracking is unsubstantiated because few true experimental studies existed on the topic. Rather, the research on tracking focused on teacher behaviors in regards to students in their assigned tracks or on student achievement without regard to curricular changes.

Moller and Stearns (2012) examined the relationship between tracking in secondary school and income in young adulthood. Moller and Stearns (2012) used data from the National Educational Longitudinal Study to determine that educational inequalities existing when students are in middle or high school are major factors that contribute to a lack of access to high paying jobs as young adults. These inequalities were explained by disparities present in most schools that used tracking to place students and claimed this path-dependent method determined a student's academic achievement and success as a young adult (Moller & Stearns, 2012). The claim that track placement is a direct cause of the income earned later in life is similar to the claims of inequality in other areas such as race, gender, and socioeconomic status. Fewer opportunities to learn problem solving skills, low quality instruction, slowly paced curriculum, and a lack of evidence that tracking increases achievement in any of the tracked groups, are all arguments against the practice. The most widely supported negative factors associated with tracking are that tracking creates segregation, low social status, heterogeneous classes within

homogeneous tracks, and slower achievement of the students in low tracks (Brunello & Checchi, 2007; Chmielewski, 2014; Chmielewski et al., 2013; Hallinan, 1994; Oakes, 1986; Slavin, 1990). Literature examining the effectiveness and equity of ability grouping while using high quality educators, ensuring all groups receive rigorous instruction, and appropriately placing students in groups that can be supportive regardless of race, gender, and socioeconomic status is sparse due to the lack of quality programs that group students appropriately.

Proponents of Grouping Practices

Proponents to grouping practices are manifested by the number of associations and groups that advocate and support the education of gifted and talented students. The National Association for Gifted Children, Davison Institute for Talent Development, Association for the Gifted Council for Exceptional Children, National Society for the Gifted and Talented, Connie Belin and Jacqueline Blank International Center for Gifted Education and Talent Development, National Foundation for Gifted and Creative Children, and many local organizations support the education of gifted students recognizing that the academic, emotional, and social needs of most gifted and talented students goes unmet. These organizations advocate for gifted and talented students to be presented with a rigorous and challenging academic experience.

Types of Grouping and Acceleration

Several types of grouping are used to place students in classroom settings.

Tracking

Tracking refers to a type of ability grouping in which students are placed on academic pathways of learning that are limitedly flexible, therefore not allowing for individual differences in growth of academic ability. Most opponents to tracking state that the practice of tracking only

further the disparity between students of varying socioeconomic classes and creates low expectations for students in lower tracks. Oakes (1985) focused on the tracking form of ability grouping and found little academic achievement growth for students, especially those in lower tracks, and placement in lower tracks was predominately students with behavioral difficulties. Many forms of ability grouping exist, but tracking is the most rigid and structured of the forms. In some schools, students are placed in a track in kindergarten and remain with the same cohort of students until middle school or high school. Tracking does not make accommodations for specific academic needs such as low academic performance in mathematics with high academic performance in reading. A student is placed in a specific track with disregard to their abilities in different academic subject areas. This is compounded by the problem of students in different tracks not receiving differentiated curriculum, varying expectations, and teaching quality among the various tracks (Brunello & Checchi, 2007; Kelly, 2004; Oakes, 1985, 1990). Research has explored tracking as an overall type of ability grouping, although three different types of tracking exist. Tracking's three forms are between-school streaming, within-school streaming, and course-by-course tracking. Each of these three forms may be found within a country, state, or individual school system.

Between-school streaming refers to grouping students according to academic ability who attend different school buildings based on their assigned track. This type of tracking is rare in the United States, especially since the 1950s *Brown vs. Board of Education* ruling citing that "separate educational facilities are inherently unequal" (*Brown v. Board of Education*, 1954). Germany predominantly used a three-tiered model of between-school streaming in the middle and high school grades until 2009. Germany has since combined the two lower levels of schools into one but still has the *Gymnasium* in middle grades and the *Fachoberschule*, or technical

school, in high school to serve students with the highest abilities (Organization for Economic Co-operation and Development (OECD), 2011). In the United States, the majority of schools designed to serve a specific population of ability defined students were found in the private sector with special schools for the gifted, magnet schools, or online schools offering highly accelerated pathways regardless of age.

Within-school streaming occurs in a school where students with differing abilities are placed in different subjects or classrooms for the entire school day. One factor that differentiates within-school streaming from flexible ability grouping is that the track where the student is placed often does not change for the entire school year and sometimes for every year the child attends that school. Within-school streaming is seen in American school systems predominantly in the elementary and middle grades. The 2009 Programme for International Student Assessment (PISA) examined the effects various types of educational tracking have on academic achievement. When comparing between-school streaming to within-school streaming and the effects on disadvantaged children, the author determined that:

If tracking is carefully designed and implemented to help these disadvantaged children catch up, it may actually lead to lower score disparities in later grades. This may explain why some countries that practice tracking have below-average score disparities between children with high and low parental education. However, this approach requires low-track classes to be *more* intensive than high-track classes, and in many tracked school systems the exact opposite is true. (Leicht, 2013, p. 8)

As with any type of educational approach to grouping students, it is important to emphasize how an initiative is implemented and the expectations set forth to students. In studies that oppose tracking, such as those conducted by Slavin (1987, 1990) and Oakes (1985), there were no comparisons between the type of tracking system present within schools or the degree to which curriculum was modified and rigorous expectations for each track examined. Within-school tracking is often used to provide a means for allowing efficiency in delivery of curriculum

content to a group of students in the same relative ability level. Accompanying this type of grouping should be an awareness of the varying ability levels of students within the groups. Even with high ability students the degree of their exceptionality can vary greatly.

Course-by-course tracking is implemented at the high school level where students are offered various levels of classes to take for certain subject areas. Honors, advanced placement, and dual enrollment classes for mathematics and English language arts are examples of this type of course-by-course tracking. Students are selected for specific tracks based on past academic performance and a review of their records. However, students or parents can request a change in track placement or opt to attend high level tracks for specific subjects and normal tracks for others. Course-by-course tracking is most prevalent in the United States, Australia, Canada, United Kingdom, Iceland, and Sweden (Chmielewski, 2014).

A review of the literature on the three main types of tracking is predominated by studies that cite the inequity caused between socioeconomic status and various levels of tracks. A challenge in education exists to close the achievement gap between different demographic groups of students and it is wise for policy makers and district leaders to examine systems and approaches to ability grouping that decrease the achievement gap.

Flexible Ability Grouping

Flexible ability grouping exists in many forms within schools, systems, and states. There are a variety of grouping arrangements that qualify as flexible ability grouping. The main characteristics of a grouping structure that qualifies it as flexible is the ability of students to frequently move in and out of groups depending upon need, skill level, multiple intelligence, or progress in the curriculum.

Mathematics and reading are the two curricular areas where the majority of research finds that its use promotes achievement (Robinson, Shore, & Enersen, 2007). The most popular forms of flexible ability grouping include the Joplin plan, between-class grouping, within-class grouping, cluster grouping, and the use of cooperative learning structures. Flexibility emerged as a key component of both the within-class grouping and the between-class grouping.

Cluster Grouping

The practice of placing students together in a classroom where they are with like ability peers is cluster grouping. This model prevents the formation of a classroom having both extremes of learning ability present and allows teachers to balance the level of differentiated instruction taking place and the types of curricular modifications necessary to meet the challenging academic needs of students in all cluster groups (Brulles, Peters, & Saunders, 2012; Brulles & Winebrenner, 2011; Pierce et al., 2011; Winebrenner & Delvin, 1998). Cluster grouping is also present in within-class ability grouping if the school is too small to have multiple classes of the same grade level where students are progressed through education according to the traditional k-12 model. In this setting clusters of like ability students are created that allow teachers to differentiate assignments for the different groups within the classroom.

The most empirically supported model for clustering students is the Schoolwide Cluster Grouping Model (SCGM) developed by Brulles and Winebrenner (2011). Many forms of cluster grouping existed prior to the SCGM; however, it presents a clear and systematic model for clustering students into classrooms on a building level and includes recommendations for training and classroom structure while providing little budget impact. The SCGM allows a school to service gifted students in an inclusionary setting on a full-time basis that also raises achievement scores for all students. All students, regardless of ability or potential, are

purposefully placed into classrooms that allow teachers to best meet the curricular needs through differentiation. The key component to the SCGM is that no extremes of academic achievement are placed in classrooms without other ability levels present. In a typical scenario for classroom placement, Classroom A would contain one to three gifted students, approximately seven high average students, 13 average students, and nine low average students. Classroom B would contain no gifted students, approximately 10 high average students, 12 average students, five low average students, and three far below average students. This is one classroom structure option presented in the SCGM and emphasizes the need for flexibility between the within-class groups that exist.

The most paramount feature presented by Brulles and Winebrenner (2011) is the need for training in curriculum modification and differentiated instruction. It is clear in the model that any form of grouping without curricular modification will produce no significant achievement gains and teachers need constant support and training in methods of differentiation that best support both the gifted and special education students in each classroom (Brulles & Winebrenner, 2011). This is supported by research from the Delcourt and Evans (1994) findings that grouping in any form is not sufficient to increase academic achievement with any of the ability levels. It must be accompanied by curricular and pedagogical changes that reflect the needs of the students in order to be successful.

Cluster grouping research using longitudinal achievement data was conducted by Gentry and Owen (1999) with a school implementing the SCGM. Their findings revealed positive achievement gains for students in each cluster group, not just those grouped with high ability. Students in grades 3-5 were followed for 3 years to track reading and math achievement between two treatment groups (cluster groups and a group of students receiving instruction in a

heterogeneous setting). The study determined that there was a statistically significant difference in reading achievement whereas no statistically significant difference was found in math achievement between the groups. Gentry and Owen (1999) attributed this lack of difference to the possibility that scores in the treatment group began much higher than those in the control group, therefore giving less opportunity for measureable growth.

Brulles, Saunders, and Cohn (2010) quantitatively examined the district level of mathematics achievement between gifted students placed in cluster grouped classrooms as compared to those who received no specific gifted education instruction or curricular modifications. They found that 72% of gifted students participated in a heterogeneous cluster grouped classroom receiving instruction by a teacher who had been trained in modifications necessary to support the gifted learner. The other 28% of students identified as gifted were placed in heterogeneous classrooms with teachers who did not attend professional development in gifted education or attend cluster group meetings where curricular modifications were discussed. Results of the research showed that in the classes containing cluster grouped gifted students, student learning and achievement was significantly higher than in classes where gifted students were placed with regular heterogeneous groups. Brulles et al's. (2010) findings supported those of Delcourt and Evans (1994) that regardless of the grouping strategy, curricular modifications that meet the needs of gifted learners are the most important factor in supporting academic achievement.

Between Class Grouping

Between class grouping is also known as cross-grade grouping, the Joplin plan, and specific subject grade skipping. The main premise behind between class grouping strategies is the placement of students in classes according to skill level. Kulik and Kulik (1992) conducted a

meta-analysis examining five grouping strategies for gifted students. The results on cross-grade grouping showed that, of the 14 studies examined, 11 found an increase in student achievement when participation in cross-grade grouping was implemented within the school.

Response to Intervention (RTI) is a between class grouping framework designed to close the achievement gap by providing specific instruction in skill gaps for students who are scoring below basic. Instead of addressing specific skill gap areas in a determined grade level, students are multi-age grouped for either math or English language arts interventions based upon common skill areas that need to be addressed. Educators are encouraged to also include gifted students in the RTI process. The structure of RTI provides the gifted student with an opportunity during the day to work at advanced levels with students, especially in grades k-5. Buffum, Mattos, and Weber (2012) stated that, “The purpose of RTI is to ensure high levels of learning for every child, and our actions must be guided by that purpose” (p. 6). In the *State of Tennessee RTI² Manual* the inclusion of gifted students is encouraged in the RTI process at the tier-2 level by providing those students with enrichment and reinforcement opportunities (Tennessee Department of Education, 2015). An RTI group may include students who are below or above grade level for the skill area addressed. However, the skill being taught during the intervention time is one that is developmentally appropriate and not yet mastered by the students in the group, regardless of their grade level or age.

Using a response to intervention framework to service the needs of gifted and talented students in between class groups requires specific implementation components to be successful. Seedorf (2014) conducted a qualitative study examining the specific themes that must be present in the three tiered identification and instruction model. The five themes identified by Seedorf (2014) include:

1. pedagogical best practices with gifted and talented students,
2. support from administration,
3. continuous professional development to better serve all three tiers in RTI,
4. providing adequate time for collaboration to conduct action research through progress monitoring of all students, and
5. highly effective differentiated work in the core curriculum delivered through Tier I instruction.

These five themes are critical not only for gifted and talented students but for all students in the RTI framework. Ensuring these five themes are present for all levels of students is the key component to a successful between-class grouping strategy in a school setting. Using the RTI framework and integrating it with existing gifted and talented programs differentiates between class grouping from tracking. Opponents to ability grouping and tracking mention that “putting the least capable and least motivated students together in a class with a curriculum that is less challenging and moves at a slower pace increases the achievement gap and is detrimental to students,” (DuFour, 2010, p. 23). The RTI framework directly addresses this by advocating that student groups for Tier 2 and Tier 3 should be accelerated and provided with interventions that research has proven to increase student achievement within the specific skill deficit area. The between class grouping design allows students to be in heterogeneous groups in regards to intellectual ability, while creating homogeneous groups in regards to the skills being addressed using small group instruction. RTI is designed as the framework that supports all students and only occurs during a small part of the day; it still allows the opportunity for gifted and talented students to interact with their intellectual peers.

Acceleration

Academic acceleration of students is considered an academic intervention in which students are advanced through their educational program at a rate faster than their age or grade level peers. A review of the literature shows that modern authors continue to reference the original definition of acceleration developed by Pressey (1949) in one of the first compilations on the use of acceleration as a practice for meeting the needs of advanced students. Acceleration is a form of ability grouping because students are placed in a setting that is separate from that in which normal age peers or grade level peers progress through traditional school structures. Acceleration contains a framework that encompasses categories, forms, and types that delineate if it is considered a service delivery model or a curriculum model (Assouline & Lupkowski-Shoplik, 2005; Callahan & Hertberg-Davis, 2013; Colangelo et al., 2010; Lipscomb, 2003; Southern & Jones, 1991). One guiding question that classifies the two interventions of content-based and grade-based acceleration is: Does the intervention shorten the number of years a student spends in the traditional k-12 school structure? If the intervention shortens the number of years a student spends in school, then it is in the grade-based acceleration category. Content-based acceleration includes all other forms of accelerative interventions provided to a student. Within each of the two categories – content-based and grade-based – there are several forms of accelerative options and various types of those options.

Many of the forms and types of acceleration are discussed but not limited to those in this review of literature, as at least 15 types of acceleration have been identified (Southern & Jones, 1991). The service delivery model of acceleration is determined by the type of intervention delivered, the curriculum model used, the rate, and sequence that material is covered. In *Evidence Trumps Beliefs: Academic Acceleration Is an Effective Intervention for High-ability*

Students, Colangelo, Assouline, and Marron (2013) stated, “The goal of acceleration... is to provide an appropriate and equitable education to high-ability students by matching the level, complexity, and pace of the curriculum with a student’s level of cognitive and academic development” (p. 164). Acceleration is an academic intervention in which students can be assured a Free and Appropriate Education (FAPE) as identified in the Individuals with Disabilities Education Act (IDEA) of 2004.

Empirical research supporting acceleration interventions is robust and spans 60 years in regards to its positive effects on academic achievement (Assouline & Lupkowski-Shoplik, 2005; Colangelo et al., 2004; Kulik & Kulik, 1991; Ma & Cartwright, 2003; Pressey, 1949; Sayler & Brookshire, 1993; Southern & Jones, 1991, 2004; Steenbergen-Hu & Moon, 2011; Wells, Lohman, & Marron, 2009). However, research addressing the social-emotional effects of students is more limited yet still shows positive effects when compared to nonaccelerated peers. Steenbergen-Hu and Moon (2011) conducted a meta-analysis in which 38 primary studies were synthesized to examine both academic achievement and social-emotional development. Steenbergen-Hu and Moon found that academic acceleration positively affected gifted students’ academic achievement, ($g = 0.180$, 95% CI = $-0.72, .431$ under a random-effects model) and the effects on social-emotional development to be slightly positive ($g = 0.076$, 95% CI = $-.025, .176$ under a random-effects model). Steenbergen-Hu and Moon concluded that students who are accelerated surpass achievements of nonaccelerated students quantitatively in achievement test performance, university and college grade point averages, and career income attainment. Qualitatively, accelerated students also have a higher self-concept, self-efficacy, and higher quality of life than their equally able nonaccelerated peers. Research supporting acceleration does not often bifurcate into evidence supporting one category of acceleration over another but

rather examines the intervention practice as a whole to support the use as a best practice in gifted education.

Content-based acceleration occurs when a highly individualized plan of service delivery or curriculum is needed for an individual or small group of students before their expected age or grade level peers will encounter the content (Southern & Jones, 2004). Students participating in a content-based acceleration model are accelerated through the curriculum in a specific subject and the content learned is most often based on grade level standards and not enrichment or inquiry exploration projects. Content-based acceleration occurs most often with one subject area in which a student progresses through advanced material associated with a grade level and is based on that grade level's curriculum standards. Content-based acceleration can occur in a variety of settings and types that determine if the intervention is a service delivery model or a curriculum model. Examples of content-based acceleration include single-subject, curriculum compacting, curriculum telescoping, dual enrollment, credit by examination, Advanced Placement (AP) courses, International Baccalaureate (IB) programs, and some forms of between class grouping strategies. Types that are service delivery models include single-subject acceleration in which a student remains with grade level peers all day except during one period of the day when the student attends a higher grade level for a particular subject or a group of students traveling to a nearby high school for a morning class in a specific subject area and traveling back to their home school for the remainder of classes. Most types of content-based acceleration are of the curriculum model in which the curriculum that a student is exposed to is noticeably different from their age or grade level peers and can occur within the regular classroom, different grade level classroom, or building (Colangelo et al., 2010).

Often content-based acceleration occurs in the student's regular classroom. For example, a student is given an individualized learning plan and receives small increments of instruction from the classroom teacher on topics that are one or more grade levels above the student's current placement, often using a textbook from the advanced grade level. VanTassel-Baska (2010a) addressed this form of differentiated curriculum and noted that in designing curriculum that is content-based for gifted learners, best practices in curriculum and instruction still apply. An essential component to the curriculum is the establishment of goals and outcomes regarding student performance and identifying means of supporting student achievement. These goals are the gold standard for student achievement and are directly drawn from the standards in a particular discipline. Identification of knowledge, reasoning, process, and product standards and the expected clear learning targets for each standard are essential for a high quality curriculum (Chappuis, 2015). Content-based acceleration alleviates the claim from opponents regarding the social and emotional stresses that are often associated with other forms of acceleration. However, content-based acceleration is found to be difficult in many school settings because of scheduling concerns or the advanced instruction qualifications of the classroom teacher.

Content-based acceleration is often used as a strategy to prevent underachievement in one or two subjects. Underachievement among gifted students is typically present when students are expected to conform to the learning rate of their lower performing peers (Rimm & Lovance, 1992). Using content-based acceleration is an academic intervention that can support the academic and social-emotional needs of high-ability learners and often the type of system delivery and curriculum model may blend to best suit the individual student.

Grade-based acceleration is a much narrower set of acceleration interventions offered to students and includes early entrance to kindergarten, whole-grade acceleration, grade

telescoping, and early graduation to allow early entrance into college. Early entrance to kindergarten does not shorten the number of years a student spends in the traditional school structure but does serve to reduce the time a student must wait to begin developmentally appropriate content. Most types of grade-based acceleration are system delivery models due to the nature of how and where the delivery occurs. Grade telescoping is a curriculum model in which a student or group of students are delivered 3 years of curriculum in a 2-year span with a focus on higher cognitive concepts and less skills and drill. Grade-based acceleration is most often criticized for its effect on the social-emotional development of gifted or talented students; this belief is not substantiated by the research. Ma and Cartwright (2003) conducted a study using the Longitudinal Study of American Youth (LSAY) to examine the effects of early acceleration in mathematics on students in grades 7-12 regarding their self-esteem. Results of the study showed that between grades 7 and 8 there was no significant difference between the self-esteem of accelerated versus nonaccelerated youth. However, between grades 9 and 12 there were slightly higher self-esteem values for the accelerated youth. Ma and Cartwright (2003) also noted that the between school comparisons varied greatly, indicating that the experience within a specific school setting also plays a role in the student's self-esteem. Any educational intervention is coupled with environmental and cultural factors that affect program success, and acceleration – especially grade-based acceleration – is no exception to this external factor. Overall, grade-based acceleration is a viable option for meeting the needs of high-ability learners. Policy makers and districts should evaluate each child to see if content-based or grade-based acceleration would be a better option to meet the child's academic and cognitive needs.

Student Self-Efficacy

Self-efficacy is evident in mathematics study and has long been studied by cognitive behavioral theorists.

Self-Efficacy in Mathematics

The impact of self-efficacy on academic achievement, life satisfaction, degree attainment, and career success has been studied by many theorists. Bandura is a major theorist in self-efficacy and proposed that there were four primary sources of self-efficacy that determine our perceived ability to perform and complete a variety of tasks. The four contributing factors are (Bandura, 1997):

1. Mastery Experience – personal perception of one’s own performance in regards to specific tasks;
2. Vicarious Experience – comparison of one’s own performance in regards to his or her peer’s;
3. Social Persuasions – interpersonal messages received from society, teachers, parents, and friends; and
4. Physiological Status – emotional and cognitive readiness of one to understand the task.

Each of the four areas is applicable to exploring self-efficacy in mathematics and serves as a guiding framework for the collection of data in regards to specific academic subject areas or overall self-efficacy. The four factors identify areas of examination and acknowledge that self-efficacy is not a singular idea or theoretical structure that can be measured independently from external factors. Classroom environment and teacher influence directly affect each of these four factors and shape a student’s mathematics self-efficacy. In a large scale study conducted in

southern California researchers used fourth, fifth, and sixth grade students to examine the effect of classroom environment on self-efficacy and mathematics achievement. The study showed that classrooms that were viewed as more challenging, caring, and mastery oriented had a significantly higher self-efficacy rate and that these higher rates were directly correlated to higher predicted mathematics achievement (Fast et al., 2010). Classroom environment directly affects all four of the contributing factors to self-efficacy.

In examining mathematical thinking with a perspective on gifted individuals it is necessary to explore what constitutes mathematical thinking. Mathematical thinking includes a variety of cognitive behaviors that include persevering in solving a complex problem, planning a solution pathway, demonstrating flexibility with representations, linking prior knowledge, inductive and deductive reasoning, identifying patterns, working with complex structures within a context, and engaging in productive metacognitive processes to successfully reach a solution (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010). An individual who is truly mathematically gifted or talented will possess these mathematical thinking behaviors in conjunction with the characteristics of a gifted individual, thus producing a set of mathematically gifted characteristics one should possess to demonstrate being gifted or talented in mathematics.

Motivation and task commitment are two important characteristics of gifted or talented individuals in mathematics. These characteristics are important components of mathematical self-efficacy. Gifted or talented individuals are a subgroup of students who are more likely to accurately assess their mathematical self-efficacy (Pajares, 1996b). However, grouping dynamics such as acceleration have impacted mathematical self-efficacy. Some researchers attribute this to the Big-Fish-Little-Pond Effect (BFLPE). In many instances, gifted or talented students who

were heterogeneously grouped had a higher mathematics self-efficacy than that of their homogeneously grouped peers. This was attributed to the peer reference group in which students were placed (Goetz, Preckel, Zeidner, & Schleyer, 2008; Pajares, 1996b).

Math self-efficacy is most widely researched in regards to its effect on academic achievement. Literature was lacking in regards to specific research examining grouping strategies on mathematical self-efficacy. Generalizations can be made in regards to grouping strategies and their effects on mathematics self-efficacy when the classroom environment and the factor of vicarious experience are used as influential factors. It would stand to reason that if the vicarious experience factor is shaped by one's peers and students are grouped with intellectual peers rather than age or grade only peers, grouping would play some role in the development of mathematical self-efficacy. Pajares (1996a) examined the problem-solving abilities of students in relation to self-efficacy and general mental ability. They reported that mathematics self-efficacy influenced mathematics achievement as strongly as overall mental ability. In a comparison of regular education students and gifted students the "self-efficacy of regular education students was directly influenced by prior achievement but not by cognitive ability; conversely, the self-efficacy of gifted students was directly influenced by cognitive ability but not by prior achievement" (Pajares, 1996a, p. 338). The implication that a student's self-efficacy to accomplish a task is just as important as his or her true mental ability to complete the problem is profound for the field of educational psychology. Districts and classrooms would be well served to examine ways to increase student self-efficacy and consider it just as important as the content and standards addressed in the classroom.

Gender and Mathematics Self-Efficacy

Cheema and Galluzzo (2013) used results from the 2003 Program for International Student Assessment (PISA) questionnaire to determine if gender had an influence on mathematical self-efficacy for students in the United States. Their findings were that math self-efficacy accounted for at least 10% of the total discrepancy in math achievement and that when math achievement and math self-efficacy were correlated the results, “had a moderate positive association with math self-efficacy, $r = 0.54$, $p < 0.001$... self-efficacy contribute[s] significantly towards explaining variation in math achievement” (Cheema & Galluzzo, 2013, p. 104). However, when using a multiple regression analysis that added in mathematics anxiety, mathematics self-efficacy, and their influence on academic achievement in mathematics, the gender achievement gap disappeared. When combined, mathematics anxiety and mathematics self-efficacy accounted for 49% of the total influence on mathematics achievement. In fact, Cheema and Galluzzo (2013) report that race, not gender, had the largest effect on mathematics achievement. This was followed by self-efficacy, socioeconomic status, and math anxiety. The study had serious implications for education in regards to closing the perceived gender gap in mathematics. If mathematics self-efficacy is a much stronger predictor than gender or socioeconomic status, it deserves much more research and analysis than the literature presents (Cheema & Galluzzo, 2013). While it is clear that math self-efficacy is a predictor of mathematics achievement, research is also lacking in relating grouping practices, math self-efficacy, and gender. This study will address the impact of acceleration on math self-efficacy and examine if differences exist between genders among the groups.

In a study examining self-efficacy beliefs and mathematical problem solving abilities with middle school gifted students who are mainstreamed in an Algebra class with regular

education students, Pajares (1996b) reported that female students exceeded male students in mathematical academic achievement but not in self-efficacy. Two meta-analyses on the effects of flexible ability grouping found significant effect sizes for achievement in all ability levels. Kulik and Kulik (1991) reported an overall effect size of +.25 and Slavin (1987) reported an overall effect size of +.34 for within-class flexible grouping models. These two studies did not directly address the issue of the effect of acceleration on mathematics self-efficacy and gender differences. They were pertinent to the study as they supported that flexible grouping provides positive effects on achievement, allowing us to examine gender differences in the context of flexible grouping and acceleration without invalidating the study results.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study was to determine if there was a significant difference in the total mathematical self-efficacy scale scores, the mathematical task self-efficacy scale score, and the math-related school subjects self-efficacy scale score for middle school students between students assigned to a homogeneously grouped accelerated math class and students assigned to a heterogeneously grouped regular math class. This chapter describes the research methodology used in this study. It is organized into seven sections including the research design, research questions and corresponding null hypotheses, instrumentation, population, the data collection procedure, overview of the data analysis, and a summary of the chapter.

Participants in this study were eighth grade students during the 2015-2016 academic school year in eight school systems in Northeast Tennessee. All students chosen took the Tennessee Comprehensive Achievement Program (TCAP) as seventh graders during the 2014-2015 school year and scored at or above the 90th percentile in all RCPI categories for mathematics. This study examines the differences in mathematics self-efficacy between students homogeneously grouped in an accelerated eighth grade Algebra I class and students heterogeneously grouped in a regular eighth grade math class. The National Association for Gifted Children defines giftedness as students scoring in the top 10% of achievement in their domain. In this study mathematics is the domain determining the gifted or talented status of the participants (NAGC, 2010). Groups were chosen based upon heterogeneous and homogeneous grouping strategies implemented in the school. The homogeneous grouping strategy targeted in this study is that of acceleration in which eighth grade students complete the Algebra I curriculum instead of the eighth grade standards being studied by the heterogeneously grouped

students. In order to increase generalizability of the study to gifted or talented students, survey data were collected from eighth graders in Northeast Tennessee representing a cross section of demographic and socioeconomic subgroups.

An existing survey instrument, the Mathematics Self-Efficacy Scale (MSES), was used for convenience, validity, and reliability. The MSES measures two domains of mathematics-related behaviors and capabilities. *Mathematics Task Self-Efficacy* and *Math-Related School Subjects Self-Efficacy* are scored separately and holistically on the survey instrument.

Quantitative data analysis techniques included descriptive statistics and inferential statistics using an independent samples *t*-test were analyzed. Participants in the study were assigned to the heterogeneous or homogeneous group by their schools and were not controlled by the researcher. Students within the groups were chosen as participants based on their math ability and scores on the seventh grade TCAP test. At the time of the survey these students attended either a k-8 elementary school or a middle school in Northeast Tennessee.

Research Questions and Null Hypotheses

The research questions help expand the depth and breadth of knowledge that exists regarding grouping and acceleration in mathematics and its influences on mathematics self-efficacy between general populations of gifted or talented students by gender. The questions serve to provide data to guide decision making by the stakeholders involved who create policy, develop curriculum, and design district level programs for students classified as gifted or talented in mathematics. Nine research questions and corresponding hypotheses were developed to serve as a guide for completing the study.

RQ1. Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:1 There is no significant difference in mathematical self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ2. Is there significant difference in mathematical self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:2 There is no significant difference in mathematical self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ3. Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:3 There is no significant difference in mathematical self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ4. Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:4 There is no significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ5. Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:5 There is no significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ6. Is there significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:6 There is no significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ7. Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:7 There is no significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ8. Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:8 There is no significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

RQ9. Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:9 There is no significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school male students between those

assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

Instrumentation

The instrument used in this study to gather information on student self-efficacy was the Mathematics Self-Efficacy Scale (MSES) (Betz & Hackett, 1993). The MSES was developed by Betz and Hackett (1983) and measures two domains of mathematics-related behaviors and capabilities. The solving of math problems related to everyday life and perceptions of performance in math related college courses is measured in two parts of the survey instrument. Part 1 of the survey is *Mathematics Task Self-Efficacy* and is designed to measure the level of confidence the student would have when successfully completing the given task. Part 2 of the survey instrument is *Math-Related School Subjects Self-Efficacy* and is designed to measure the level of confidence the student would have when successfully completing a college level course with a final grade of an A or B. Both parts of the MSES may be scored and individual means calculated in addition to holistically scoring to obtain a total score representing overall mathematical self-efficacy.

The MSES has been tested for both reliability and validity with internal consistency reliability values (coefficient alpha) of .96 for the total scale and .92 for both the *Mathematics Tasks* and *Math-Related School Subject* portions of the test (Betz & Hackett, 1993). These values were calculated using Cronbach's alpha, which is commonly used as a tool to assess the reliability of Likert-type scaled questions. Cronbach's alpha is "the most common measure of internal consistency ("reliability"). It is most commonly used when you have multiple Likert questions in a survey/questionnaire that form a scale and you wish to determine if the scale is reliable" (Laerd Statistics, 2013, para. 1). The MSES has research supporting content,

concurrent, and construct validity. Total MSES scores were tested twice by Betz and Hackett for concurrent validity in 1983 and 1993. Each time the “total MSES scores were as follows: math anxiety ($r = .56$), confidence in doing math ($r = .66$), perceived usefulness of math ($r = .47$) and effectance motivation in math ($r = .46$)” (Betz & Hackett, 1983, p. 11, as cited in Betz & Hackett, 1993). Tables reporting the means, standard deviations, gender comparisons, and approximate percentile equivalents for the MSES are shown in Appendix B. Because this noncognitive survey measures attitude and is a self-reported instrument, it is inherently susceptible to subject faking and response set, which may affect the accuracy of the results reported (McMillan & Schumacher, 2006).

Population

The population for this study included students in Northeast Tennessee public school systems in eighth grade for the 2015-2016 school year. Student participants were administered the mathematics TCAP during the 2014-2015 academic year as seventh grade students and were identified as being gifted or talented in mathematics based on scoring at or above the 90th percentile on the RCPI category for mathematics. These eighth grade students were in either a homogeneously grouped eighth grade accelerated math class taking Algebra I or a heterogeneously grouped eighth grade math class studying the Common Core State Standards. The *advanced* level is identified as,

Students who perform at this level demonstrate **superior** mastery in academic performance, thinking abilities, and application of understandings that reflect the knowledge and skill specified by the grade/course level content standards and are significantly prepared for the next level of study. (Tennessee State Board of Education, 2009, p. 3)

For this research the student’s Reporting Category Performance Index (RCPI) for each category of mathematics was used to determine a student scoring at or above the 90th percentile in all

areas of mathematics during the 2014-2015 academic year. RCPI results can be used to help identify areas of student strengths and needs in each reporting category. Students selected for the study scored at the Advanced level in all RCPI categories at the 90th percentile or above (Tennessee State Board of Education, 2009). It is accepted in the gifted education community and with implicit theorists that the terms gifted and talented are interchangeable terms and that giftedness is not based solely upon the Intelligence Quotient (IQ) but rather a many faceted concept (Gardner, 1983, 1999, 2006, 2011; Plucker & Callahan, 2008; Renzulli, 2002, 2009, 2011; Sternberg, 1986, 2004). Therefore, for this study a student did not need to be participating in a gifted and talented program or identified by Tennessee as intellectually gifted to be included. Rather, scoring at or above the 90th percentile in all RCPI categories in mathematics is the definition of gifted or talented in mathematics for this study.

Data Collection

Approval was granted by the Institutional Review Board (IRB) at East Tennessee State University for this study (see Appendix C). The survey was administered online and by paper and pencil in the spring semester of 2016 after securing written permission from the Director of Schools in the participating districts, respective building level administrators, parents of the participants, and the participating students (see Appendix D). The classroom teachers acknowledged the privacy and ambiguity of the participants by signing a confidentiality form prior to administering the surveys. Classroom teachers have permission to view student achievement data obtained from the Tennessee Comprehensive Achievement test, and the information was reviewed for students in each group by the classroom teacher with no identifying information obtained or used by the researcher regarding achievement data. Based on the population criteria for selection in the study, two groups of students were identified as being

gifted or talented. One group of students participated in a homogeneously grouped accelerated math class by taking Algebra I in eighth grade. The second group of students participated in a heterogeneously grouped math class in eighth grade. Both student groups were given the Mathematics Self-Efficacy Scale (see Appendix E) consisting of 34 questions designed to measure perceived ability regarding mathematical tasks and behaviors (Betz & Hackett, 1993). The Mathematics Self-Efficacy Scale is a 10-value Lickert-type scale ranging from *no confidence at all* to *complete confidence* (McMillan & Schumacher, 2006). Data were collected for part 1 (Mathematics Task Self-Efficacy) and part 2 (Math-Related School Subjects Self-Efficacy). The scores were combined to obtain a total mathematics self-efficacy score.

The surveys were given only to those students who scored at the *advanced* level in all RCPI categories at the 90th percentile or above. The student's scores were examined by the teacher of record and students were chosen based on the criteria. Other than determining the criteria for selection in the study, the researcher had no knowledge of student names, demographic information, socioeconomic status, or life situation. A research packet was mailed to the school where the survey was conducted. Included in the research packet were the criteria and directions for selection of students within each group, directions and protocol for sending the packet home and collecting parent and student permission forms, the survey booklets, instructions for taking the survey online with Google forms, an entry form for a gift card drawing for the teacher, and a postage-paid return envelope for return of permission forms and any surveys that were taken on paper. Students were given the option to take the survey online or with the provided booklet. The online survey is a duplicate of the printed version and was created in Google forms to aid with data collection. The researcher assigned a unique identifier code to the top of the booklets and the online Google form for the heterogeneous and

homogeneous groups to differentiate the group of students from which returned the survey or online Google form had originated. Once permission was granted to take the survey by parents and students, the paper copy and a link to the Google forms online survey were provided to the student. Students chose to take the survey online or on paper, which was dependent upon preference and Internet availability at the student's home.

A nonrandom sample of 198 heterogeneously grouped and 159 homogeneously grouped students classified as gifted or talented in mathematics were surveyed. Names of classroom teachers agreeing to assist in the dissemination, administration, collection, and returning of the surveys were placed in the drawing for a \$200 gift card to Walmart as an incentive for supporting the research. The findings in this research may not be generalizable to other groups of gifted or talented students in mathematics.

Data Analysis

Data obtained from the surveys were divided into the groups of homogeneous and heterogeneous students. Scores from each item on part 1, part 2, and the total scores for each part and overall were entered into SPSS. Descriptive statistics were used to evaluate each part of the survey and the survey total to examine the frequency distribution of responses to each question on the scale. Measures of central tendency for each item were also calculated. Descriptive statistics were used for organizing and summarizing the inevitable variability in the collection of actual observations or scores (Witte & Witte, 2007). Nonnumeric data, such as gender and associated group, were coded as nominal data (1 = heterogeneously grouped, 2 = homogeneously grouped). The descriptive statistics were used to examine overall trends in mathematics self-efficacy for the population of gifted or talented students as a whole.

Inferential statistics were used to analyze the null hypotheses associated with each research question. Nine null hypotheses were tested using a series of independent samples *t*-tests. All data were analyzed at the .05 level of significance. According to Witte and Witte (2007) two independent samples are created when the samples of populations are independent of each other and are not paired on a one-to-one basis with each other between the samples.

Chapter Summary

This study describes the relationship among mathematics self-efficacy and the grouping practice of acceleration; it examines the influence that gender has on mathematics self-efficacy scores between the groups. The Mathematics Self-Efficacy Scale survey was used as the research design and instrument for this study. This survey measured two domains of a student's mathematical self-efficacy. Part 1 of the survey measured *Mathematics Task Self-Efficacy* and part 2 measured *Math-Related School Subjects Self-Efficacy*. The mean scores for each student were calculated with each part of the survey and for the survey as a total score. A series of independent samples *t*-tests were used to address the research questions and null hypotheses.

CHAPTER 4

FINDINGS

The purpose of this study was to evaluate a theoretical model that described the relationship among mathematics self-efficacy and the grouping practice of acceleration and examined the relationship between gender and mathematics self-efficacy. The study was focused on middle school gifted or talented students who were in either a homogeneously grouped eighth grade accelerated math class taking Algebra I or a heterogeneously grouped eighth grade math class studying the Common Core State Standards. The instrument used in this study to gather data on student self-efficacy was the *Mathematics Self-Efficacy Scale* (MSES) (Betz & Hackett, 1993). Part 1 of the survey – *Mathematics Task Self-Efficacy* – consists of 18 items and was designed to measure the level of confidence students would have when successfully completing the given task. Part 2 of the survey instrument – *Math-Related School Subjects Self-Efficacy* – consists of 16 items and was designed to measure the level of confidence students would have when successfully completing a college level course with a final grade of an A or B. Both parts of the MSES can be scored as subtests in addition to holistic scoring to obtain a total score representing overall mathematical self-efficacy. Differences between groups for subscores on the *Mathematics Task Self-Efficacy* and the *Math-Related School Subjects Self-Efficacy* were examined for the entire population and for gender differences.

The population consisted of 357 gifted or talented middle school math students in six school districts in Northeast Tennessee. Demographics for grouping and gender are reported in Table 1. Descriptive statistics are reported for total scores and frequencies for Part 1 – *Mathematics Task Self-Efficacy* (Figure 1) and Part 2 – *Math-Related School Subjects Self-Efficacy* (Figure 2).

Table 1

Students by Group and Gender

Gender	Homogeneous Group	Heterogeneous Group	Total
	<i>N</i>	<i>N</i>	<i>N</i>
Female	60	84	144
Male	99	114	213
Total	159	198	357

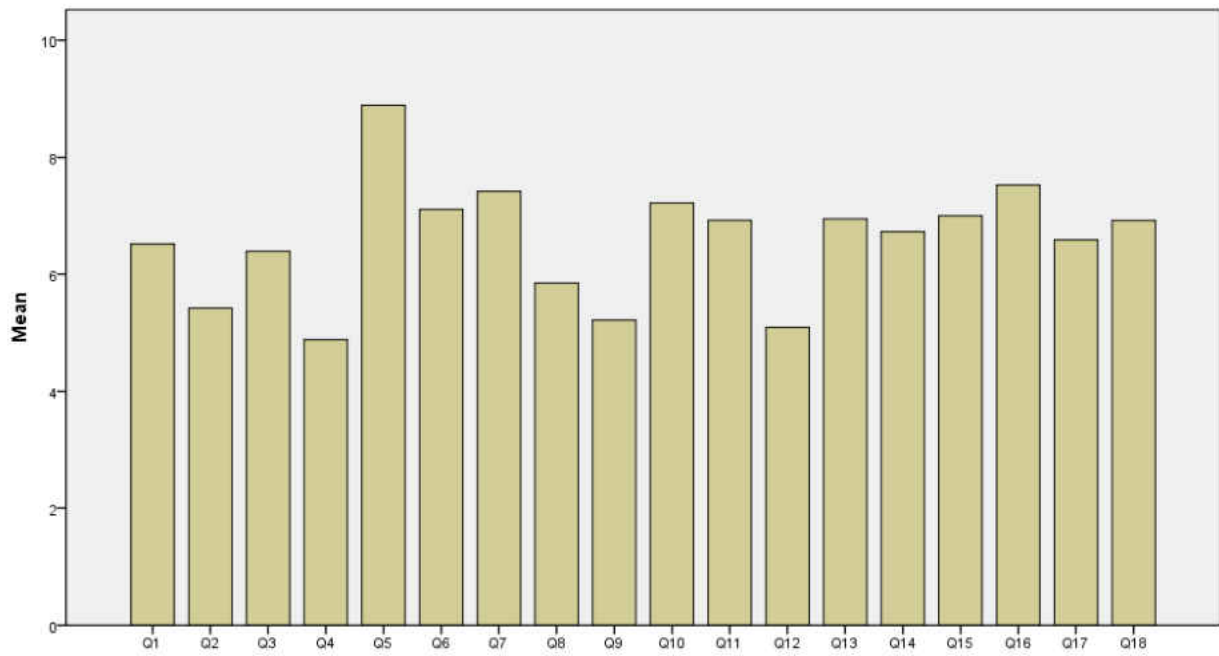


Figure 1. Total Score Average per Item on Mathematics Task Self-Efficacy

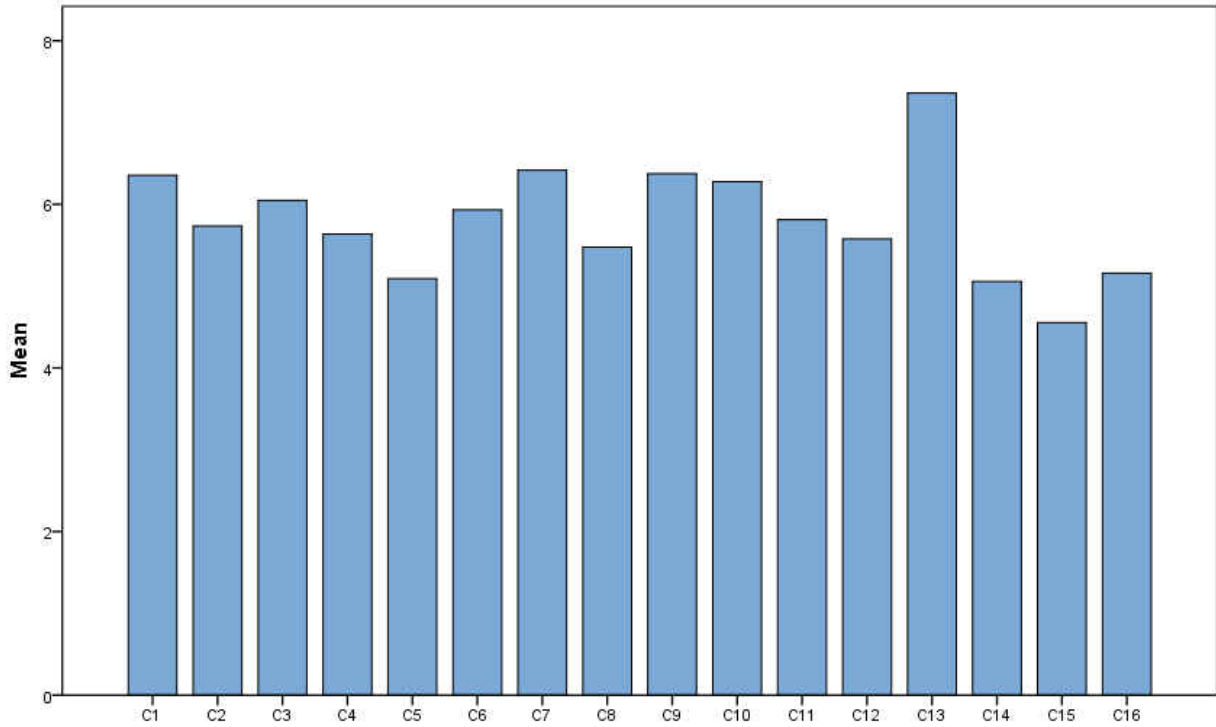


Figure 2. Total Score Average per Question on *Math-Related School Subjects Self-Efficacy*

Results of Analysis

Nine research questions and corresponding null hypotheses guided this study and are addressed in this chapter.

Research Question 1

Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

Ho:1 There is no significant differen in mathematical self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical self-efficacy scale scores between students who were homogeneously grouped and those who were heterogeneously grouped. The total mathematical self-efficacy scale score was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .89$) indicated equality of variances. The result of an independent samples t test indicated that the mean mathematical self-efficacy scale score for the homogeneous group ($M = 208.89$, $SD = 39.34$) was not significantly different from the mean mathematical self-efficacy scale score for the heterogeneous group ($M = 213.62$, $SD = 36.52$), $t(355) = 1.18$, $p = .240$. Therefore, $H_0:1$ was not rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -12.65 to 3.18. In summary, gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical self-efficacy scale.

Research Question 2

Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:2$ There is no significant difference in mathematical self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical self-efficacy scale scores between female students who were homogeneously

grouped and those who were heterogeneously grouped. The total mathematical self-efficacy scale score for females was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .08$) indicated equality of variances. The result of an independent samples t test indicated that the mean mathematical self-efficacy scale score for the female homogeneous group ($M = 200.3, SD = 36.66$) was not significantly different from the mean mathematical self-efficacy scale score for the female heterogeneous group ($M = 211.96, SD = 42.21$), $t(142) = 1.7, p = .087$. Therefore, $H_0:2$ was not rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -25.03 to 1.7 . In summary, female gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical self-efficacy scale.

Research Question 3

Is there a significant difference in mathematical self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:3$ There is no significant difference in mathematical self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical self-efficacy scale scores between male students who were homogeneously grouped and those who were heterogeneously grouped. The total mathematical self-efficacy

scale score for males was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .098$) indicated equality of variances. The result of an independent samples t test indicated that the mean mathematical self-efficacy scale score for the male homogeneous group ($M = 214.09, SD = 40.16$) was not significantly different from the mean mathematical self-efficacy scale score for the male heterogeneous group ($M = 214.84, SD = 31.83$), $t(211) = .152, p = .880$. Therefore, $H_0:3$ was not rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -10.48 to 8.98. In summary, male gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical self-efficacy scale.

Research Question 4

Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:4$ There is no significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical task self-efficacy scale scores between students who were homogeneously grouped and those who were heterogeneously grouped. The mathematical task self-efficacy scale score was the test variable and the grouping variable was the student's assignment to a homogeneously

grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .883$) indicated equality of variances. The results of an independent samples t test indicated that the mean mathematical task self-efficacy scale score for the homogeneous group ($M = 116.83, SD = 19.17$) was not significantly different from the mean mathematical self-efficacy scale score for the heterogeneous group ($M = 120.11, SD = 18.94$), $t(355) = 1.61, p = .107$. Therefore, $H_0:4$ was not rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -7.26 to $.712$. In summary, gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical task self-efficacy scale.

Research Question 5

Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:5$ There is no significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical task self-efficacy scale scores between female students who were homogeneously grouped and those who were heterogeneously grouped. The mathematical task self-efficacy scale score for females was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade

math class. The result of Levene's test ($p = .076$) indicated equality of variances. The result of an independent samples t test indicated that the mean mathematical task self-efficacy scale score for the female homogeneous group ($M = 121.67$, $SD = 16.1$) was not significantly different from the mean mathematical self-efficacy scale score for the female heterogeneous group ($M = 121.11$, $SD = 20.35$), $t(142) = .17$, $p = .860$. Therefore, $H_0:5$ was not rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -3.161 to -5.69 . In summary, female gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical task self-efficacy scale.

Research Question 6

Is there a significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:6$ There is no significant difference in mathematical task self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical task self-efficacy scale scores between male students who were homogeneously grouped and those who were heterogeneously grouped. The mathematical task self-efficacy scale score for males was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .713$) indicated equality of variances. The result of an

independent samples t test indicated that the mean mathematical task self-efficacy scale score for the male homogeneous group ($M = 78.63$, $SD = 27.42$) was significantly different from the mean mathematical task self-efficacy scale score for the male heterogeneous group ($M = 90.86$, $SD = 27.24$), $t(211) = 2.09$, $p = .009$. Therefore, $H_0:6$ was rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -10.632 to $-.307$. In summary, male gifted or talented students grouped homogeneously tended to have lower scores than those grouped heterogeneously on the mathematical task self-efficacy scale.

Research Question 7

Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:7$ There is no significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical school subjects self-efficacy scale scores between students who were homogeneously grouped and those who were heterogeneously grouped. The math-related school subjects self-efficacy scale score was the test variable and the grouping variable was the student's assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .146$) indicated equality of variances. The result of an independent samples t test indicated that the mean math-related

school subjects self-efficacy scale score for the homogeneous group ($M = 92.06$, $SD = 27.14$) was not significantly different from the mean math-related school subjects self-efficacy scale score for the heterogeneous group ($M = 93.52$, $SD = 23.65$), $t(355) = .54$, $p = .590$. Therefore, $H_0:7$ was not rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -6.75 to 3.83. In summary, gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the math-related school subjects self-efficacy scale.

Research Question 8

Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:8$ There is no significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical school subjects self-efficacy scale scores between female students who were homogeneously grouped and those who were heterogeneously grouped. The math-related school subjects self-efficacy scale score for females was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .713$) indicated equality of variances. The result of an independent samples t test indicated that the mean math-related

school subjects self-efficacy scale score for the female homogeneous group ($M = 78.63$, $SD = 27.42$) was significantly different from the mean math-related school subjects self-efficacy scale score for the female heterogeneous group ($M = 90.86$, $SD = 27.24$), $t(142) = 2.65$, $p = .009$. Therefore, $H_0:8$ was rejected. The standard effect size index, η^2 , was $< .01$ indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -21.35 to -3.1. In summary, female gifted or talented students grouped homogeneously tended to have lower scores than those grouped heterogeneously on the mathematical school subjects self-efficacy scale.

Research Question 9

Is there a significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class?

$H_0:9$ There is no significant difference in mathematical school subjects self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class.

An independent-samples t test was conducted to evaluate differences in the mean mathematical school subjects self-efficacy scale scores between male students who were homogeneously grouped and those who were heterogeneously grouped. The math-related school subjects self-efficacy scale score for males was the test variable and the grouping variable was the students' assignment to a homogeneously grouped Algebra I class or a heterogeneously grouped regular eighth grade math class. The result of Levene's test ($p = .044$.) indicated equality of variances. The result of an independent samples t test indicated that the mean math-related

school subjects self-efficacy scale for the male homogeneous group ($M = 100.19$, $SD = 23.62$) was not significantly different from the mean math-related school subjects self-efficacy scale score for the male heterogeneous group ($M = 95.47$, $SD = 20.52$), $t(211) = 1.56$, $p = .120$. Therefore, $H_0:9$ was not rejected. The standard effect size index, η^2 was .01 indicating a small effect size. The 95% confidence interval for the mean difference between the two groups was -1.24 to 10.67. In summary, male gifted or talented students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the math-related school subjects self-efficacy scale.

Chapter Summary

Chapter 4 reported the results of 357 middle school students in six school districts in Northeast Tennessee on the *Mathematics Self-Efficacy Survey* (MSES). The *Mathematics Self-Efficacy Survey* is a 34-item survey with responses given on a 10-point Likert scale. The survey was designed to gather information regarding students' beliefs about their ability to perform various math related tasks – *Mathematics Task Self-Efficacy* – and success on future math related college courses – *Math-Related School Subjects Self-Efficacy*. Three different scores for each student were examined including the total mathematical self-efficacy, the subtest of tasks, and the subtest of school subjects. Each of these was examined as related to gifted or talented students grouped homogeneously and those grouped heterogeneously. Chapter 5 summarizes the findings of the research, discusses implications for practice, and provides recommendations for further research.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Summary of Findings

This chapter presents a summary of findings for the nine research questions and corresponding null hypotheses that guided this study.

Research Question 1

Research question 1 interpreted the differences in mathematical self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the groups using an independent samples t test. Gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical self-efficacy scale.

Research Question 2

Research question 2 interpreted the differences in mathematical self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the female groups using an independent samples t test. Female gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical self-efficacy scale.

Research Question 3

Research question 3 interpreted the differences in mathematical self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the male groups using an independent samples *t* test. Male gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical self-efficacy scale.

Research Question 4

Research question 4 interpreted the differences in mathematical task self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the groups using an independent samples *t* test. Gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical task self-efficacy scale.

Research Question 5

Research question 5 interpreted the differences in mathematical task self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the female groups using an independent samples *t* test. Female gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical task self-efficacy scale.

Research Question 6

Research question 6 interpreted the differences in mathematical task self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. A significant difference was found between the male groups using an independent samples t test. Male gifted or talented middle school students grouped homogeneously tended to have lower scores than those grouped heterogeneously on the mathematical task self-efficacy scale.

Research Question 7

Research question 7 interpreted the differences in mathematical school subjects self-efficacy scale scores of gifted or talented middle school students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the groups using an independent samples t test. Gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical school subjects self-efficacy scale.

Research Question 8

Research question 8 interpreted the differences in mathematical school subjects self-efficacy scale scores of gifted or talented middle school female students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. A significant difference was found between the female groups using an independent samples t test. Female gifted or talented middle school students grouped

homogeneously tended to have lower scores than those grouped heterogeneously on the mathematical school subjects self-efficacy scale.

Research Question 9

Research question 9 interpreted the differences in mathematical school subjects self-efficacy scale scores of gifted or talented middle school male students between those assigned to a homogeneously grouped accelerated math class and those assigned to a heterogeneously grouped math class. No significant difference was found between the male groups using an independent samples t test. Male gifted or talented middle school students grouped homogeneously and those grouped heterogeneously tended to have similar scores on the mathematical school subjects self-efficacy scale.

Conclusion

The nature of gifted or talented students and their ability to learn and apply information at various levels of rigor warrants educators to be investigative of best practices in the field. While research is available regarding the socioaffective and academic needs of gifted individuals, more is needed to give definitive answers regarding best practices. Ma (2002) used data from the Longitudinal Study of American Youth (LSAY) database. The LSAY followed students who participated in early acceleration into secondary grade levels. The study indicated that acceleration provided significant growth in male students. Ma's (2002) result is contradictory to the results of the present study for Research Question 6.

There is no definitive best practice recommendation in the existing research regarding acceleration and its long-term effect on an individual. The self-efficacy of a student is just as important a focus as are the academic endeavors. Cheema and Galluzo (2013) indicated that other than race self-efficacy is the primary predictor of student achievement. Self-efficacy in a

subject area is a primary determining factor in achievement more than gender, socioeconomic status, or prior achievement.

The findings in the present study indicate that acceleration causes no harm to student self-efficacy. The number of schools included in the sample may have impacted the results that no significant difference existed between homogeneous and heterogeneous groups in Research Questions 1 through 5 and Research Questions 7 and 9. These results are supported by the findings of Steenburgen-Hu and Moon (2011) in their synthesis of 38 studies that found academic acceleration to have a positive impact on gifted students' academic achievement and whereby social-emotional impact was slightly positive. Literature that contradicted these findings reported that mathematical self-efficacy was higher in heterogeneous groups and attributed the difference to the student peer reference group (Goetz et al., 2008; Pajares, 1996b).

Mathematical self-efficacy has decades of research to support its importance in academic settings. A student's belief in his or her ability to successfully do mathematics is a contributing factor to success in high school and college. Conversely, a lack of mathematical self-efficacy is detrimental to the success of an individual (Pajares, 1996a). Education has a wealth of research, professional development, and programs to support the delivery of academic material to a student. Somehow over the decades the emotional side of teaching has been neglected. It is not just an educator's duty to deliver curriculum and design engaging lessons. It is also essential to positively influence how students think and feel about themselves academically and in terms of general self-efficacy and self-esteem. This gives the greatest direct impact on academic achievement without changing the delivery model and is important whether the student is heterogeneously or homogeneously grouped. The classroom teacher and school environment are

the primary opportunity that students have to experience encouragement in self-efficacy, especially for those with low socioeconomic status.

The present study does not support or discourage the practice of acceleration by retaining seven of the nine null hypotheses that there is no significant difference between homogeneously grouped eighth grade math students who were placed in accelerated coursework by taking Algebra I and those students who were heterogeneously grouped in a regular eighth grade math class. Research question 6 showed a significant difference in the mathematical task self-efficacy scale scores of male gifted or talented middle school students. The results of the study showed that heterogeneously grouped males have a higher mathematical task self-efficacy scale score than their homogeneously grouped male peers. Research question 7 showed a significant difference in the mathematical school subjects self-efficacy scale scores of female gifted or talented middle school students. Caution should be noted with male students and their self-efficacy regarding ability to complete complex math tasks and females in school subjects. Accountability measures must be in place to monitor and adjust the curriculum for all students who are given an accelerative option.

Students who are heterogeneously grouped may require that their individual needs are accounted for through high quality differentiated instruction. Gifted or talented students who are given the same curriculum as regular education students may not be receiving a fair and appropriate education (FAPE). Heterogeneous grouping that recognizes the individual needs of the student can still provide accelerative options within the classroom. A level of personalized learning should take place for these students to be provided a rigorous and challenging high quality education. Technology makes this easier for the classroom teacher to differentiate,

especially in rural settings. The ability to work with intellectual peers provides a positive and supportive environment in which students can relate to and understand one another.

Recommendations for Practice

The findings and conclusions of this research have led to ten recommendations for practice.

1. Acceleration into an Algebra I class for eighth grade students will not negatively impact their perception of total ability to complete math tasks or be successful in math related subjects. Districts should examine options to provided accelerative options to students, even in remote instances.
2. Districts should explore offering accelerated classes to middle school students that go beyond a higher level class like Algebra I. Compacting the curriculum is a best practice for middle school gifted or talented students and should be supported by the Common Core State Standards shown in Appendix A; provide recommendations for seventh and eighth grade students so that no learning is lost by placement into an Algebra I class.
3. The Common Core State Standards are a nationally recognized set of learning expectations that have been backwards designed from the ACT anchor standards. The council of teachers and leaders who developed these standards recognized the importance and value of accelerated options for middle school math students. They provide a structure to support districts in developing an accelerated standards option for seventh and eighth grade that support both the traditional and integrated pathways for mathematics. Districts should form a teacher committee with an extensive understanding of mathematics to develop a curriculum that reflects these standards.

4. Districts that choose not to offer accelerated options to gifted or talented students can best support higher level learning by providing training and professional development on differentiated instructional strategies. Much time should be invested in developing a high quality parallel curriculum for the highest achievers in a classroom (Tomlinson et al., 2002).
5. Provide and monitor social and emotional support for gifted or talented males in the classroom. The research supports that male beliefs regarding their ability to solve math tasks was significantly different between groups. The adolescent brain is susceptible to peer influence and environment; teachers should take note and provide these supports for gifted and talented male learners.
6. Provide and monitor social and emotional support for gifted or talented females in the classroom. The research supports that female beliefs regarding their ability to earn a high grade in college level math related subjects was significantly different between groups.
7. Mathematical self-efficacy is the highest predictor of college success in mathematics and STEM fields of study (Cheema & Galluzo, 2013; Fast et al., 2010; Hoogeveen et al., 2009; Louis & Mistele, 2012; Neihart, 2007; Schunk, 1991). This information should encourage schools to provide programs and structures to support student self-efficacy such as positive behavior programs, mentors, and peer groups.
8. Educate professionals, students, and parents about the nature of self-efficacy and ways to enhance it in students. An awareness of the importance of self-efficacy and an examination of the behaviors that can damage or enhance it will provide students

- with better opportunities for success. Response to behavioral interventions should provide for school climates where general self-efficacy and self-esteem are enhanced.
9. Examine acceleration options before embedding into the school curriculum and culture. Acceleration is a student-by-student decision and criteria that evaluate students for their ability to succeed in accelerated conditions should be established by the district. Socioeconomic status, parental support, previous achievement history, and general behavior are all considerations when choosing a student or an acceleration program.
 10. School counselors and mental health workers should also be aware of the special needs that accelerated students face and be another support mechanism.

Recommendations for Further Research

The results of this study indicate that further research is needed to determine the greater impact that acceleration has on gifted or talented students and general self-efficacy and mathematical self-efficacy. These nine recommendations for further research will further our knowledge and understanding of the nature of giftedness in a middle school setting.

1. A qualitative study to examine specific student beliefs and perceptions regarding being gifted or talented in mathematics independent of the academic program in which the student participates and the role of gender upon these beliefs and perceptions.
2. A mixed-methods study examining the impact of race, ethnicity, and socioeconomic status on mathematical self-efficacy.

3. Expand the current study to compare the mathematical self-efficacy of gifted or talented students to the mathematical self-efficacy of regular eighth grade math students.
4. A comparison of the mathematical self-efficacy scores and student achievement scores on standardized tests.
5. A quantitative study to examine the relationship between mathematical self-efficacy and perceived classroom environment.
6. A quantitative study to examine the relationship between mathematical self-efficacy and teacher level of effectiveness.
7. A mixed methods study to examine the relationship between teacher level of effectiveness and the level of differentiated instruction provided for above-level and below-level students.
8. A qualitative study examining the impact of the implementation of Common Core State Standards on mathematical self-efficacy.
9. A qualitative study to examine the impact of gender on mathematical task self-efficacy and mathematical school subjects self-efficacy.

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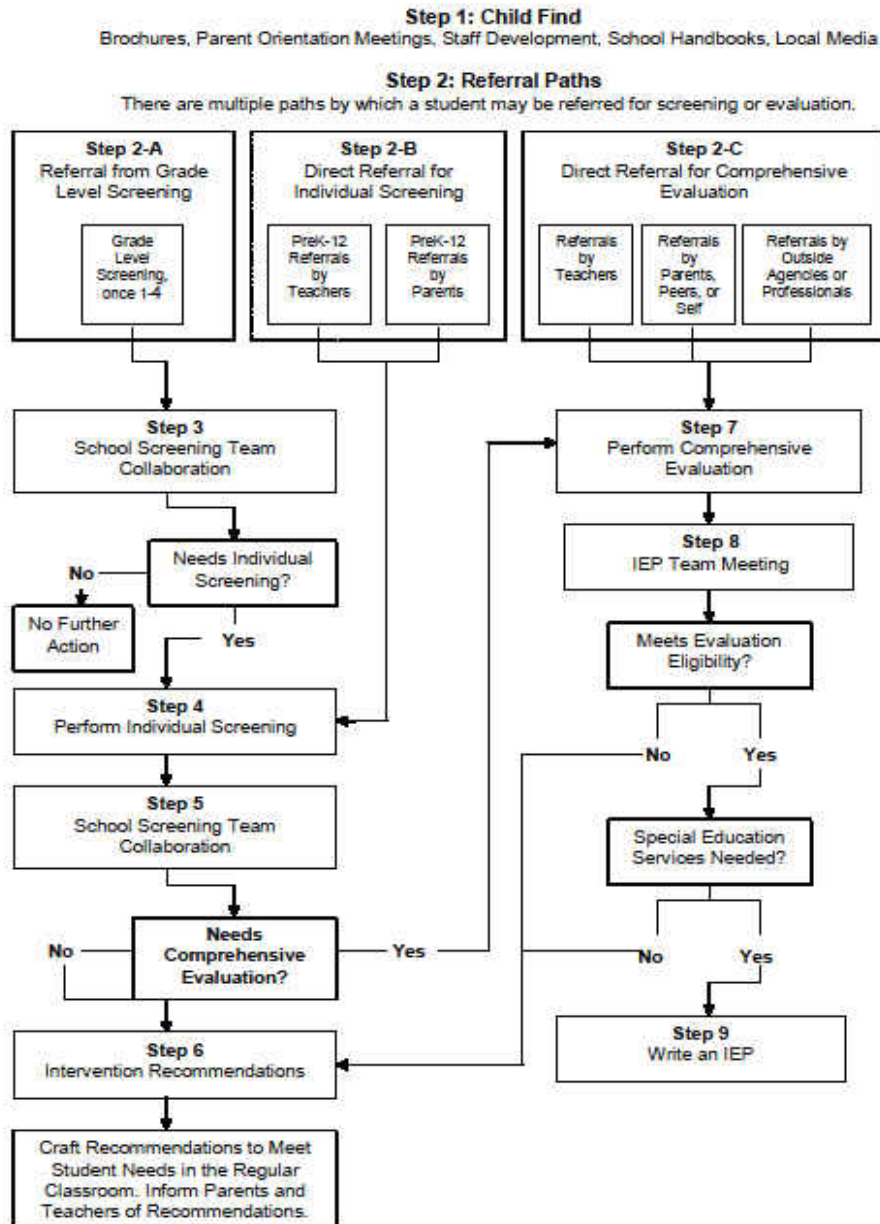
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APPENDICES

APPENDIX A

Gifted Assessment Flowchart

GIFTED ASSESSMENT FLOWCHART



22

Gifted Assessment Flowchart. From “Tennessee State Plan for the Education of Intellectually Gifted Students.” Tennessee Department of Education, Manual, 2010. Copyright 2010 by Tennessee Department of Education. Reprinted with permission. (p. 22)

APPENDIX B

Mathematics Self-Efficacy Survey Data

For use by Amanda Waits only. Received from Mind Garden, Inc. on March 4, 2016

Table 1
Means, Standard Deviations, and Gender Comparisons
for Mathematics Self-Efficacy Scores Across Studies

Ohio State University Undergraduates (Betz & Hackett, 1983)

Scale	Females (N = 153)		Males (N = 109)		t
	M	SD	M	SD	
Mathematics self-efficacy expectations					
Math tasks (18 items)	6.4	1.2	7.0	1.2	-3.9***
College courses (16 items)	4.9	1.4	5.5	1.5	-3.5***
Average Total Score	5.7	1.3	6.3	1.3	3.75***

University of Utah Undergraduates (Lapan, Boggs, & Morrill, 1989)

Scale	Females (N = 71)		Males (N = 77)		t
	M	SD	M	SD	
Math tasks (18 items)	6.3	1.3	7.0	1.1	3.55***
College courses (16 items)	5.4	1.5	6.2	1.3	3.48***
Average Total Score	5.9	1.4	6.6	1.2	3.5***

Note. Scale Scores represent average scores and can range from 0 to 9, indicative of "No Confidence" (0) to "Complete Confidence" (9).

*p < .05.

**p < .01.

***p < .001.

APPENDIX C

IRB Approval



EAST TENNESSEE STATE
UNIVERSITY

Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

IRB APPROVAL – Initial Expedited Review

April 11, 2016

Amanda Waits

Re: Interpreting Differences of Self-Efficacy of Gifted or Talented Students with Grouping Practices in Middle School Mathematics

IRB#: c0316.40s

ORSPA #:

The following items were reviewed and approved by an expedited process:

- New protocol submission xForm; External site Permissions: Cocke County Schools, Hamblen County School, Carter County Schools, and Greene County Schools; Bibliography; PI vita; Parental permission letter; Student assent; Teacher email; Student survey letter (2.0 and 2.1); MSES Survey; Google forms data file (data collection sheet)

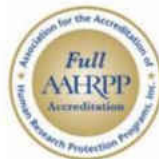
The following revisions were received and approved as part of the requested changes:

- Requested changes xForm, Revised parental permission, revised child assent, protocol changes

The IRB has approved your study request to work with **children as a vulnerable population**. This approval was granted under category 1: this study presents no more than minimal risk to children because it involves benign and anonymous survey questions.

IRB determined **parental permission is required** under Category 2: The permission of each child's parents or guardian will be obtained unless one parent is deceased, unknown, incompetent, or not reasonably available, or when only one parent has legal responsibility for the care and custody of the child. Documentation of Parental Permission is required.

The IRB has determined that **assent is required** under Category 1 because the minors, who are in 8th grade, are old enough and cognitively capable of providing assent. Documentation of assent is required. Assent must be documented by the child signature on the assent form.



Accredited Since December 2005

On **April 11, 2016**, a final approval was granted for a period not to exceed 12 months and will expire on **April 10, 2017**. The expedited approval of the study *and* requested changes will be reported to the convened board on the next agenda.

The following **enclosed stamped, approved Informed Consent Documents** have been stamped with the approval and expiration date and these documents must be copied and provided to each participant prior to participant enrollment:

- Teacher consent (stamped approved 4-11-16), Parental Permission (stamped approved 4-11-16); Student Assent (stamped approved 4-11-16)

Federal regulations require that the original copy of the participant's consent be maintained in the principal investigator's files and that a copy is given to the subject at the time of consent.

Projects involving Mountain States Health Alliance must also be approved by MSHA following IRB approval prior to initiating the study.

Unanticipated Problems Involving Risks to Subjects or Others must be reported to the IRB (and VA R&D if applicable) within 10 working days.

Proposed changes in approved research cannot be initiated without IRB review and approval. The only exception to this rule is that a change can be made prior to IRB approval when necessary to eliminate apparent immediate hazards to the research subjects [21 CFR 56.108 (a)(4)]. In such a case, the IRB must be promptly informed of the change following its implementation (within 10 working days) on Form 109 (www.etsu.edu/irb). The IRB will review the change to determine that it is consistent with ensuring the subject's continued welfare.

Sincerely,
Stacey Williams, Chair
ETSU Campus IRB

cc: James Lampley, Ph.D.

APPENDIX D

Director of Schools Permission to Conduct Research

Letter to the Director of Schools

Dear Director of Schools,

I am a doctorate student at East Tennessee State University in the Department of Educational Policy and Leadership Analysis. I am conducting research on student mathematics self-efficacy as it pertains to grouping and acceleration practices with students classified as gifted or talented in mathematics. The scope of this research will include review of standardized test scores of students in 8th grade who score in the 90th percentile on the 7th grade Tennessee Comprehensive Achievement Program (TCAP) in mathematics during the 2014-2015 administration of the test. Students who score in 90th percentile or higher will be given the Mathematics Self-Efficacy Scale as an online survey. The survey will take approximately 15 minutes to complete and will be facilitated by agreeing teachers in the mathematics classrooms of participating schools. Teachers who choose to assist in the administration of the survey will be put in a drawing for a \$200 Walmart gift card as a show of appreciation for their support.

The results from the surveys will be kept confidential and the student's name will not appear on the survey. Students will be asked to take a 34 question survey online and in no way will any student's answers be individually revealed or publicized. The students' opinions, perceptions, and achievement are very important to my research and the improvement of educational practices in the field of gifted education.

If you have any questions regarding this research please contact me at [REDACTED] or e-mailing me at zagw1@goldmail.etsu.edu. If you have further questions, you may contact my Dissertation Chairperson, Dr. James Lampely at lampely@mail.etsu.edu or [REDACTED]

Thank you,

Amanda Waits

____ I give permission for Amanda Waits, a doctorate student at East Tennessee State University, to contact principals in my district regarding this research opportunity once IRB approval has been granted.

____ I do not give permission for Amanda Waits, a doctorate student at East Tennessee State University, to contact principals in my district regarding this research opportunity.

Signature of the Director of Schools

Date

APPENDIX E

Parental Permission to Conduct Research

Research Parental Permission Form

Dear Participant:

My name is Amanda Waits and I am a doctorate student at East Tennessee State University. I am working on my dissertation and looking at mathematics self-efficacy (how students feel about themselves as math students). The name of my research study is "Interpreting Differences of Self-Efficacy of Gifted or Talented Students with Grouping Practices in Middle School Mathematics".

The purpose of this study is to examine mathematics self-efficacy with 8th grade math students. I would like to give a brief online survey using google forms to your child who is in an 8th grade math class. It should only take about 10 minutes to complete. Your child will be asked to take a 34 question survey. They can take the survey online or on paper. The survey can be taken anywhere the student has internet access or wants to fill out the paper survey.

Once you return this permission form and your child signs the assent form, they can take the survey. A letter will be given to the student that has a website address for them to take the survey. If they decide to take the paper copy of the test, they will put it in an envelope that I provide and return it to their teacher, who will mail the survey and permission forms to me, the researcher.

A sample of the questions has been attached and all questions are available for your review; if you wish to view them, please contact me at the numbers listed below. The results will be kept confidential. Your child's name, date of birth, or any other identifiable information is **not** collected. There is little to no risk involved in your child taking this survey. The students' opinions, perceptions, and achievement are very important to my research and the improvement of educational practices in the field of education. Since this project deals with math, it might cause some minor stress. However, your child may also feel better after they have had the opportunity to express themselves about their perceived math abilities. This study may provide benefit by providing more information about mathematics self-efficacy.

Your confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties, as is the case with emails. In other words, we will make every effort to ensure that your name is not connected with your responses. Specifically, google forms has security features that will be enabled such as not asking for your child's name, date of birth, school, or any other identifiable information. Although your rights and privacy will be maintained, the ETSU IRB, and the study team (Amanda Waits, myself and Dr. Jim Lampley my dissertation chairperson), have access to the study records.

If your child does not want to fill out the survey, it will not affect you or them in any way. Your child may simply exit the online survey form if you wish to remove yourself entirely. Alternatives include taking the paper version of the test if the prefer to use paper rather than online. Participation in this study is voluntary. Your child may refuse to participate. Your child can quit at any time. If you quit or refuse to participate, the benefits or treatment to which you are otherwise entitled will not be affected.

If you have any research-related questions or problems, you may contact me, Amanda Waits, at [REDACTED] or zagwl@goldmail.etsu.edu, or my research advisor, Dr. Jim Lampley, at [REDACTED] or lampely@mail.etsu.edu. Also, the chairperson of the Institutional Review Board at East Tennessee State University is available at [REDACTED] if you have questions about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone independent of the

research team or you can't reach the study staff, you may call an IRB Coordinator at [REDACTED] or 423/439/6002.

Sincerely,

Amanda Waits

Agreement:

The purpose and extend of this research has been explained, I have ready the above information, and I give permission for my child to participate.

I understand that this survey is voluntary and my child is free to withdraw at any time without incurring any penalty. Your child's grades will not be impacted by weather or not they complete the survey. The survey is being given for the completion of research by Amanda Waits at East Tennessee State University.

Parent Signature: _____ Date: _____

Child's Name (print): _____

Please return this form and the signed student assent form in the envelope provided to your child's teacher. Thank you!

APPENDIX F

Student Assent Form

Research Participant/Student Permission Form

Dear Student,

I am a doctorate student at East Tennessee State University with the Department of Educational Policy and Leadership Analysis. I am conducting research on student mathematics self-efficacy, which is how you feel about yourself as a math student.

My dissertation research requires that I conduct a study of students in many school systems in Northeast Tennessee and you have been chosen to participate. You will be asked 34 questions and can take the survey online or on paper. It will be your choice which version you take. Once you sign and return this form, you will be given an envelope that contains information on how to take the survey online. This envelope will also contain a paper copy of the survey. Your opinions, perceptions, and achievement are very important to my research and the improvement of educational practices in the field of education. Since this project deals with math, it might cause some minor stress. However, you may also feel better after they have had the opportunity to express yourself about your perceived math abilities. This study may provide benefit by providing more information about mathematics self-efficacy.

The results will be kept confidential and your name will not appear on the surveys. You do not have to answer any question(s) that you do not feel comfortable answering, and you may stop the survey at any point during the time the survey is given.

Also, please feel free to ask any questions before, during or after the session by calling me at [REDACTED] or e-mailing me at zagw1@goldmail.etsu.edu. If you have further questions, you may contact my Dissertation Chairperson, Dr. James Lampely at lampely@etsu.edu or [REDACTED]. If you have any questions or concerns about the research and want to talk to someone independent of the research team or you can't reach the study staff, you may call and IRB Coordinator at [REDACTED].

Please sign this permission form to show that you are agreeing participate in my research by taking survey. Participation in this survey is voluntary and you may withdraw at any time without penalty and it will not impact your grades. Thank you for your participation.

Sincerely,

Amanda Waits

Please return this form to your teacher with your parent permission form in the envelope provided. *Once you return both permission forms, you will get the survey link and a paper copy of the survey.*

Agreement:

The reason for this research has been explained and I agree to participate.

I understand that I can decide not to take the survey at any time and that I am volunteering to take this survey. This survey is being given for the research of Amanda Waits at East Tennessee State University.

Student Signature: _____ Date: _____

Student Name (print): _____

APPENDIX G

Mathematics Self-Efficacy Survey

For use by Amanda Waits only. Received from Mind Garden, Inc. on March 4, 2016

There are two parts to this instrument: Part I and Part II.
Please read all instructions and respond carefully and completely.

Score: _____

Please provide the following information:

Gender (Please Circle): **F** **M**

Part I: Everyday Math Tasks

Please indicate how much confidence you have that you could successfully accomplish each of these tasks by circling the number according to the following 10-point confidence scale.

Confidence Scale:

<u>No Confidence at all</u>	<u>Very little Confidence</u>	<u>Some Confidence</u>	<u>Much Confidence</u>	<u>Complete Confidence</u>
0	1 2 3	4 5	6 7	8 9

Example: How much confidence do you have that you could successfully:

91. Multiply two large numbers
in your head.0 1 2 3 4 5 6 7 8 9

If your response on the 10-point continuum was #5, "Some Confidence," you would circle the number 5 next to question #91 like so:

91. Multiply two large numbers
in your head.0 1 2 3 4 (5) 6 7 8 9

Now turn to the next page and begin Part I.

Part I

<u>No Confidence at all</u>	<u>Very little Confidence</u>			<u>Some Confidence</u>		<u>Much Confidence</u>		<u>Complete Confidence</u>	
0	1	2	3	4	5	6	7	8	9

How much confidence do you have that you could successfully:

- | | | | | | | | | | | |
|--|---|---|---|---|---|---|---|---|---|---|
| 1. Add two large numbers in your head
(e.g., 5379 + 62543)..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2. Determine the amount of sales tax on
a clothing purchase. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 3. Figure out how much material to buy
in order to make curtains..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4. Determine how much interest you will
end up paying on a \$675 loan over 2
years at 14 $\frac{3}{4}$ % interest. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 5. Multiply and divide using a
calculator..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 6. Compute your car's gas mileage..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 7. Calculate recipe quantities for a dinner
for 3 when the original recipe is for
12 people..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 8. Balance your checkbook without
a mistake. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 9. Understand how much interest you will
earn on your savings account in 6
months, and how that interest is
computed..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Go on to the next page.

Part I (Cont.)

<u>No Confidence at all</u>	<u>Very little Confidence</u>			<u>Some Confidence</u>		<u>Much Confidence</u>		<u>Complete Confidence</u>	
0	1	2	3	4	5	6	7	8	9

How much confidence do you have that you could successfully:

- | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10. Figure out how long it will take to travel from Columbus to Chicago driving at 55. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 11. Set up a monthly budget for yourself taking into account how much money you earn, bills to pay, personal expenses..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 12. Compute your income taxes for the year..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 13. Understand a graph accompanying an article on business profits. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 14. Figure out how much you would save if there is a 15% mark-down on an item you wish to buy..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 15. Estimate your grocery bill in your head as you pick up items..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 16. Figure out which of 2 summer jobs is the better offer: One with a higher salary but no benefits; the other with a lower salary but with room, board, and travel expenses included. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 17. Figure out the tip on your part of a dinner bill total split 8 ways..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 18. Figure out how much lumber you need to buy in order to build a set of bookshelves. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Go on to Part II.

Part II: Math Courses

Please rate the following college courses according to how much confidence you have that you could complete the course with a final grade of “A” or “B.” Circle your answer according to the 10-point scale below:

<u>No Confidence at all</u>	<u>Very little Confidence</u>			<u>Some Confidence</u>		<u>Much Confidence</u>		<u>Complete Confidence</u>	
0	1	2	3	4	5	6	7	8	9

How much confidence do you have that you could successfully:

- | | | | | | | | | | | |
|----------------------------------|---|---|---|---|---|---|---|---|---|---|
| 19. Basic College Math..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 20. Economics..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 21. Statistics..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 22. Physiology..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 23. Calculus..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 24. Business Administration..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 25. Algebra II..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 26. Philosophy..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 27. Geometry..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 28. Computer Science..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 29. Accounting..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 30. Zoology..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 31. Algebra I..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 32. Trigonometry..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 33. Advanced Calculus..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 34. Biochemistry..... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

Please put this survey in the envelope provided and return this survey to your teacher immediately.

**You have now completed the Mathematics Self-Efficacy Scale.
Thank you for your cooperation.**

VITA

AMANDA WAITS

Education: East Tennessee State University, Johnson City, TN, Ed.D.,
Educational Leadership, May 2016.
Lincoln Memorial University, Harrogate, TN, Ed.S., Supervision
and Administration, 2007.
Tusculum College, Greeneville, TN, M.A., Curriculum and
Instruction K-12, 2005.
East Tennessee State University, Johnson City, TN, B.S.,
Elementary Education K-8, 2002.
Walters State Community College, Morristown, TN, A.S.,
Interdisciplinary Studies, 1999.

Professional Experience Cocks County Schools, Newport, TN, Instructional Supervisor K-
12, 2014-Present.
Tennessee Department of Education and Battelle for Kids,
Nashville, TN, Regional Math Coordinator, 2012-2014.
Greene County Schools, Greeneville, TN, Academic Coach, 2011-
2012.
Greene County Schools, Greeneville, TN, Middle School Teacher,
2006-2011.
Greene County Schools, Greeneville, TN, Gifted Education
Teacher, 2003-2006.