EIGHTH GRADE PERSPECTIVES:
THE RELATIONSHIP BETWEEN STUDENTS’ ATTITUDES TOWARDS MATH AND STUDENTS’ ATTITUDES TOWARD MUSIC

by
Glen Alan Lowe
Liberty University

A Dissertation Presented in Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

Liberty University
2016
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ABSTRACT

Being successful in math is considered to be important for future employability, and music may be an important venue for students to improve their math skills. Rather than being unrelated, strong musical education programs have been linked to higher performance in math and academics in general. The purpose of this correlational study was to determine whether a statistically significant relationship exists between students’ attitudes toward math and their attitudes toward music with regard to gender. A convenience sample of 107 eighth grade students from a metropolitan Atlanta, Georgia school district participated in two surveys: Tapia’s Attitude Toward Mathematics Inventory (ATMI) and Shaw and Tomcala’s Music Attitudes Inventory (MAI). Pearson correlations were utilized to test three null hypotheses to describe students’ attitudes toward math and music with regard to gender. No statistically significant relationship was found between students’ attitudes towards math and music. It was concluded that further research is needed to expand the sample to include sixth, seventh, and eighth grade students instead of just eighth grade students.

Keywords: attitudes, math and music, middle school students
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From my Native Americans roots, we say, “Uh Uh Da Ho” which means “Thank You” in its highest form possible. So, from the deepest part of me, I say, “Uh Uh Da Ho.”
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List of Abbreviations

Attitude Towards Mathematics Inventory (ATMI)
Elementary and Secondary Education Act (ESEA)
English as a Second Language (ESL)
Every Student Succeeds Act (ESSA)
Intelligence Quotient (IQ)
Least Restrictive Environment (LRE)
Local Education Agencies (LEAs)
Music Attitudes Inventory (MAI)
National Aeronautics and Space Administration (NASA)
National Center for Education Statistics (NCES)
No Child Left Behind (NCLB)
Organization for Economic Cooperation & Development (OECD)
Program for International Student Assessment (PISA)
Quality of School Life (QSL)
Science, Technology, Engineering, and Math Education (STEM)
United States Department of Education (USDE)
CHAPTER ONE: INTRODUCTION

Background

Even though the United States spends $11,000 annually per elementary student and $12,000 annually per high school student, there has been a steady decline in math achievement scores as well as interest in math related professions since the space race of the 1960s (The Associated Press, 2013). Currently, the United States ranks last in an international comparison of 36 Organization for Economic Cooperation & Development (OECD) countries within the spectrum of math performance (Coughlan, 2014). The United States values education and spends more than the average OECD country on education, with 7.3% of its gross domestic product (GDP) being allocated for education (The Associated Press, 2013). According to Mullich (2015), math and science skills are essential building blocks of our economy. However, the ratio of educational funding to student performance on standardized assessments has not yielded expected academic gains. As with other generalized education trends, children from wealthier and more well educated families achieve at a higher level than students from more impoverished and less educated families (Coughlan, 2014). This does not account for discrepancies in U.S. math performance, as the most privileged young people in the U.S. significantly underperform in math when compared to similar demographics in other OECD countries (Coughlan, 2014). In 2014, the U.S. patent and trademark office issued more patents to foreigners than to Americans for the first time in history (Mullich, 2015). In addition, the majority of graduate students in science and technology are students from China and South Korea (Mullich, 2015). While technology plays an increasingly important role in our society, its links to math and science seem less actualized by the general U.S. public. The Executive Director of the National Science Teachers Association stated that, regardless of how much
money the United States spends on education, poor math and science performance will probably prevent the U.S. from having another Sputnik type movement (Mullich, 2015).

The negative attitudes towards math in the United States have been noted for some time. As early as 1969, Neale (1969) noted, “Mathematics educators are troubled because many students have mistaken impressions about math and dislike math activities” (p. 631). The author continued by observing that students often feared and even hated math (Neale, 1969). The first wave of researchers who examined math attitudes in the 1960s and carried over into the 1970s focused on math attitudes as they relate to anxiety or enjoyment (Tapia & Marsh, 2004). The Dutton Scale, which was one of the earliest known examinations of math attitudes, was created in 1968 and essentially excluded potential factors for poor math performance other than anxiety that affected performance (Tapia & Marsh, 2004). As time progressed, it has become more apparent that there are a number of intertwined complex elements that can impact math attitudes, and these can be projected into the realm of math performance. In generalized education surveys, it is clear that students perform better on those skills they value and have a motivation to master than those that do not (Liddell & Davidson, 2004). Teachers, parents, peers, and schools all have varying degrees of influence over student attitudes toward particular subjects (Akey, 2006). The trends related to student performance and attitudes in U.S. public schools are not stagnant; they can best be characterized as being progressive. As students age, their math proficiency scores decrease. By 12th grade, only slightly more than half of students perform at basic levels and 26% perform at or above proficient levels (National Center for Education Statistics [NCES], 2015). One way to help students overcome their negative attitudes towards math is by exploring the influence music programs can have on math attitudes.
When compared to music education, math achievement programs are less popular among U.S. students. However, this is not reflected in the current educational budget trends in the U.S. With many schools facing harsh cutbacks, typically the first programs that are eliminated are music, arts, and foreign language (Boyd, 2014). Despite that, there still remains a very favorable attitude toward music education among students and the general population and 85% of Americans feel that music programs do correlate with better grades or making students smarter (Lyons, 2003). In addition, on December 10, 2015 the Every Student Succeeds Act (ESSA; USDE, 2016), was signed into law. The ESSA, among other things, recognizes music as a core subject and will provide new opportunities for all students. Although funding has not been established, educators and parents anticipate the results of additional music curriculum.

In areas where general academic achievement is low, music has the potential to be one area in which inner city or other disadvantaged youth are able to experience positive results from their efforts (Shaw & Tomcala, 1976). Buchanan (2008) agrees that this can help to establish higher levels of self-esteem and improved perceptions regarding their potential for success beyond the music classroom. Shaw and Tomcala (1976) stated, “Children sing, hum whistle, pat their feet, and dance to music. These behaviors denote a positive effect” (p. 74). Brown (2015) highlighted a study that demonstrated schools with superior music education programs scored higher in English and math. While attitudes toward math and music show a perceptual deviation, music education contains elements of learning, self-esteem, and thinking mechanisms that can positively correlate with math performance (Brown, 2015). Stewart, Walsh, and Frith (2004) described automaticity as a skill that is cross-curricular with music and math. It requires much practice to reach the point where playing an instrument, reading music, mental math, or math calculation becomes second nature or habit. Stewart et al. (2004) noted that just as reading
seems automatic to someone who is literate, automaticity in reading music is acquired through practice. Cholmsky (2011) reported that

Math fact mastery, included the following: a) systematic introduction of small sets of new facts using appropriate strategies; b) development of the student’s preliminary ability to recall these new facts from memory; c) progression to timed retrieval once the student has demonstrated readiness; d) automatization through game-based practice, wherein facts are recalled while the student’s working memory is increasingly loaded with game-based tasks. (p. 8)

Despite the efforts to improve math achievement scores, research shows that students’ attitudes towards math in the U.S. needs improvement (Mullich, 2015). According to Brown (2015) quality music education programs could be the answer to improving student’s attitudes towards math which should improve math achievement scores.

**Problem Statement**

Students in the U.S. are performing poorly in math and they generally have an unfavorable view of the subject (NCES, 2015). According to Mullich (2015), this is a problem that becomes worse over time. Early interventions positively impact attitudes toward math making success more likely. Since the 1960s, educational stakeholders have noticed that there was a trend in unfavorable attitudes toward math by students. The current math performance paradigm is one that has been noted by stakeholders and while volumes of material have been written on the subject, the trend shows little signs of reversing under the “no child left behind” approach to education (Mullich, 2015). While there are no data available at this time, expectations are high for the new education law ESSA of 2015. The problem is the literature was unclear whether or not a correlation exists between students’ attitudes toward math
education and their attitudes toward music education. More recent studies of students’ attitudes are needed. With math and music having similar components, more research is needed to examine a possible correlation. In other studies (Eerola & Eerola, 2014; NCES, 2015), attitudes toward music have been more positive than attitudes towards math. The Pythagoreans taught music and math together and even developed the $X, Y$ axes using pitch and time.

**Purpose Statement**

The purpose of this study was to determine if there was a relationship between 8th grade students’ attitudes toward math and their attitudes towards music. The participants used in this study were 107 students from a metropolitan Atlanta, Georgia school district. The researcher utilized Tapia’s (1996) Attitudes Towards Math Inventory (AIMI) and Shaw and Tomcala’s (1976) Music Attitudes Inventory (MAI) to determine if there was a relationship between students’ attitudes toward math education and their attitudes toward music education. The predictor variable was *attitudes toward math*, which was defined as the participants’ expression of their experience with math education. The criterion variable was *attitudes towards music*, and was defined as the participants’ expression of their experience with music education.

**Significance of the Study**

Attitudes of students toward a subject are indicators of the degree of success they will experience in that particular subject (Farooq & Shah, 2008). Basic math skills are important for success in school and in everyday life (Maloney & Beilock, 2012). As the U.S. struggles to remain a global leader economically, the degree to which success will manifest depends highly on future math and science innovations (Hamel & Prahalad, 2013; Mullich, 2015). Therefore, research is still needed to examine the relationship between attitudes and achievement. Music and math have many cross-curricular elements. Timing calculations, transposing intervals, and
fractions are just a few of these elements (Liddell & Davidson, 2004). Students’ attitudes toward these elements, according to Farooq and Shah (2008) will indicate the level of success the individual student will experience while working through these elements.

The literature indicates that students have more positive attitudes towards music than math (Eerola & Eerola, 2014). Eerola and Eerola, (2014) found that extended music education had a positive effect on the school’s social vibe. The students had a more positive attitude toward the overall quality of school life (QSL). A follow-up study was then conducted to examine whether the increase in QSL were related to music, and the results showed that extended music education did have a positive effect on the QSL (Eerola & Eerola, 2014). There were no studies with similar results concerning math education. Therefore, this study was needed to determine if a correlation exists between the attitudes of students towards the two similar curricula. The significance of such findings could change the way school districts implement music into the required curriculum.

**Research Questions**

**RQ1:** Is there a relationship between students’ attitudes toward math education and their attitudes toward music education?

**RQ2:** Is there a relationship between male students’ attitudes toward math education and their attitudes toward music education?

**RQ3:** Is there a relationship between female students’ attitudes toward math education and their attitudes toward music education?

**Null Hypotheses**

**H₀₁:** There is no statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education.
**H₀₂:** There is no statistically significant relationship between male students’ attitudes toward math education and their attitudes toward music education.

**H₀₃:** There is no statistically significant relationship between female students’ attitudes toward math education and their attitudes toward music education.

**Definitions**

*Attitude Toward Mathematics Inventory* – The ATMI was designed by Tapia (1996) to determine student attitudes toward mathematics. It considers a variety of potential impacts that go beyond the previous anxiety based approaches to research gathering in the field. The 40 question survey provides statements and has students assign “letters” indicating the degree to which they agree or disagree with the provided statement. It works like a modified Likert style scale.

*Attitudes* – The way in which an individual perceives something. This work operates on the contingency that attitudes are related to performance (Dolgin, 2011). Attitudes can be influenced by a variety of factors in the micro, exo, and macro systems. In addition, attitudes can be changed and they are not necessarily consistent conditions over a life time.

*ESSA* – Every Student Succeeds Act is the new education bill signed into law on December 10, 2015.

*Gender Variance* – This is statistical variation that manifests in regards to gender. Within the sphere of attitudes toward a particular subject, research has demonstrated that a great deal of variance can occur related to one’s gender (Simpson & Oliver, 1990). Reasons for this have been suggested to be anything from cultural concepts of gender to microsphere expectations.
Math attitudes – This is the perception of a population towards math education. While some selected resources will highlight math as they are a part of STEM, this study isolates math based courses. Math subjects include, but are not limited to, basic math, algebra, calculus, geometry, combinatorics, logic, trigonometry, and number theory.

Music attitudes – This is the perception of a population towards music education. This can include general music courses as well as learning a musical instrument or utilizing the voice as an instrument. For this particular study, music will be considered only as it relates to in-school musical education and not extracurricular or recreational uses of music.

Music Attitudes Inventory - The MAI was devised by Shaw & Tomcala (1976) and employs a five-point scale to assess the degree to which students agree with provided statements corresponding with attitudes toward music. Like the ATMI, the survey utilizes a Likert style system for quantitative analysis.

NCES – Is the National Center for Education Statistics (NCES). It is a government program and generally the primary source for education related statistics, including spending and performance. The NCES is the primary federal entity for collecting and analyzing data related to education in the United States. It is part of the Department of Education and exists as a nonpartisan agency to help shape and evolve the U.S. education system.

OECD countries – The Organization for Economic Co-operation and Development. It is an international economic organization of 34 countries that was founded in 1961. Founding OECD members include: Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States.
STEM – An acronym for science, technology, engineering, and math education. They are generally considered by researchers to be interrelated as they are intertwined deeply in real world applications (California, 2015).
CHAPTER TWO: REVIEW OF LITERATURE

Introduction

The following review of literature examines phenomena related to the attitudes of eighth grade students toward music and mathematics. In conducting this examination, data sets are highlighted, as well as specific data. The theoretical framework will be presented, and then the review of literature will begin with overviews of general attitudes and student performance. This section highlights findings related to how and to what degree that attitude impacts student performance. In addition, elements that impact attitude including gender, instruction quality, and other related variables are explored. The second section of the literature review examines specific elements of math education, instruments for measuring attitudes toward mathematics, and current student attitudes. Current rates of U.S. math performance are assessed as well as generalized attitudes and elements that may influence those attitudes. These aspects are highlighted and structured thematically. The third section of the review of literature focuses on student attitudes and music. This section not only examines the attitudes related to music, but current policy impacting music education and academic literature related to benefits of music education. The final section examines links between math and music and highlights how the attitude data impacts the literature in the reported findings.

In all sections, relevant peer reviewed articles will be combined with statistical representations as well as current policy to obtain an accurate research based foundation for the respective study. When lack of symmetry is present between research findings, these instances are noted and possible explanations based on the related findings will be proposed. This review of literature is by no means exhaustive; however, the amount of research selected and the quality of those studies selected was found by the researcher to be sufficiently robust to represent the
general themes present in available literature on the subject. Many studies and discussions were consulted, and the ones selected for citation were considered to be representative of the current themes. Therefore, this literature review can be considered an extensive examination of what is currently known about student attitudes and measuring those attitudes and performance as they relate to music and math education.

**Theoretical Framework**

This study will reflect theoretical perspectives from some of the most well-known educational theorists of the 20th century. These modern day theorists have put ideas in motion that are still taught in university educational programs across the world. More importantly, these theories are still being used in classrooms all over the world to educate students and prepare them for whatever future awaits. The first perspective will come from Robert Gardner’s (1983) theory of multiple intelligences, primarily the musical-rhythmic modality of intelligence. Other perspectives will come from Piaget’s (1973) cognitive developmental theory, followed by Maslow’s (1943) theory of hierarchy of needs, Dewey’s (1938) experiential learning, and Bloom’s (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956) taxonomy of cognitive development. None of these is a panacea for educators, but together they are all relevant to this study.

Cognition is based on the student’s type of intelligence; therefore, the teacher must develop the student’s individual intelligence type (Gardner, 1983). This is accomplished through effective communication and meaningful relationship building skills (Bohonos, 2013). Depending on the school district’s instructional pacing guide, also known as scope and sequence, it is difficult to achieve this with each student.
In his book *Frame of Mind: The Theory of Multiple Intelligences*, Gardner (1983) identifies seven intelligence modalities; one of them being musical-rhythmic. According to Gardner, a person with this modality hears rhythmic patterns, identifies pitches easily, plays instruments, and composes music. Someone with this intelligence may or may not have an understanding of the written language of music or music theory. Their understanding may differ in various degrees from no understanding of written music to a full understanding, and the individuals who play instruments or sing without being able to understand written music are often mistaken for people who can read music. The musical performances of those who cannot read music most often will have more of an emotional connection than someone who is relying on the written music to provide their guidance. The emotional attachment is often missing or is not as strong when the musician relies on the written music (Gordon, 1989).

The seven types of intelligences according to Gardner (1983) are:

1) Linguistic – These learners think in words, have highly developed auditory skills, enjoy writing, and expanding their vocabulary;

2) Logical-Mathematical – These learners think abstractly and conceptually and place more value on concepts than details. They are problem solvers;

3) Spatial – These learners will think in terms of the physical space or their environment such as sailors or architects. They need to see the whole picture to fully understand;

4) Musical – These learners will be sensitive to rhythm and patterns, will love music, be able to play instruments with or without a knowledge of the written language of music, listen to music while studying, and can be found in all walks of life;
5) Bodily Kinesthetic – These learners incorporate movement in their learning, communicate very well through body language and are in tune with their bodies such as dancers, surgeons, and special operations operatives;

6) Interpersonal – These learners will have an understanding of others and learn from interacting with others. They will have a strong desire to communicate socially and need much attention from their teacher or coworkers. They work well with the public, such as sales representatives, wait staff, and entertainers;

7) Intrapersonal – These learners are the most independent learners with high self-confidence, discipline, drive, and motivation. They enjoy spending time alone rather than with a crowd.

The violinist, Yehudi Menuhin, was an example Gardner (1983) used to illustrate how musical intelligence is one of the seven basic forms of intelligence. Menuhin was a professional international performer by the age of 10; however, his musical abilities were apparent much earlier. Gardner noted that Menuhin was able to master the violin without much practice. Menuhin’s ability to develop musically was clearly biological. In fact, Gardner reported that some students, who have severe mental disabilities and are unable to speak, are able to perform masterfully on an instrument. This suggests that the right side of the brain, as well as the left side, is heavily used to make music (Gardner, 1983). However, music cognition is not clearly localized in any one central location of the brain. While damage to specific regions of the brain has negative effects on the associated cognitive functions of that brain region, music cognition can be negatively affected regardless of which area of the brain may be damaged (Critchley & Henson, 1977). Gardner (1983) believed that this indicated that musical intelligence is associated with all areas of the brain.
Gardner’s (1983) focus was educational intelligences, whereas Piaget (1973) focused more on development. Piaget’s theory of cognitive development states that humans’ knowledge acquisition is grounded in what he called a basic mental structure with which each is born. How students’ cognition develops is based on what they have at birth. Piaget’s interest in development more than education has been identified in three components of his theory: schema, adaptation, and stages of development. Schema is the basic structure necessary to obtain knowledge; whereas adaptation is the process of moving through each stage of development. An example of schema would be a child being able to identify an object from seeing it on paper, such as a tree in a book (McLeod, 2015). Adaptation is the ability to process information in a way that allows a child to progress from one stage to the next. While there are suggested ages for each stage, the progression from one stage to the next depends on the individual and the environment. An example would be a child seeing someone in public with their hair in the style of a clown, and when the child identifies the individual as a clown, the parent explains to the child that the person is not dressed as a clown, is not wearing a red nose, and is not making people laugh (McLeod, 2015). The child is then able to change his schema of what a clown is or is not. Piaget’s stages of development include: sensorimotor, preoperational, operational, concrete operational, and formal operational (sometimes referred to as abstract) and are how the child views the world based on the developmental framework of his or her current stage. Sensorimotor occurs from birth to age two. This is when the child learns to suckle, use its hands, sits up, stand, walk, identify objects, talk, and form simple sentences. Preoperational occurs from age two to age seven. During this stage, the child learns the concept of “no,” how to socialize with others, how to cope with isolation, how to read and write, and how to expand vocabulary. This is also the time at which the individual’s personality solidifies. Operational is
from ages 7-11. During this stage, the child enters preadolescence and begins to experience physical changes to the body. These physical changes, or the lack of physical changes for late bloomers, can have an impact on mental development (McLeod, 2015). Formal operational is ages 11 and older and is the most difficult stage of development to maintain. Often the individual will fluctuate from operational to formal operational even into early adulthood (Bohonos, 2013). Some individuals will develop physically into adults but never reach the formal operational stage of development (Piaget, 1938). Piaget communicated the importance of age and physical development when presenting information to students. Dolgin (2011) agreed with Piaget in that the student’s stage of development must be respected and nurtured for the student to reach the highest learning potential. Abraham Maslow (1943) expanded on Piaget’s work through his hierarchy of needs theory.

McLeod (2014) summarized Maslow’s (1943) hierarchy of needs as having five stages that serve as motivators for all humans. The first deals with the most basic or deficiency needs such as food, shelter, and clothing. The second stage is physiological or survival needs such as sleep, air, and reproduction. The third is safety, which would include job security, savings accounts, and insurance policies. The fourth stage is love and would include emotional human interaction. The fifth stage is self-actualization or self-fulfillment. According to Maslow’s theory, the needs must be met in the order of the stages listed above. In other words, if a student comes to school hungry, that student will not be able to focus fully on new information until the hunger is fed. As the hunger intensified, so would the motivation for that individual to find food. Thus, for students to give their undivided attention at school, or adults to concentrate at work, the first three needs must be fulfilled. If any of these five stages are lacking, the individual loses focus.
Maslow believed that only one in 100 humans ever becomes fully self-actualized because, as events in life occur, such as the loss of one’s job or loved one, the stages are interrupted and some people are not able to recover from some of these types of events. Other researchers (Pekmezaris et al., 2013) have combined the first two stages (basic needs and physiological needs), with food, clothing, shelter, physical touch, and even prescription medication for seniors. Greenacre, Freemen, Filby, and Ostrovsky, (2015) noted that music can be instrumental in meeting the needs of the highest three stages in Maslow’s hierarchy - safety, love, and self-actualization. These music therapists (Greenacre et al., 2015) have used music to create safe, loving environments for mental health patients in an effort to aid them in finding their way to the final stage of self-actualization. The student’s perception upon entering a classroom the first day and each day thereafter is key in determining the outcome of that experience (Dewey, 1938).

Dewey (1938) introduced his style of education to the world, and pioneered new ideas on how to reach students during the progressive educational movement of the 20th century. According to Dewey, there are seven areas of experiential education which include: (a) social environment, (b) knowledge, (c) content organization, (d) role of the teacher, (e) learner readiness, (f) experience of the student, and (g) learning outcomes. Participation in high school music programs allows students the opportunity to address each of these areas (Roberts, Christenson, & Gentile, 2003).

Experiential learning is learning through one’s experiences, and according to Wurdinger and Carlson (2010), the music classroom setting is the perfect environment for each of Dewey’s (1938) areas of learning. The students are encouraged to interact with others, thus developing their social environmental skills. High school musical participation programs require students to
travel. This allows great opportunities for students to mingle and develop their social skills (Scheib, 2006). Students gain new knowledge through rehearsal and daily practice. Music performance programs are very demanding (Levitin & Menon, 2003) and require extensive rehearsal sessions away from class.

To say that music theory (the study of how music works) is organized is an understatement (Wurdinger & Carlson, 2010). Music students experience depth of content organization through studying the complexity of music theory (Levitin & Menon, 2003). They observe the role of the teacher through conducting protocol. The conductor is in complete control of the performance, from the raising of the instruments to start the performance to the termination of the final note. In high school, the conductor is not always the teacher. Often, the conducting is the responsibility of a student leader. These opportunities to learn readiness, and to be responsible to their fellow classmates and accountable to the educator helps them in other classes with collaborative assignments and prepares them to be self-starters as adults (Buchanan, 2008). When each student applies what they have learned in order to accomplish a set outcome and solve real-world problems through the ultimate form of collaboration, educators have accomplished their goal (Levitin & Menon, 2003). The experiences of the high school music performer not only allow, but demands, that each student develops higher order thinking skills (Schieb, 2006).

Bloom (1956) spent the majority of his life dedicated to studying the different levels of human cognition, and in 1956 he directed a committee, that created Bloom’s Taxonomy of Cognitive Development in an effort to promote higher levels of thinking as opposed to rote memorization (Clark, 2003). The committee came up with three levels of learning they referred to as domains, which were cognitive or mental skills, affective or emotional growth, and
psychomotor or physical skills (Bloom et al., 1956). Bloom’s model is not the only example or system of hierarchal levels of cognition, but it is still the most utilized model. His model has been modified over the years by other experts. The original model went into great detail with the first two areas, cognitive and affective, but offered very little detail on psychomotor. The committee claimed to have little experience in high school education, and therefore left it for others to develop (Clark, 2003).

Clark (2003) reported that others have reshaped Bloom’s original model into what is currently used today and identifies Bloom’s levels of thinking from simple to complex. These levels were renamed knowledge, comprehension, application, analysis, evaluation, and synthesis. Knowledge is simply being able to recall facts, terms, or concepts. Comprehension is the ability to explain cause and effect or how things are similar and different. Application is applying the knowledge one has to new situations in order to solve problems. Analysis is dissembling concepts and examining the relationship of the parts. Evaluation is making sound judgments based on logic, value, and adequacy. Synthesis is creating something new or providing new solutions by integrating the ideas and solutions of others. A great example of synthesis is when the engineers at the National Aeronautics and Space Administration (NASA) saved the lives of the astronauts of the Apollo 13 mission to the moon in 1970. These engineers, who were in Houston Texas, created a CO₂ scrubber for the lunar module based on the materials that the astronauts, who were in space, had with them in the craft. The engineers instructed the astronauts how to assemble the scrubber, resulting in NASA’s most successful “failure” (Kauffman, 2002).

Now that scientists have identified how the brain learns music, how the brain learns math, and how the two are connected, the relationship between the two will be explored using the
aforementioned thoughts of the leading educational theorists. As Gardner (1983) pointed out, all mathematicians are not musicians, and all musicians are not mathematicians. He identified a modality for each learner, yet according to Cohen (2011), music is the math that takes place in the brain without the learner realizing that he is doing math. Counting beats within measures to a set timing (80 beats per minute) while calculating the value of the individual notes as well as determining the distance of intervals in the pitch, is math (Cohen, 2011). Deere (2010) found in a study conducted with fourth and eighth grade students that there is a correlation between music and math in that the music students scored higher in reading and math than did the nonmusic students. Buchanan (2008) suggested that this relationship may be coincidental because the students who are proficient in math are the students who choose the take music classes and vice versa. Kraus (2011) showed clear evidence in her study of the brain that music energizes the brain in ways no other activity does, and therefore is a strong indicator that music does impact the brain in ways we still do not understand. Boyd (2014) found that students who studied music three years or longer had a significantly higher math score than students who studied music two years or less. Dewey (1938) placed a great deal of importance on learning through experiences, the experiences a music student encounters such as discipline, self-advocating, leadership opportunities, responsibility to classmates, and accountability to the director, will generalize into all of the other classes those music students will take and will have an impact on their development at the same time (Cranmore, & Tunks, 2015). Dolgin (2011) noted that music can be a conduit to aid in a child’s development. According to Clark (2003), Bloom’s taxonomy was undeveloped due to the committee’s lack of experience in high school curriculum. The music programs in high school address this area and allow multiple opportunities for psychomotor development, such as sight reading performances and chair placement tests (Clark, 2003). Sight
reading is having the ability to read written music for the first time and play it without practicing. This is a difficult skill to develop and takes years of experience to master (Schieb, 2006).

Automaticity, or the development of muscle memory, is required in order to sight read fluently. This skill is required for mental math and math calculation as well. A chair placement test is a short section of music assigned ahead of time allowing the student time to practice. Each student performs the selection by themselves (solo) for the director. This is done in the presence of the classmates and forces the individual to demonstrate how well he or she has developed the assigned skills and adds a level of competition to enliven the experience (Scheib, 2006). The students are then ranked according to how well they perform (Levitin & Menon, 2003). This also allows the students who cannot read music (Gardner, 1983) to hear the assigned selection played before they have to perform. Maslow (1943) said for humans to reach their full potential, their basic needs must be met. Safety is one of those basic needs. Kimbel and Protivnak (2010) noted that the use of music can offer a soothing and safe environment for many students. While these experiences may cause a certain level of anxiety (Feng, Suri, & Bell, 2014), it is helpful in their development (Dewey, 1938), but the environment must be controlled by an educator who reassures and disallows mockery (Maslow, 1943).

**Review of Literature**

**Attitude Impacts Student Performance**

The link between attitude and performance is one that has been documented for some time in organizational theory and has become a point of focus in recent times in regards to education and student performance. On the organizational level, change theorists have noted that employee attitudes and work place culture impact a company’s ability to manage for change as well as the organization’s ability to operate at peak efficacy (Ancona, Kochan, Scully, Van...
Maanen & Westney, 2005). Similarly, Newman (2008) illustrated that positive attitude is an important component of a strong leader, both in their daily tasks and modeling behavior to followers. Literature has suggested these same findings are consistent for students and academics. This portion of the review of literature focuses on available studies and links between attitudes and general student performance. If links between attitudes and student behavior can be substantiated, this would potentially mean those subjects toward which individuals have a more favorable attitude would be ones in which they would demonstrate higher performance.

Liddell and Davidson (2004) found that “Students perform better on those skills that they value and this may be influenced by underlying motivation to master the skill” (p. 52). The researchers concluded that this overall attitude toward a subject or a task is intrinsically different than one’s perceived ability to perform a task. In this capacity, a student’s confidence in performing a skill is not necessarily related to their assessed performance (Liddell & Davidson, 2004). Thus, “using confidence as a performance measure may misrepresent the quality of learning that is being assessed” (Liddell & Davidson, 2004, p. 52). In this study, it was the perception the student had of the task or subject that was a better performance indicator than how well they perceived themselves to be able to perform the task. This is an important “attitude” based distinction. If these results were translated to music or mathematics performance measures, it would mean that the way students feel about music and math, rather than their confidence in performing math and music related tasks, would be a better predictor of success.

Weinburgh (2006) applied a similar thematic but, instead, focused on attitudes toward subject, achievement, and variation according to gender. According to Weinburgh, perspectives on a particular subject often vary according to gender. Weinburgh suggested that there are few
patterns related to this that can be used for broader scale projections of data (Weinburgh, 2006). Weinburgh’s finding mirrored the general themes of Liddell and Davidson (2004). Weinburgh found that “The correlation between attitude and achievement as a function of selectivity indicates that in all cases a positive attitude resulted in higher achievement,” and this remains consistent across both gender spectrums (Weinburgh, 2006, p. 387). Weinburgh found that this was especially true of situations when girls had low performance measures. Weinburgh indicated that the degree to which attitude impacts performance does have variations and some of these variations are present within the spectrum of gender. Among students with average performance skills, male students had a greater positive attitude than their female counterparts (Weinburgh, 2006). In contrast, among students with high performance skills, female students indicated a greater positive attitude than male students (Weinburgh, 2006). It is not enough, to simply declare that attitude plays a role in student performance. The degree to which it influences performance is contingent on other characteristics that the researcher suggests necessitates further research to understand more completely. As with Liddell and Davidson (2004), Weinburgh (2006) agreed that students who view a subject favorably have a higher propensity to perform better in that subject.

While Weinburgh (2006) demonstrated that gender could impact a student’s attitude toward a particular subject, gender is not the only indicator. Attitudes can also be impacted by primary care givers, society, socioeconomic status, community, and other micro and macro system dynamics (Simpson & Oliver, 1990). Simpson and Oliver cited Bloom’s (1976) classic study, which suggested that 25% of the variance in school achievement could be attributed to how students felt toward what they were studying, their school environment, and their concept of self. This is one of the few studies that placed an actual number on the degree to which attitude
impacts performance. If it is accepted that it is 25% or even slightly higher or lower, this is a significant amount and one that has sufficient impact to be considered in educational policy and curriculum. A 25% variance is the difference between a student performing average or failing or performing average or demonstrating high performance. Within the former paradigm of *No Child Left Behind*, poor attitude is leaving cross sections of the student population at a severe disadvantage to other students. Simpson and Oliver take these statistical variances a step further and again cite Bloom, who indicated that another 25% of variance in student achievement could be attributed to the quality of instruction. Therefore, schools, curriculum, and instruction play a strong role in influencing students’ attitudes toward a particular subject.

Akey (2006) found that supportive teachers who had clear and high expectations about behavior are key to the development of student engagement and their perceived competence in a subject. Akey further concluded that the earlier schools and teachers begin to build student confidence in their ability to do well, the more equipped a student will be. While Liddell and Davidson (2004) stated previously that how a student perceived his/her ability to do a task was not necessarily indicative of the degree to which the student would actually perform, Akey (2006) suggested that a student’s perceived ability to perform a task impacts their attitude or outlook on a subject. Therefore, the way in which it impacts may be indirect. This research suggests that if a student thinks they can perform well, it does not necessarily mean that they can; however, it does mean that they will have a greater propensity for having a favorable attitude toward the subject and task. What would appear to be contradictory results is actually complementary when put into the proper context. Akey illustrated that “students’ perceptions of their capacity for success are key to their engagement in school and learning” (Akey, 2006, p. 2). If a student feels he or she cannot succeed, he or she will have a less favorable attitude toward
the task and it can become a self-fulfilling prophecy. The reverse of this statement also would hold true. Success in education, in addition, is compounding. For example, Akey (2006) demonstrated that students who feel they can succeed or have succeeded in one educational endeavor will likely be confident in their ability to succeed in future endeavors and therefore have a more favorable attitude toward them. Monica Wood (1998) reported that student effort had a positive correlation with student attitudes.

Awang et al. (2013) demonstrated that the students’ perception of their lecturers plays a statistically significant role in determining their learning outcomes. The way in which the instructor is perceived contributes significantly to the students’ achievement in the subject (Awang et al., 2013). Freedman (1998) found that laboratory instruction influenced, in a positive direction, the students’ attitudes toward science and their acquisition of science knowledge. According Freedman, these findings remained consistent across gender and across students with diverse backgrounds, who all lived within a large urban center (Freedman, 1998). While these findings were scientifically based, they have general thematic content that is relevant to other subjects. Having a hands-on or kinesthetic element present in instruction had a favorable impact on engagement. This research builds on the notion that engaging students is the key to facilitating student attitude. Not all students, however, are engaged in the same way. Variation of instruction to accommodate all learning types is one way that educators can engage large cross sections of the students and produce more favorable attitudes overall.

According to Walling (2006), “Students of all ages construct knowledge in a variety of ways based on how their brains process stimuli” (p. 1). Although the idea of learning styles is widely contested (Rayner, 2007), students can be placed into categories of auditory, visual, or kinesthetic style learners (Walling, 2006). One researcher, (Denig, 2004), suggest that, for the
best results, learning styles and multiple intelligence methods be used together. Although most educators have moved away from using lectures, Denig (2004) suggests that the lecture and taking notes style of instruction fits within the context of auditory learning, but it does not generally engage kinesthetic or visual learners. Visual learning styles are the most accommodated in the sphere of education (Walling, 2006). In academic subjects, teachers will employ a combination of visual and auditory instruction methodologies. Kinesthetic, though widely employed outside of academia, is far less utilized in general classroom settings (Walling, 2006). The hands on elements Freedman (1998) observed in a laboratory setting were representative of kinesthetic based learning protocols. The current instructional model favors group activity as the basic unit of operation over the individual as the basic unit of operation (Ancona et al., 2005). Therefore, it is necessary for teachers to prepare students for the global job market by teaching cooperative learning and team building activities. Group learning has been illustrated by researchers to have a favorable impact on student attitudes (Springer, 1999). Bates (2013) found that peer review and peer interaction positively impacted both the performance and the attitude of eighth graders in a physical science classroom. While working together was found to be a favorable activity, Bates (2013) ultimately concluded that peer review alone was not efficacious in assignment performances. While this brings into question the individual strategy of peer review, it does not hinder the assumption that cooperative style education tactics are more congruent with 21st century school districts and positive student attitudes.

Cooperative educational mechanisms, as an attitude enhancer, follow the same thematic as the least restrictive environment (LRE) in special education. According to the U.S. Department of Education (2015), the LRE is “To the maximum extent appropriate, children with
disabilities, including children in public or private institutions or other care facilities, are educated with children who are not disabled” (p. 5). The LRE further states that “If the State does not have policies and procedures to ensure compliance with clause (i), the State shall provide the Secretary an assurance that the State will revise the funding mechanisms as soon as feasible” (p. 5). This educational law allows for peer interactions between individuals with diverse learning styles and those with learning deficiencies. By not being isolated, these learners manifest a more favorable view of their ability to succeed in education through positive instruction. Though at a cursory glance it may not be obvious, the LRE construct is rooted in the same thematic that attitudes impact academic performance, as well as the idea that teachers impact the degree to which students are engaged.

Attitudes impact student performance (Liddell & Davidson, 2004; Weinburgh, 2006). Those students who have more favorable attitudes toward a subject or task are more likely to have more success at that task (Liddell & Davidson, 2004; Weinburgh, 2006). This phenomenon is not isolated to education. Organizational science has similarly concluded that attitudes impact the productivity of workers and the success of leaders (Ancona et al., 2005; Newman, 2008). While attitudes impact performance, there are a number of constructs that impact attitude. For example, variations in attitudes among students have been found to have gender related elements (Weinburgh, 2006). As a result, the way that a male or female student in the same classroom perceives a subject can be very different. Beyond the gender related influences (some students respond to one gender differently than the other gender.), quality of instruction has a great impact on student attitudes and success (Simpson & Oliver, 1990). Instructors who better engage students through varied instruction that include auditory, kinesthetic, and visual learning components, as well as team components are more likely to engage their student population
In terms of statistical representations, 50% of student achievement variance is related to quality of instruction and attitude, with both of them impacting student performance respectively at 25% (Simpson & Oliver, 1990). The literature in this section was primarily related to general links between attitude and student success, as well as the literature that have been linked to student attitudes. The following section will explore the attitudes of students regarding math.

**Student Attitudes Regarding Math**

In the previous section of the review of literature, it was demonstrated that students’ attitudes toward a subject are an indication of the degree to which a student will perform in that subject (Liddell & Davidson, 2004; Weingburgh, 2006). While these studies were a result of generalized conclusions, they hold true specifically for math performance. According to Farooq and Shah (2008), “students’ success in mathematics depends upon attitude towards mathematics” and it also influences the participation rate of learners” (p. 75). Quality of instruction, in addition, relates directly to math thus echoing the same sentiment established by Simpson and Oliver (1990). Unfortunately, one of the problems that arises is the way in which instructors are presenting math versus the students’ perception of the instruction (Farooq & Shah, 2008). Farooq and Shah found that “even when teachers believe they are presenting information in authentic context,” their techniques are actually alienating many students from the subject (Farooq & Shah, 2008, p. 75). However, when the teacher displays positive attitudes towards mathematics, students respond to the teacher’s positive attitude and are drawn toward a successful experience in mathematics. What instructors think is necessary to engage and what they do to facilitate favorable attitudes toward math are not always synchronized to what actually engages and facilitates favorable attitudes toward math (Farooq & Shah, 2008). Building from
the statistics taken from Simpson and Oliver, this means that the disadvantage for math students who have this unfavorable attitude is twice as damaging because of their own attitudes and problems with instructional quality. If this 50% negative influence on the math classroom exists nationwide, it explains why the overall U.S. math student performance is lacking.

The U.S. is one of the world’s leading economies and dominant political forces. While it would be logical to conclude that student performance in the U.S. would be equally as impressive, the opposite is actually true. Ryan (2013) concluded that, when compared to the rest of the world, U.S. schools are expensive to operate, yet have failed to close the math achievement gap. Since 2000, the rate of educational performance in the United States has been fairly consistent, with little improvement (Ryan, 2013). The U.S. scored below the Organization for Economic Cooperation and Development (OECD) average in almost every subject (Ryan, 2013). In math, the U.S. ranks 26 out of 34 OECD countries, and statistically, they are not mathematically different from Norway, Portugal, Italy, Spain, Russian Federation, Slovak Republic, Lithuania, Sweden, or Hungary (Ryan, 2013). Overall, one in four U.S. students was not at the Program for International Student Assessment (PISA) baseline math level (Ryan, 2013). At this particular level, “students begin to demonstrate the skills that will enable them to participate effectively and productively in life” (Ryan, 2013). The U.S. allocates more funds towards the education system than other nations; however, their math scores indicate that one in four students are below the PISA baseline level (Ryan, 2013). It is not clear, however, if the other countries are including all students in their testing population, such as students with disabilities, English language learners, and high transient students, as does the U.S.

The National Center for Education Statistics (NCES) illustrated similar performance deficiencies in U.S. math scores. In 2013, 83% of fourth graders performed at or above the basic
achievement level and 42% performed at or above the proficient level in math (NCES, 2015). By 12th grade, 64% were performing at or above basic (average) levels and only 26% were performing at or above proficient (above average) levels (NCES, 2015). As U.S. students get older, their mathematics proficiency scores decrease. Even though there has been some improvement on these measurement tests, they are nowhere near where they would have to be for the U.S. to be considered above average or a global leader in math scoring. While there are a number of ways in which school performance and student performance can be measured for national comparisons, the PISA indicates a similar level for poor performance, as was illustrated in the OECD average comparison previously cited. Desliver (2015) found that the U.S. placed 35th out of 64 countries in math and 27th in science. The math and science scores for U.S. students are not consistent with where they should be for a global economic and political leader.

There is a great deal of literature related to statistical representations of attitudes toward math in the United States. This makes it easier to get an accurate overview of how Americans and American students view math. In a Pew Research Center study, it was found that only 29% of Americans rated their nation’s K-12 education in science, technology, engineering and math (STEM) above average or the best in the world (Desliver, 2015). The statistics reported by the American Association for the Advancement of Science were even more perceptually unfavorable. Only 16% of scientists found U.S. K-12 STEM the best or above average (Desliver, 2015). Of this group, 46% placed the U.S. at below average in these areas, which account for STEM designation (Desliver, 2015). Many scientists in the United States perceive the nation as being below average in STEM education. Based on this data, the public and scientific perspective on mathematic student performance in the nation is consistent with how
students are actually performing when compared to established standards and the rest of the world.

The perspective of Americans on their ability to do math also demonstrates a problematic element. In this regard, 30% of Americans report that doing math well is a challenge (Ogilvy, 2015). Young Americans are the most likely group of people to believe that they struggle with math, with 18-24 year olds saying so at a rate of 39% and 24-34 year olds saying so at 36% (Ogilvy, 2015). Over one third of Americans (36%) admit that, at many times, they have declared themselves as having low confidence in their math abilities (Ogilvy, 2015). This attitude is more prevalent among younger Americans. More than 50% of the young people in the U.S. have a low confidence in their ability to perform math computations (Ogilvy, 2015). Sixty-three percent of Americans say they have had some difficulty doing math including simple operations such as estimating distances or weight (Ogilvy, 2015). This same notion was noted for figuring out how much savings are necessary for retirement and calculating tax (Ogilvy, 2015).

When students do not believe they will succeed, or if they are not proficient in a subject, they perform more poorly in that subject (Akey, 2006). Student perceptions of their capacity for success are essential to their engagement and learning (Akey, 2006). Since such strong cross sections of the American public are skeptical of their ability to perform mathematical tasks for everyday life successfully, it is not surprising that the U.S. is scoring poorly on standardized math testing (Akey, 2006). According to Maloney, Ramirez, Gunderson, Levine, and Beilock (2015) parents who perceive that they struggle with math are having children who also perceive that they struggle with math. These children then enter the public schools with a negative attitude towards math. In addition, they are being taught by educators who are presenting math
in a way that is alienating students, despite the fact that these educators believe they are presenting math in the proper manner to engage students (Farooq & Shah, 2008).

Females do not enter math or STEM fields at the same rate as men. Girls who have unfavorable attitudes toward STEM subjects will be less likely to go into STEM majors or to perform well in STEM related testing situations. Gunderson, Ramirez, Levine, and Beilock (2011) found that “Girls tend to have more negative math attitudes, including gender stereotypes, anxieties, and self-concepts, than boys” (p. 153). These attitudes transfer directly into math performance, course taking, and pursuing such careers (Gunderson et al., 2011). Math performance and attitude discrepancies are exacerbated over time. In elementary schools, girls’ attitudes are more consistent with their male counterparts toward math, but these attitudes gradually become more negative as they progress in school (Mata, Monteiro, & Peixoto, 2012). In 2012, 40-45% of degrees in math, statistics, and physical science went to women (Olson, 2014). This represents an improvement from the early 1970s when less than 20% of those degrees went to females (Olson, 2014). Currently, women in college outnumber men three to two (Olson, 2014). While math has some degree of gender difference between males and females entering the field, it is not to the extent of computer science. In 2012, only 20% of the people who entered the computer field were females (Olson, 2014). Overall, there is a difference in gender within the STEM majors (Olson, 2014). In contrast, Olson reported that women dominate the following majors: health professions (85%), public administration (82%), education (79%), and psychology (77%). There are fields of study and interest that seem to attract females more than males and vice versa. Males continue to dominate the STEM fields.

Attitudinal research in the field of math has generally focused primarily on anxiety or enjoyment of the subject matter, which in turn excluded other potential factors (Tapia & Marsh,
One of the original instruments developed was the Dutton Scale in 1968 (Tapia & Marsh, 2004). Since then, tools for measuring math attitudes evolved and include, but are not limited to, unidimensional scales, enjoyment scales, and value scales (Tapia & Marsh, 2004). By 1982, Michaels, Forsyth, and Sandman created multidimensional attitude scales (Tapia & Marsh, 2004). As stated, these scales all were unified in the root assumption that negative attitudes toward math create performance problems as a result of anxiety (Tapia & Marsh, 2004). One of the more current robust tools for measuring student attitudes toward math is the Attitude Towards Mathematics Inventory (ATMI).

With student performance in mathematics generally understood to be poor in the U.S. and issues related to gender and performance well publicized, there has been no shortage of proposed solutions or proposed reasons for such inconsistency. Gunderson et al. (2011) suggested that “parents’ and teachers’ own math anxieties and their beliefs about whether math ability is a stable trait may prove to be a significant influence on children’s math attitudes” (p. 153). Since it has been established that large cross sections of the population consider themselves to struggle with math, if these same attitudes are projected on children and, according to Maloney et al. (2015) such a trait is genetic, then children are more likely to consider themselves poor at math. According to Gunderson et al. (2011), the same can be said of parental involvement in that positive parental and educator perspectives on student ability will transfer into positive student self-perception of their ability to accomplish a task or subject. Therefore, teachers and parents have the potential to impact student attitudes. Gunderson et al. (2011) recommended that early intervention is key to improving children’s math attitudes.

These interventions should be focused on breaking the “cycle” of poor attitudes toward mathematics and the belief that one is poor at math. There are also elements related to gender
rigidity that could yield insight into development of math attitudes (Gunderson et al., 2011). Gender rigidity theory suggests that students actively collect information about gender and gender stereotypes that becomes solidified over time to form gender stereotypes. As previously illustrated, there are certain fields and majors that are more likely to be occupied by females than males. This is not necessarily due to related abilities of either gender; instead, it is more likely related to societal expectations of gender (Gunderson et al., 2011). If a young woman determines early in life that being a nurse is a more gender appropriate profession for a female than a mathematician, it is likely that her collected information over the years would only reinforce that schema rather than point to other possibilities. If these notions can be broken at a young age, gender rigidity impact could be minimized and stereotypes could be replaced with notions that would more favorably impact female attitudes toward STEM subjects.

Gunderson et al. (2011) found that “research, primarily from U.S. samples, show(s) parents’ and teachers’ expectancies for children’s math competence are often gender-biased and can influence children’s math attitudes and performance” (p. 153). Math attitudes can be transmitted socially. Therefore, the solution for this problem would likely be rooted in different social tradition attitudes that are opposed to existing schemas that negatively impact female attitudes and general attitudes for both genders as they relate to math (Gunderson et al., 2011). Further research related to development of attitudes has been conducted as it relates to motivation (Mata et al., 2012). Researchers have suggested that understanding what motivates students is necessary for fostering learning environments that engage students and that develop favorable attitudes toward subjects. The younger the students are when they develop these attitudes, the more likely those attitudes will become rigid. Therefore, positive or negative habits
are easier to develop earlier and much more difficult to change as time progresses, as time generally will only make them more pronounced (Mata et al., 2012).

Mata et al. (2012) employed an adapted intrinsic motivation inventory to access the main determinants of intrinsic motivation as they relate to how children develop attitudes toward mathematics. In this particular study, it was found that students generally held positive attitudes toward mathematics and also highlighted the main effects of grade and math achievement as being contingent on these attitudes (Mata et al., 2012). The study also found that the main determinants of attitude toward math were facilitated by teachers and the social support of peers (Mata et al., 2012). This study reinforced the data that already existed that found that attitude toward math positively impacts performance. In addition, it mirrors the findings that quality of education impacts student attitude toward math. It offers new data related to peer structures. Bates (2013) reported that peer interactive activities were positively associated with student attitude toward a subject and subsequent performance. Mata et al. (2012) specifically found that peer social structures influence attitudes toward mathematics. While all of these studies present important reinforcement of previously expressed data in the literature review and extend some of these themes directly into math, they do present a data convolution as well.

Mata et al. (2012) found that the attitudes of students toward math were generally positive. They also found that attitudes positively impact performance (Mata et al., 2012). If these findings were correct, it means that across the board, students in the U.S. have positive attitudes toward math and this is reflected in positive performance. Unfortunately, this is not true. Math performance in the U.S. is below average and there are generally unfavorable perspectives in the general population as highlighted through research relating to math and the ability to do math. This does not mean that the Mata et al. study is not valid. It just means that
all of the findings are not congruent to what we know to be true regarding the state of math in the U.S.

Based on the data presented, it can be concluded that there is generally a poor attitude towards mathematical ability in the U.S. (Ogilvy, 2015). In addition, the U.S. has been underwhelming in their math performance when compared with the rest of the world (Desliver, 2015; NCES, 2015; Ryan, 2013). Research suggests that peer interaction, parents, and teachers all play a role in influencing attitudes toward mathematics (Gunderson et al., 2011; Mata et al., 2012). Beyond these generalities, it can also be stated that there are gender related disparities in math performance and attitudes toward mathematics. As time progresses, girls are more likely than boys to facilitate a negative perspective toward math, and this is further reinforced by the lower numbers of women entering into STEM majors in college (Mata et al., 2012; Olson, 2014). Congruent with the links between attitude and performance, there is an abundance of unfavorable attitudes present in the US toward mathematics and student performance in mathematics is also suffering. Research findings such as Gunderson et al. (2011) and Mata et al. (2012) suggest that there may be a causal link between these two phenomena.

**Student Attitudes Regarding Music**

Since 2008, funds have been cut in more than 80% of U.S. school districts, and the first programs to be eliminated are often disciplines such as music, art, and foreign language (Boyd, 2014). From a legislative perspective, there is a trend toward focusing on educational programs that are related to what is considered to be “employable subjects,” like math and science (Boyd, 2014). Deficiencies in STEM related subject performance among secondary and primary students in the United States has only bolstered the perspective that focusing on core subjects over electives is advantageous for educating today’s youth. These opinions that have been
favored by legislators and that are often times forced upon schools facing budget cuts due to lack of alternatives do not echo the sentiment of the general population. Unlike math, there is a favorable perspective on music education in the U.S. and a majority of the population disagrees with cutting these programs. Thirty percent of all respondents aged 12 and older who played musical instruments stated that they first played or learned about music in school (Lyons, 2003). Overwhelmingly, 85% of Americans believe that participating in a school music program correlates with better grades and 80% feel that playing an instrument does make people smarter (Lyons, 2003). This sentiment goes further in that 54% of Americans believe that children should be exposed to music before their first birthday, and 88% of Americans say that music is a very important part of their lives (Lyons, 2003). Such sentiment has also been present in the philosophical fields of discourse. Plato suggested over 2,000 years ago that “music is a moral law. It gives a soul to the universe, wings to the mind, flight to the imagination, a charm to sadness, gaiety and life to everything” (as cited by Lyons, 2003).

While this may be the general attitude that is being projected to young people by adults in the community, the reality is bleaker. Ryan (2013) stated that U.S. schools are not only mediocre in comparison with the results produced by other countries, but they are also expensive, with the U.S. being the highest spender worldwide on public education. Nearly all states budgets are in a fiscal crisis and at least five states have budget gaps of one billion dollars or more; additionally, educational spending continues to be reduced (Lyons, 2003). As previously stated, when cuts come to education, it is the arts and humanities that are generally first to be eliminated (Lyons, 2003). While this may be the reality of the situation, music continues to be important to people. North, Hargreaves, and O’Neill (2000) stated that music is important to adolescents to the extent that they often listen to an average of 2.45 hours of music
per day. When put on a continuum of preferred activities, music was second only to outdoor activities (North et al., 2000). Attitudes among students and even adults have indicated that listening to and playing popular music has different perceived benefits than listening to or playing classic music. However, they are both considered to be beneficial (North et al., 2000). While the general public may not think that math is unimportant per say, the general public does not perceive mathematics favorably. The favorable perspective of music generally carries into favorable performance in music education for students who choose to take music courses (North et al., 2000).

The entire context of attitudes toward music was described by Liu et al. (2014) as being a product of either intrinsic or extrinsic motivation. Both constructs bode favorably toward performance in the subject. While extrinsic motivation did not predict learning achievement necessarily, it was a significant moderator and it strengthened the relationship between intrinsic motivation and child achievement (Liu et al., 2014). The degree to which parents were intrinsically motivated had a positive relationship to children learning achievement (Liu et al., 2014). This demonstrates that the parental perspective on a subject impacts the student performance. Overall, Liu et al. (2014) found that “the results showed that children’s learning engagement mediated the interaction between intrinsic motivation and extrinsic motivation regarding children’s learning achievement” (p. 661). This finding has theoretical and practical implications.

While the general public’s attitude and student attitudes toward music is favorable, why it is important to the educational process beyond entertainment value is less well known and sometimes even debated. O’Williams (1972) stated that one of the ultimate goals of music education is to recognize differences in the student’s musical environment while learning their
attitudes toward changes in the environment. Those who are equipped for change are at an advantage then those who are ill equipped (Ancona et al., 2005). To say that music education enables people to manage for change may be difficult to substantiate with quantitative data. However, there are data that demonstrates the benefits of music education beyond what can be considered enjoyment or entertainment. Though it certainly has values within those contexts, it also has benefits for academia beyond enjoyment and entertainment. Rickard, Appelman, James, Murphy, Gill, and Bambrick, (2013) explain,

Music training has been found to produce a range of cognitive benefits for young children, although well-controlled evaluation of the effects on psychosocial functioning has been limited. Results indicated that school-based music classes prevented a decline in global self-esteem measures experienced by the control group in both the younger and older cohorts, and in general and academic self-esteem for the older cohort. While difficulties inherent in performing experimental research within schools prevent strong conclusions, the data imply that increasing the frequency of quality of arts based activities can be beneficial for the self-esteem of primary school aged children. (p. 292)

Having higher self-esteem has been demonstrated to aid in academic performance, social adjustment and adjustment into life after secondary school. As a result, from these data it could be considered that utilizing music and arts programs to facilitate self-esteem and confidence would be a worthy endeavor. Preliminary data collected by the same researchers also demonstrated that engaging activities, like juggling, may confer similar benefits for older children in gaining self-esteem (Rickard et al., 2013). Music education benefits are no different
than juggling in that it would be difficult to justify the expenditures if self-esteem were the only benefit. However, theorists have demonstrated benefits beyond self-esteem.

Some of the earliest to champion the study of music education were physicians and music educators from the early 1930s. Critchley and Henson (1977) did extensive research on the relationship between music and the brain. They explained the science behind each and as they did so, they added validity to Pythagoras’ theory that mathematical relationships were integral to physical properties, including music. The Pythagoreans did not see music and math separately. In fact, they saw them as synonymous (Southgate & Roscigno 2009). Critchley and Henson (1977) introduced the term *inter-hemispheric rival* to explain how the brain’s right and left hemispheres function very differently, and respond to music very differently, yet respond to music at the same time. Later, research conducted by Clynes (1982) revealed the theory of music competence.

Evidenced by Kraus’s research (2011), more areas of both hemispheres of the brain are activated, engaged, and stimulated while playing an instrument than any other activity. Kraus is currently researching in the field of neuroscience at Northwestern University, with music being the focal point of many of her studies. In 2008, she and two other researchers, (Musacchia, Strait, & Kraus, 2008) conducted a study involving 26 adults. This was an auditory study on musicians and non-musicians to explore the differences in how the brain interprets various sounds presented to both groups. The study focused on the perceptual and cortical development of the two groups. Musacchia et al. concluded, “taken together, these data imply that neural representations of pitch, timing and timbre cues and cortical response timing are shaped in a coordinated manner, and indicate corticofugal modulation of subcortical afferent circuitry” (p. 2).
Students engaged in music related activities were demonstrated by Whitaker (2011) to be highly proficient in understanding rapport between director and peers, as well as demonstrating the ability to read verbal and nonverbal cues necessary for music direction. This suggests that the dialogue present in music education is beneficial to the social development of young people, and this is a skill that can translate into the job market and into higher education (Whitaker, 2011). Furthermore, the nature of music education is such that it encourages hands on learning, which makes it naturally conducive to kinesthetic learning; kinesthetic learning does not happen as naturally with all students in a math classroom as it does in a music classroom (Walling, 2006). Music has also been used successfully to promote academic growth in young children involved in special education in an inclusive setting (Vaiouli & Ogle, 2014). Hallam (2010) specifically attempted to review empirical evidence relating to the effects of active engagement with music on the intellectual, social, and personal development of children and young people. Drawing from quantitative and qualitative psychological and educational studies, the researcher determined that music education has a positive effect on engagement on a personal and social development level provided it is a rewarding and enjoyable experience (Hallam, 2010). Quality of instruction, as in the other research examined, would be the difference between music education having benefits or not having benefits for language development, literacy, numeracy, measures of intelligence, general attainment, creativity, fine motor coordination, concentration, self-confidence, emotional sensitivity, social skills, team work, self-discipline, and relaxation (Hallam, 2010).

There is evidence that music can positively impact the aforementioned areas so long as it is a quality program. Simply being in a music program does not guarantee such benefits (Hallam, 2010). Brown (2015), in an explorative study of literature for PBS (Public
Broadcasting System), found that schools that have rigorous programs and high-quality music and arts teachers may also have high-quality teachers in other areas. People tend to perform better in an environment filled with creativity, joy, and positive attitudes. Harvard President Drew Faust stated that there is a propensity for education and legislative decision makers to overlook the benefits of music programs in addition to encouraging students not to follow their “interest in art or linguistics or any of the other humanity disciplines” (Boyd, 2014, p. 4).

Neuroscientists have done work that suggests those activities considered “extras” in education are critical for strengthening the mind (Boyd, 2014). In this regard, studying Mandarin or music as a child may do more for your adult brain and long term economic prospects than studying biology (Boyd, 2014).

Brown (2015) found that the brain of a musician, regardless of the age, works differently than that of a nonmusician. The whole context of focusing on “employable subjects,” therefore, may actually be flawed if “employable subjects” are considered to be only STEM related activities. Rather than just preparation for a certain job, the crux of the liberal arts education still holds value in developing character and even long term neuroscience gains as expressed in research (Boyd, 2014).

While measuring intelligence is a confusing and problematic paradigm in consideration of multiple intelligences, cultural bias, and testing validity, there is evidence that music enhances intelligence quotient (IQ) scores (Newman, 2008). IQ scores, though they do not necessarily influence the degree to which a person will be successful as a student or leader, are a consistent measurement for judging the potential academic intelligence of a student (Newman, 2008). While emotional intelligence has been found to be a greater predictor of success in the real world, IQ still holds an important place in the education process (Newman, 2008). Schellenberg
(2004) found a small increase in the IQs of six year olds who were given weekly voice and piano lessons. Specifically, in his study, students who were given music lessons over the school year tested on average three IQ points higher than the other groups (Schellenberg, 2004).

While the vast majority of the general population in the U.S. deems music important and has a positive attitude toward music education, when it comes to cuts in budget it is still a logical starting point for budget cuts. While it may be true that it would be difficult to suggest cutting one of the core educational subjects in favor of keeping music, it does not change the positive implications of music education, as expressed by Boyd (2014) and Rickard et al. (2013). With the attitude of the public toward music education combined with current research data, the school district and government decision makers will need to find ways to continue music education alongside of the conventional subjects. How to handle the music situation within the sphere of cutbacks may largely depend on one’s stakeholder position in society.

Both male and female students consider careers in the field of music plausible for personal success and enjoyment (Griswold & Chroback, 1981). While this is true, there are still some gender designations that plague the music education spectrum. Undergraduate music majors and nonmajors rated the names of 17 musical instruments and put them on a scale of most masculine to most feminine (Griswold & Chroback, 1981). According to the results, the harp, flute, and piccolo had the highest feminine ratings and the trumpet, string bass, and tuba had the most masculine ratings (Griswold & Chroback, 1981). These attitudes expressed by postsecondary students were likely cultivated in early education. In primary and secondary music education, there is a propensity for students to consider certain instruments for “girls” and others for “boys.” It would be more likely to see boys take up those instruments found on the “masculine” continuum and girls more likely to take up instruments on the “feminine”
continuum (Griswold & Chroback, 1981). Therefore, gender may influence the way in which music students choose to learn music. However, it does not change their actual attitude toward music education in general, which remains fairly consistent across gender respondents in surveys (Lyons, 2003).

There is a perception among the general public that music education is beneficial for social and academic growth (Lyons, 2003). Even Ivy League education presidents have indicated concern over cutting music programs and its potential negative impact on the educational process (Boyd, 2014). Beyond this attitude, there is science to bolster such claims. Boyd (2014) and Hallam (2010) both examined volumes of empirical neuroscience evidence related to the research question. Hallam determined that music must be of high quality if it is to have a positive impact on language development, literacy, numeracy, measures of intelligence, general attainment, creativity, fine motor coordination, concentration, self-confidence, emotional sensitivity, social skills, team work, self-discipline, and relaxation. This reinforces the importance of quality instruction which can cause a significant increase in achievement according to Simpson and Oliver (1990). While the way in which students enjoy music has gender variation, the attitude toward music programs does not have the type of gender variation that is seen in STEM subjects or mathematics. Beyond this, however, challenges related to funding remain. Cuts in school funding for music and arts programs make it difficult to continue quality music programs in public schools in the conventionally accepted monetary manifestations that would normally fund such programs. Quite simply, unless some new type of funding mechanism is proposed, despite its favorable perception, it is still likely that these programs will continue to be cut regardless of the scientific research that is published regarding their benefits. However, with the passing of the new ESSA (U.S. Department of Education,
2016), music is now considered a core subject. Music education will now fall within the legislative condition of “employable subjects” or “core subjects.” Funding issues for the new law still must be resolved.

**Links Between Math and Music**

While there is not an abundance of literature examining relationships between music and math education, there are common components shared by the two subjects. Rather than establishing contexts of math or music education, the two are actually complimentary phenomena. Vaughn (2000) stated, “according to conventional wisdom, music and mathematics are related, and musical individuals are also mathematically inclined” (p. 149). Though Vaughn found some modest support for this proposed relationship, a musical individual is not necessarily mathematically inclined. Music education does have elements that build math skills and reasoning that can be used in math (Vaughn, 2000). Vaughn’s modest research asked perhaps as many questions as it answered regarding links between math and music. There are other studies such as those undertaken by Gupta (2009) that examined empirical research that has been conducted on the two subjects.

In a 2006 article for the *Educational Psychologist*, Frances Rauscher said, “Young children provided with instrumental instruction score significantly higher on tasks measuring spatial-temporal cognition, hand eye coordination, and arithmetic,” it is estimated that this is a result of overlap between music skills and math skills (as cited by Gupta, 2009, p. 1). Elements that are related to understanding fractions and decimals are also relevant for understanding the concepts of rhythm (Gupta, 2009). Rauscher also stated, “A literate musician is required to continually mentally subdivide beat to arrive at the correct interpretation of rhythmic notation. The context has changed, but the structure of the problem is essentially the same as any part-
whole problem posed mathematically” (as cited by Gupta, 2009, p. 1). One of the more enduring and debated theories related to math and music is called the “Mozart Effect.” Popularized in the early 1990s, some research indicated that test subjects performed better on spatial temporal tasks immediately following exposure to a Mozart sonata (Gupta, 2009). Some of those who accept a link between math and music are not ready to accept that just simply listening to music makes someone better at a task. Most researchers, like Rauscher of the University of Wisconsin, gives more credit to the active playing of instruments as a tool to help build math skills (Gupta, 2009). Though perhaps not significantly, listening to music alone in certain contexts can disrupt academic skills. Thompson, Schellenberg, and Letnic (2011) found that loud and fast background music disrupts students’ reading comprehension, which negatively impacts any academic endeavor attempted by those students.

A reoccurring phenomenon in math is called “math anxiety” (Young, Wu & Menon, 2012). With the negative perceptions among students about math courses and their ability to succeed in math courses, there is a tendency for anxiety to exist, which inhibits the student’s ability to perform well on tests (Young et al., 2012). While the degree to which this impacts grades cannot be stated definitively, some of the problematic scores of U.S. students in math can be attributed to anxiety (Young et al., 2012). The amount of students it affects and the degree to which it affects them is difficult to pinpoint statistically. Math anxiety, when present, diminishes the student’s intellectual capacity, working memory, and reading ability (Young et al., 2012). It is equivalent to test taking anxiety. However, a student does not have to have test taking anxiety in order to have math anxiety, which can manifest without the presence of the other (Young et al., 2012). Music has been known to be a therapeutic treatment for reduction of anxiety, and researchers have proposed that it could potentially be used to reduce math anxiety and therefore
contribute to greater math performance (Young et al., 2012). Further research would have to be conducted on math anxiety and on music therapy to substantiate such claims. However, the theoretical underpinnings are present to warrant such exploration.

General cognitive advantages of music education have been found. In a review of more than 75 reports, Costa-Giomi (2014) found that consistent results are present in the short-term effects of music instruction on cognitive abilities. The complex nature of music instruction necessitates studying, perseverance, and intellectual ability to succeed. Long term benefits of music can be related to the ways in which it forces the student’s brain to work continuously (Costa-Giomi, 2014). All of these generalized findings are educational and cognitive constructs that would likely positively impact math scores and self-perception, which in turn could give students more confidence for success in the subject.

A study published by Hawkins (2015) demonstrated that students in the elementary schools with superior music education programs scored approximately 22% higher in English and 20% higher in math when compared to schools that had low quality music programs. The concentration that music training requires for success contributes favorably to the concentration needed to study for and take math examinations. Preparation for both requires persistence and attention to detail, which is required for proficiency in music and math since both require automaticity to excel (Brown, 2015). It is important to note that there was no difference in English and math achievement between low socioeconomic schools with high quality music programs and high socioeconomic schools with high quality music programs (Brown, 2015). This is important because it suggests that the potential benefits of music education on academics and on math are consistent for all demographics.
Gender Differences in Math

According to Genesis 1:27 (Holman Christian Standard Bible) God created man in His own image; the verse then goes on to explain man as being both male and female. Some versions refer to man as mankind. However, God made a choice to create male and female with differences. Researchers have studies these differences extensively. Voyer and Voyer (2014) found in a multi grade level study that female students held a small but significant advantage over male students in all subject areas. The smallest advantage was in math. However, DiPrete and Buchmann (2006) found that females have always out-performed males in school. After universities began allowing female students to attend, the universities found that the female students were receiving far more academic awards than male students, and some reversed their attendance policies. Female students tend to take more advanced classes and have earned more bachelor and master’s degrees than male students (DiPrete & Buchmann, 2006).

According to Gaspard et al. (2015), an important consideration when attempting to understand students’ attitudes is to better understand their values. Expectancy-value theory (Eccles, 1983) is a prominent approach to explaining gender differences in math-related academic choices. Expectancy-value theory identifies four value components: intrinsic value, attainment value, utility value, and cost. Gaspard et al. (2015) conducted a study on gender differences in value beliefs about math and found there were considerable differences in mean levels favoring boys on some but not all value components. These gender differences depended not only on the value component, but also on the specific facet under consideration.

Gender Differences in Music

In the Old Testament, David displayed masculinity, yet played the harp. The harp was identified by music students as one of the most feminine instrument (Griswold & Chroback,
1981). Hallam (2002) found that students make their instrument selection based on their personalities rather than gender. Aside from instrument selection, there are other gender differences in music. According to a study by Kölsch, Maess, Grossmann, and Friederici, (2003), males appeared to have greater left brain control than females in language domain. This contradicts the study by Voyer and Voyer (2013) that reported females outscored males in every subject area especially in language domain.

**Summary**

Overall, it is difficult to deny that there are some connections between math and music. The degree to which one impacts the other in the short- and long-term is being debated. A student who excels in math would likely have some of the attributes that are necessary for success in music (Brown, 2015). As students develop the computational and perceptual skills in each of the respective subjects, there would be some carry over into the other subject (Brown, 2015). The relationship between the two, based on available literature, can be considered complimentary. The reports that schools with high quality music education programs score 20% higher in mathematics than schools with lower quality or no music programs is important; however, it has to be considered that it is not just the music program influencing these scores (Brown, 2015).
CHAPTER THREE: METHODS

Design

This study was a correlational design, which examined student attitudes toward math and music education. Pearson correlations were used in this study with attitudes towards math as the predictor variable and attitudes towards music as the criterion variable. This correlational design, according to Gall, Gall, and Borg (2007) was appropriate for this study because the purpose was “to measure the degree and direction of the relationship between two or more variables and to explore possible causal factors” (Gall et al., p. 336). Attitudes towards math is defined as the participants’ expression of their experience with math education (Tapia, 1996). Attitudes towards music is defined as the participants’ expression of their experience with music education (Shaw & Tomcala, 1976). The predictor variable was attitudes toward math education and the criterion variable was attitudes toward music education.

Research Questions

RQ1: Is there a statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education?

RQ2: Is there a statistically significant relationship between male students’ attitudes toward math education and their attitudes toward music education?

RQ3: Is there a statistically significant relationship between female students’ attitudes toward math education and their attitudes toward music education?

Null Hypotheses

H₀₁: There is no statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education.
H₀₂: There is no statistically significant relationship between male students’ attitudes toward math education and their attitudes toward music education.

H₀₃: There is no statistically significant relationship between female students’ attitudes toward math education and their attitudes toward music education.

Participants and Setting

Participants for this study were from a convenience sampling and were selected from a Metropolitan Atlanta, Georgia school district. The school district is the largest in Georgia and over 100 nationalities are represented among the students giving it a vastly diverse population. The school is a Title 1 school which means that according to the Elementary and Secondary Education Act of 1965, as amended (ESEA) provides financial assistance to local educational agencies (LEAs) and schools with high numbers or high percentages of children from low-income families to help ensure that all children meet challenging state academic standards.

The sample size was 107 eighth grade students which, according to Gall et al. (2007, p. 145), exceeds the required minimum for a medium effect size with a statistical power of .7 at the .05 alpha level. The age of the participants ranged from 13 to 15. No personal data will be designated on the forms (beyond gender) and the answers will come from a demographic that is 87% Hispanic, 8% Black, 3% Asian, and less than 2% White. There are 60 (56%) males and 47 (44%) females.

Instrumentation

Two instruments were selected for this study. They were the Attitudes Toward Math Inventory (ATMI) and the Music Attitudes Inventory (MAI).
The ATMI, developed by Tapia (1996) contains 40 questions to which students had to assign a letter that corresponds with their opinion on that particular statement. The purpose of the instrument was to measure the attitudes of young students’ experiences with math education. Some statements on the survey included: “I am comfortable answering questions in math class,” “I really like mathematics,” and “Mathematics is dull and boring” (Tapia, 1996). The potential responses ranged from A-E with the following designations: A (strongly disagree), B (disagree), C (neutral), D (agree), and E (strongly agree; Tapia, 1996). In referencing other measurement tools commonly utilized in research studies, this instrument has been considered a modified Likert scale adaptation that employs letters rather than numbers. There were four subscales. Fifteen of the 40 items were designated to subscale self-confidence, 10 were designated to value, 10 were also designated to enjoyment, and five to motivation. If the responses to each subscale were more As and Bs than Ds or Es, then the confidence level, value, enjoyment, and motivation would be strong. The validity of this particular tool has been tested and it has been noted to have a variety of benefits. These distinctions have led to widespread utilization of this instrument in academic research on the subject. According to Majeed, Darmawan, and Lynch (2013), confirmatory factor analysis of ATMI demonstrated that “ATMI is a viable scale to measure attitudes toward mathematics” (p. 121). This conclusion was reached from a study that included a robust sampling of 699 seventh and eighth grade students (Majeed et al., 2013). According to the researchers, the tool had a range of variance from .56 to .88, which was suitable to declare that the tool was valid (Khine & Afari, 2014). See Appendix A and C for the questions that comprise the instrument and Appendix B and D for Permission to Use Instrument.
MAI

Musical attitudes were accessed by using the MAI originally crafted by Shaw and Tomcala (1976). According to the authors, this instrument was created as a result of “the unavailability of a published standardized music attitude scale suitable for use in upper elementary school grades to devise an attitude instrument and to begin the standardization process” (Shaw & Tomcala, 1976, p. 75). The purpose of this instrument was to examine the attitude of young students towards music education. The survey consisted of a 4-point Likert scale self-assessment statements. The survey was similar to the ATMI and was be administered to the students upon completion of the ATMI survey. The MAI has an estimated reliability of .87 that yielded 13 factors (Shaw & Tomcala, 1976). The instrument consisted of 44 items and students responded whether they strongly agree (4), agree (3), disagree (2), or strongly disagree (1). Data from the MAI was classified based on scores, frequency, and cumulative percent. The range of scores was from 44-176. A score of 44 is the lowest possible score, meaning the attitude of the participant toward music is negative; a score of 176 is the highest possible score, meaning that the attitude of the participant towards music is positive. Based on the data collected in their study, the authors stated that, “Sufficient construct validity exists to warrant its use in studies for which another suitable instrument cannot be located” (Shaw & Tomcala, 1976, p. 77).

Procedures

Approval from Liberty University’s Institutional Review Board (IRB) and the target school was requested and received prior to the administration and or collection of any data for this study (Appendix E). Permission from participating school’s principal was received (Appendix F). All participants read, signed, and returned a written consent form prior to
participating in this study. (Appendix G). An informational pamphlet that included the consent form was sent to the parents explaining the study and allowed them the opportunity to withhold their child from participating in the study. A written script (Appendix H) was prepared and approved by the IRB to be read to the participants prior to the consent form being signed and before the surveys are administered. Before the administration of the surveys, the researcher had a colleague read the script. The colleague then collected the consent forms and administered the surveys to all the students who agree to participate. This ensured the researcher could not know who participated and who did not. The surveys took approximately 45 minutes to complete. The first survey, ATMI, was given the first day to the colleague’s eighth grade Language Arts classes; the second survey, MAI, was given on the second day to the same students. Special education instructors were available to provide read aloud support to the one student whose IEP allowed for the read aloud accommodation. Similar support structures were also available for English as a Second Language (ESL) students. After the data was collected, the researcher recorded the responses and demographic (male/female) data on a spread-sheet. The data was analyzed using SPSS 18 software to calculate the Pearson $r$ for each of the null hypotheses.

**Data Analysis**

The three null hypotheses were analyzed using the Pearson Product Moment Correlation or Pearson’s $r$. It is a measure of the linear correlation between variables x and y giving a value between $+1$ and $-1$ inclusive, where 1 is total positive correlation, 0 is no correlation, and $-1$ is total negative correlation (Kornbrot, 2005). Data screening was used to screen for missing data. Preliminary analyses were conducted in order to check for bivariate normal distribution, linearity, and violations of the assumptions of normality. Due to the sample size, $N = 107$, the researcher used the Kolmogorov-Smirnov test to check for normality at the .05 alpha level.
Scatter plots and box plots were used to check the assumptions of bivariate outliers, linearity, and bivariate normal distribution. Because of the testing of three null hypotheses and a Bonferroni correction, Warner (2013) suggests the researcher use an alpha level of .0167 (two-tailed).
CHAPTER FOUR: FINDINGS

Research Questions

RQ1: Is there a statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education?

RQ2: Is there a statistically significant relationship between male students’ attitudes toward math education and their attitudes toward music education?

RQ3: Is there a statistically significant relationship between female students’ attitudes toward math education and their attitudes toward music education?

Null Hypotheses

H₀₁: There is no statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education.

H₀₂: There is no statistically significant relationship between male students’ attitudes toward math education and their attitudes toward music education.

H₀₃: There is no statistically significant relationship between female students’ attitudes toward math education and their attitudes toward music education.

Descriptive Statistics

Mean and standard deviation obtained for the predictor variable (attitudes toward math) can be found in Table 1. Means and standard deviations for the criterion variables (attitudes towards music and gender) can be found in Table 2.
Table 1

*Descriptive Statistics of Predictor Variable*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$N$</th>
<th>$M$</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
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<td>100.82</td>
<td>29.54</td>
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<tr>
<td>Males</td>
<td>48</td>
<td>95.31</td>
<td>28.29</td>
</tr>
<tr>
<td>Females</td>
<td>43</td>
<td>106.33</td>
<td>30.15</td>
</tr>
</tbody>
</table>

Table 2

*Descriptive Statistics of Criterion Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$N$</th>
<th>$M$</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>10.64</td>
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<tr>
<td>Males</td>
<td>48</td>
<td>109.92</td>
<td>10.47</td>
</tr>
<tr>
<td>Females</td>
<td>43</td>
<td>103.47</td>
<td>9.87</td>
</tr>
</tbody>
</table>

**Results**

**Data Screening**

The researcher screened for outliers, missing data, and inconsistencies among the predictor and criterion variables. Outliers, data errors, and inconsistencies were identified in accordance with the procedure recommended by Warner (2013, pp. 132-137, 270-271). One participant (case 84) only took the music survey and did not complete it. This resulted in a great deal of missing scores, thus the information for this participant was omitted from the study. In addition, nine participants (cases 29, 40, 63, 64, 65, 66, 71, 73, and 78) all had missing data resulting in large numbers of omitted scores. Therefore, the information for these nine
participants was removed from the data set (Warner, 2013, p. 134). Boxplots (Figure 1) were used to detect outliers for the predictor variable and criterion variable (Warner, 2013, pp. 153-157). Three other participants’ data was omitted from the data set (cases 12, 17, and 25) due to outliers. Normality for this study was tested using SPSS 18 and the conclusion concerning skewness and kurtosis was that these data are somewhat negatively skewed and kurtotic for both male and females (Male skewness = .4, Kurtosis = -.9, Female skewness = .59, Kurtosis = .01) but it does not differ significantly for normality (-1.96 to 1.96). Therefore, it was assumed that the data are approximately normally distributed in terms of skewness and kurtosis. Thus, the researcher ran a series of histograms, and after a graphical inspection, determined to continue with the analysis using the Pearson $r$. The assumption of normality was also found to be tenable at the .05 alpha level for the predictor variable: attitudes toward math education ($p = .738$).
Figure 1. Boxplots

Assumption Tests

The three null hypotheses were tested using Pearson’s $r$. According to Warner (2013, pp.267-270), five assumptions are required when using Pearson’s $r$. The five assumptions are: independence, normality, linearity, bivariate normal distribution, and bivariate outliers. The criterion variable scores for each participant were independent of each other for the assumption of independence (Warner, 2013, pp. 25, 267). See the above section for the assumption of normality. Scatter plots were used to examine the linear relationship between the predictor variable and the criterion variable. Because there were no curvilinear plots identified, the
assumption of linearity was tenable (Warner, 2013, pp. 267-269). A visual examination found the assumptions of bivariate normal distribution and bivariate outliers to be tenable.

**Statistical Analysis**

To test the three null hypotheses at the .05 alpha level Pearson correlations were used. A Bonferroni correction was used (PCalpha = EWalpha/k or PCalpha = .05/3 = .0167) to help prevent a Type I error across the three correlations (Warner, 2013, pp. 98-99).

**Null Hypothesis One**

For hypothesis one, the researcher examined if there was statistically significant relationship between students’ attitudes toward math education and students’ attitudes toward music education. The researcher failed to reject the null $r(91) = .36, p = .738$; therefore, no statistically significant relationship between students’ attitudes toward math education and students’ attitudes toward music education could be determined. The relationship between attitudes toward math and attitudes toward music is shown in Figure 2.
Null Hypothesis Two

For hypothesis two, the researcher examined if there was a relationship between male students’ attitudes toward math education and male students’ attitudes toward music education. The researcher failed to reject the null hypothesis: $r(48) = -0.153$, $p = 0.300$; therefore, no statistically significant relationship between male students’ attitudes toward math education and male students’ attitudes toward music education could be determined. The relationship between male students’ attitudes towards math education and male students’ attitudes toward music education is shown in Figure 3.
Null Hypothesis Three

For hypothesis three, the researcher examined if there was relationship between female students’ attitudes toward math education and female attitudes toward music education. The researcher failed to reject the null $r(43) = .219, p = .159$; therefore, no statistically significant relationship between female students’ attitudes toward math education and female attitudes toward music education could be determined. The relationship between female students’ attitudes towards math education and female students’ attitudes toward music education is shown in Figure 4.
Figure 4. Scatter Plot between Female Attitudes Toward Math and Female Attitudes Toward Music
CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

The literature was unclear whether or not a correlation exists between students’ attitudes toward math education and their attitudes toward music education. The purpose of this study was to determine if a relationship does exist between the predictor variable, students’ attitudes toward math education, and the criterion variable, students’ attitudes toward music education, in regards to gender.

This study utilized the Attitude Towards Mathematics Inventory (ATMI; Tapia, 2006) and the Music Attitudes Inventory (MAI; Shaw & Tomcala, 1976). The data gathering instrument was used to answer the following research questions:

**RQ1:** Is there a statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education?

**RQ2:** Is there a statistically significant relationship between male students’ attitudes toward math education and their attitudes toward music education?

**RQ3:** Is there a statistically significant relationship between female students’ attitudes toward math education and their attitudes toward music education?

Pearson correlations were used in this study with attitudes toward math education as the predictor variable and attitudes toward music education as the criterion variable among male and female students. This correlational design was appropriate for this study since its purpose was “to measure the degree and direction of the relationship between two or more variables and to explore possible causal factors” (Gall et al., 2007, p. 336).

None of the hypothesis showed a statistically significant relationship between students’ attitudes toward math education and their attitudes toward music education regardless of gender.
Cranmore and Tunks (2015) investigated high school students’ perceptions of the relationship between music and math and found that high school students perceived math to be the basis for music. This was the opposite from previous studies (Cranmore & Tunks, 2015).

Cranmore and Tunks (2015) noticed rhythm seemed to have the most significant connection to math. According to Piaget’s (1973) theory of cognitive development, this rhythmic connection to math would reinforce the student’s schema. The more frequent someone is exposed to information, the more likely it is that they will retain more of that information. This leaves several possibilities for educators in both fields. They suggest that math and music educators encourage students to notice the connections in both areas of study and not one over the other. Additionally, Cranmore and Tunks pointed out that teachers in both fields should work together to support student achievement in math as well as music (Cranmore & Tunks, 2015, p. 51). Doing so will increase the opportunities the students will have to practice basic skills, and as the student’s automaticity develops, they make new connections in both math and music.

Regarding gender, there was not a statistically significant relationship found between male students’ attitudes toward math education and music education. Gaspard et al. (2015) pointed out that male students placed less value on math achievement and were more willing to accept a low grade in math than female students and were less willing to put forth extra time studying than female students. There were no studies that showed a correlation (positive or negative) between male students’ attitudes toward math education and music education.

Gaspard et al. (2015) found that the majority of female students seemed to be more concerned with higher math achievement scores than did the majority of male students and were willing to put forth more effort studying than the male students. There were no studies that
showed a clear correlation (positive or negative) between female students’ attitudes toward math education and music education.

Conclusions

When the researcher began this study, the prediction was made that there would be a statistically significant relationship between students’ attitudes toward math education and music education. The researcher also predicted that there would be statistically significant relationships between male and female students’ attitudes toward math education and music education. After analyzing the data, controlling for the risk of a Type I error, it was discovered that no statistically significant relationship exists between students’ attitudes toward math education and the other two criterion variables. The researcher found a common theme concerning students’ attitudes, and that was the impact the instructor’s attitude was toward the students. Parents’ attitudes towards curricula also made a direct impact on a child’s attitude toward the same curricula. According to Cranmore and Tunks (2015), further examinations are needed in the area of students’ attitudes toward math education and music education, to include gender and other variables. Since the present study did not find a statistically significant relationship between students’ (male or female) attitudes toward math education and music education, it may be implied that more attention be placed on studying why students who participate in music education classes outperform non music students on standardized exams (Costa-Giomi, 2004). However, Elpus (2013) found that music students did not outperform non-music students when controlling for the domains of demography, prior academic achievement, time use, and attitudes toward school. Additionally, Costa-Giomi (2014) found in her study of 117 fourth graders that three years of piano lessons improved the students’ self-esteem and school music grades but not their math scores. Gupta (2009) did find that there are many cross circular skills in music and
math that have great benefits to both subjects. While this study does show many common skills within math education and music education, such as automaticity, mental calculations, and discipline to practice, it did not offer much new information as to whether a statistically significant relationship exists between students’ attitudes towards math and their attitudes toward music.

**Implications**

The implications of the study relate to the education of all students. As Gardner (1983) pointed out, there are multiple intelligences. Therefore, educators must work together, across curriculums such as math and music, to allow the best opportunities for all students. It is difficult to teach to each student’s needs and maintain scope and sequence. According to Cohen (2011) it is imperative for the success of all students to be engaged by the educator. While there are studies that indicate that studying music can benefit math understanding (Cohen, 2011), this study showed that there was no statistically significant relationship between students’ attitudes toward math and their attitudes toward music. This is important because there were no studies that examined this phenomenon in the middle school grades.

**Limitations**

There were several known limitations to this study. Although the sample was diverse; the participants were all eighth grade students from the same school. Therefore, the study cannot represent the attitudes of all eighth grade students. Also, the participants were not identified as music students or non-music students; therefore the researcher had no way of knowing how many music students participated.

**Recommendations for Further Research**

The following are recommendations for further research.
(1) Further research could be conducted with a different sample. For example, select a larger population and recruit a larger sample to include multiple grade levels.

(2) Further research could be conducted to determine whether automaticity offers music students an advantage in math over non-music students.
REFERENCES


Deere, K. B. (2010). *The impact of music education on academic achievement in reading and math*. ProQuest LLC. Ann Arbor, MI.


May 2, 2016

Glen Alan Lowe  
IRB Approval 2491.050216: Eighth Grade Perspectives: The Correlation of Attitudes Towards Math and Music

Dear Glen,

We are pleased to inform you that your study has been approved by the Liberty IRB. This approval is extended to you for one year from the date provided above with your protocol number. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. The forms for these cases were attached to your approval email.

Thank you for your cooperation with the IRB, and we wish you well with your research project.

Sincerely,  

[Signature]  

Administrative Chair of Institutional Research  
The Graduate School
Appendix B: Principal Permission Letter

April 15, 2016

To Whom It May Concern:

We at [Insert School Name] are happy to allow Mr. Glen Lowe the opportunity to work on his Educational Doctorate degree and research project in conjunction with our staff. Our students will partake in the survey created by Mr. Lowe to assist him in his work.

Thank you,

[Signature]

Principal
Appendix C: Consent Form

The Liberty University Institutional Review Board has approved this document for use from 5/2/16 to 5/1/17
Protocol #: 2491.050216

PARENTAL CONSENT FORM
EIGHTH GRADE PERSPECTIVES: THE CORRELATION OF ATTITUDES TOWARDS MATH AND MUSIC
Glen Alan Lowe
EdD Dissertation Requirement
Liberty University
School of Education

Your child has been invited to be in a research study looking at the relationship of eighth grade students’ attitudes between math and music. Your child has been selected as a possible participant because he/she is an 8th grade student who has taken math class and may or may not have taken music classes. Please read this form and ask any questions you may have before agreeing to allow your child to participate in the study.

Glen Lowe, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this correlational study is to examine the relationship between students’ attitudes towards math education and their attitudes towards music education. All students take the required math curriculum. Some students do well while many struggle. Music contains a great deal of math; therefore, this study will examine male and female students’ attitudes towards math and music to see if a significant correlation exist between to two.

Procedures: If you agree to allow your child to be in this study, I would ask you to allow them to do the following things:
1.) Complete a 40 question survey giving your honest attitude towards math which will take approximately 20 minutes to complete.
2.) Complete a 44 question survey giving your honest attitude towards music which will take approximately 25 minutes to complete.
The surveys will be online and administered by another teacher. Therefore, I will not know who participates and who does not participate.

Risks and Benefits of being in the Study: The risks involved in this study is no more than what they would experience in a regular school day. It is safe for them because there is no way for me to know if they participated or not. Participants should not expect to receive any direct benefit. However, this study will benefit society by providing information useful to furthering education.

Compensation: Because participation in this study is completely anonymous, your child will not receive any compensation for taking part in this study.
Confidentiality: The records of this study will be kept private. The only demographic information your child will provide is their gender. Therefore, any sort of report I might publish will not include any information that will make it possible to identify a subject. Research records will be stored securely and only the researcher will have access to the records.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not affect their current or future relations with Liberty University or their grade in my class. If you decide to allow your child to participate, they are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions: The researcher conducting this study is Glen Lowe. You may ask any questions you have now. If you have questions later, you are encouraged to contact him at glen_lowe@gwinnett.k12.ga.us. You may also contact the researcher’s faculty advisor, Dr. Barbara Boothe, at bboothe@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Institutional Review Board, Green Hall, Carter 134, Lynchburg, VA 24515 or email at irb@liberty.edu.

Please notify the researcher if you would like a copy of this information to keep for your records.

Statement of Consent:
I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study. As the parent, I consent to my child’s participation in this study.

(Note: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)

<table>
<thead>
<tr>
<th>Student Signature</th>
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<tbody>
<tr>
<td>Parent Signature</td>
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<tr>
<td>Investigator Signature</td>
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Appendix D: Script for Research

The researcher’s colleague will address the four classes and say the following: “Class, those of you whose parents have giving their approval for you to participate are being asked to provide your opinions on two different surveys. The first survey, your attitude towards math education, will be administered online today, and the second survey, your attitude towards music education, will be administrated online tomorrow. Your participation is voluntary. Your responses will be anonymous which means that I will not know if you participate or not. Either way, your grade in Social Studies will not be affected in any way.” The researcher will then leave the room while the surveys are administered.