COMPARING THE EFFECTS OF ELEMENTARY MUSIC AND VISUAL ARTS LESSONS ON STANDARDIZED MATHEMATICS TEST SCORES

by

Molly Elizabeth King

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

The purpose of this quantitative, causal-comparative study was to compare the effect elementary music and visual arts lessons had on third through sixth grade standardized mathematics test scores. Inferential statistics were used to compare the differences between test scores of students who took in-school, elementary, music instruction during the same semester state standardized mathematics tests were administered and those who took in-school, elementary visual arts instruction during the same semester standardized mathematics tests were administered. The students attended seven elementary schools in the same North Alabama school district. The research questions were: (a) Does participation in elementary school music lessons have a greater positive effect on the proportion of third through sixth grade students who score Level III and Level IV on the ARMT mathematics test compared to third through sixth grade students participating in elementary school visual arts lessons? and (b) Does participation in elementary school music lessons have a greater positive effect on the mean SAT-10 mathematics test scores of third through sixth grade students compared to third through sixth grade students participating in elementary school visual arts lessons? There results indicated there was not a statistically significant difference in the analysis of the ARMT scores; however, the analysis did reveal that on average a greater proportion of students scored higher on the mathematics section of the ARMT when taking school music lessons compared to visual arts lessons. The analysis results of the SAT-10 scores did yield a statistically significant difference.

Keywords: the arts, math, mathematics, Mozart Effect, music, visual arts

Dedication

When I was three years old my mother enrolled me in ballet lessons as a form of exercise. She never imagined dance lessons would lead to a career in the arts, inspire and aid me in other career fields, and become a life-long passion. I sincerely believe in the integration of arts into our schools and classrooms as a way to reach each and every individual student and assist them in succeeding to their fullest potential. This dissertation is dedicated to my mother and grandmother who not only provided funding and transportation to dance, singing, piano, and visual arts lessons, but also made sure I had the opportunity to attend the best Christian high school to prepare me to be able to fulfill the academic demands of college and a doctoral program. My mother also set an example of how a caring and talented teacher can make a difference in the future through teaching our youth!

My husband, Rick, and our children, Allen and Alex, also deserve credit for helping me fulfill this goal. They allowed me time away from our family to take classes, study, attend residencies, and write my dissertation. Not only did they sacrifice time, but they never complained about the money taken from our family budget to finance my education. Rick and Allen also assisted in proof reading and teaching me formulas needed to analyze data, while Alex cheered me on when I became frustrated.

My dissertation is dedicated to my mother, Sheila Hawk, grandmother, Gladys Wells, my husband, and my two wonderful sons.

Acknowledgements

A dissertation cannot succeed without a committee. Although I did not know Dr. Jones very well when this process started, she proved to be a wonderfully, patient guide. Having had Dr. Tierce as a professor in a course at Liberty University, I was happy when he agreed to serve on my committee, as I knew he was a person who was attentive to details, and he would convey his suggestions in a clear way with kindness. Many years ago Dr. Davenport was my oldest son's elementary principal, but she quickly became more. She has been an amazing mentor, role model, cheerleader, and friend to me for more than a decade in many endeavors beyond my dissertation. Dr. Watson has also been a supportive guide from the day I contacted him about transferring credits and becoming a student at Liberty University. I cannot thank my committee members and research consultant enough for all they have done.

I also want to thank Amy Protus, the Advanced Placement Statistics teacher at James Clemens High School, where it is great to be a Jet! She patiently helped me sort through the data collected, taught both my husband and me how to analyze it correctly, and checked to be sure it was done correctly.

In closing, although mentioned last but certainly not least, nothing on this earth could be done without the many blessings from God. Although at times I have been resistant to where He was trying to lead me, eventually I quit trying to control things and followed Him and that is when things worked out. My family and committee have played significant roles in my success, but without God, none of us would have been capable of succeeding in our roles along this journey. Ecclesiastes 3: 11-12 has always been a favorite verse as it reminds us there is a time to dance. In rereading it, I also think several parts encompass many of the feelings one experiences in the doctoral process:

> . . .there is a time for every purpose under heaven. . . A time to plant and a time to uproot what is planted . . . A time to tear down and a time to build up. A time to weep and a time to laugh; A time to cry and a time to dance. . . A time to search and a time to give up as lost; A time to keep and a time to throw away. . . A time to tear apart and a time to sew together; A time to be silent and a time to speak. A time to love and a time to hate; A time for war and a time for peace. What profit is there to the worker from that in which he toils? . . .God has made everything appropriate in its time. . . I know that there is nothing better for them than to rejoice and to do good in one's lifetime; moreover, that every man . . . sees good in all his labor—it is the gift of God.

Now is the time to dance and see good in all our labor!

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List of Abbreviations

Alabama Reading and Math Test (ARMT)

American Mathematical Society (AMS)

Adequate Yearly Progress (AYP)

Attention Deficit Disorder/Hyperactivity Disorder (ADD/HD)

Compact Disc (CD)

Composers in Public Schools (CiPS)

Early Childhood Longitudinal Study, Kindergarten (ECLS-K)

Education Longitudinal Study of 2002 (ELS: 2002)

Elementary and Secondary Education Act (ESEA)

Emotional Intelligence (EI)

English Language Learner (ELL)

English as a Second Language (ESL)

Every Student Succeeds Act (ESSA)

Grade Point Average (GPA)

Institutional Review Board (IRB)

Intelligence Quotient (IQ)

Kuder-Richardson Formula 20 (KR20)

Magnetic Resonance Imaging (MRI)

Modern Language Association (MLA)

Multiple Intelligences (MIs)

National Assessment of Educational Progress (NAEP)

National Association of Music Merchants (NAMM)

National Coalition for Core Arts Standards (NCCAS)

National Educational Longitude Study of 1988 (NELS: 88)

National Longitudinal Survey of Youth of 1997 (NLSY97)

No Child Left Behind (NCLB)

Otis-Lennon School Ability Test (OLSAT)

Positron Emission Tomography (PET)

Revised Minnesota Paper Foam Board (RMPFB)

Science, Technology, Engineering, Arts, and Math (STEAM)

Science, Technology, Engineering, and Math (STEM)

Socio-Economic Status (SES)

Sounds of Learning (SoL)

Stanford Achievement Test (SAT)

Stanford Achievement Test 10th edition (SAT-10)

Statistical Product and Service Solutions (SPSS)

CHAPTER ONE: INTRODUCTION

Throughout history, music education and music activities have been a part of most civilizations and human societies, having been recognized as possessing the ability to serve a variety of human needs (Zafranas, 2004). The early Greek philosopher Plato "defined rhythm as an order of movement" (Pollatou, Karadimou, & Gerodimos, 2005, p. 361). Plato claimed that rhythm and movement mimicked the heavenly bodies, thus defining the music of the spheres and imitating the moral organization of the universe. Plato regarded music as a psychosociological phenomenon, and his main concern was related to the effects of music on character and morals. He considered music as a part of ethics; as a result, he valued music in its ethically approved forms (Pollatou et al., 2005).

Background

More than 20 years ago researchers Rauscher, Shaw, and Ky (1993) published an article in *Nature*, which indicated that listening to music makes people smarter. The study claimed that university students scored higher on standardized tests of spatial abilities after listening to 10 minutes of a Mozart sonata in contrast to sitting in silence or listening to relaxation tapes. This phenomenon became known as The Mozart Effect and created a renewed interest in researching the non-musical benefits of music as related to cognitive functions (Thompson, Schellenberg, & Husain, 2001).

National Standards for Arts Education

In 1994, the *National Standards for Arts Education*, developed by the Consortium of National Arts Education (under the supervision of the National Committee for Standards in the Arts), identified and divided the arts into four distinct categories: dance, visual arts, drama, and music. The *National Standards for Arts Education* is a manuscript that explained the

fundamental arts learning outcomes that are essential to the comprehensive education of each American student in kindergarten through 12th grade. The National Association for Music Educators provided a grant to the Consortium that allowed for the publication of the National Standards in 1994 (Consortium of National Arts Education Associations, 1994).

Music is one of the four categories of the arts identified in the *National Standards for Arts Education* as essential to the comprehensive education of each American student. National music standards for kindergarten through 12th grade have been established and published (Consortium of National Arts Education Associations, 1994). Through the years, various studies (Campbell, Connell, & Beegle, 2007; Cornett, 2011; Cox & Stephens, 2006; Crncec, Wilson, & Prior, 2006; Fehr, 2007; Gullatt, 2007; Kokotsaki & Hallam, 2007) have claimed that participating in music lessons and activities can increase test scores, promote creative thinking and problem solving skills, such as those needed in the 21st century workforce, and engage at-risk and disadvantaged students. Studies have also claimed participation in music lessons can assist in the teaching of ESL/ELL students and other diverse learners, increase self-esteem, provide an aesthetic release for fears and stress, and promote a positive and cooperative environment, which contributes to safer schools (Campbell et al., 2007; Cornett, 2011; Cox & Stephens, 2006; Crncec et al., 2006; Fehr, 2007; Gullatt, 2007; Kokotsaki & Hallam, 2007).

Elementary and Secondary Education Act

The Elementary and Secondary Education Act (ESEA), generally referred to as the No Child Left Behind (NCLB) act was created in 2001. President George W. Bush signed the NCLB act into law in 2002. The NCLB act required the use of high stakes testing in core academic subjects. The NCLB act identified the arts as a core subject; however, no measure of testing accountability was required in the arts as opposed to mathematics and reading. NCLB

required schools to show Adequate Yearly Progress (AYP) in reading, mathematics, English, and language arts. Students showing growth in the four subjects tested (mathematics, reading, language arts, and science) determined AYP (Cornett, 2011; NCLB, 2004; No Child Left Behind Act of 2001, 2008; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010a).

The NCLB act required equitable AYP for all students including subgroups such as economically disadvantaged, minority, English Language Learners (ELL) or English as a Second Language (ESL), and students identified in special education (Cornett, 2011; NCLB, 2004; No Child Left Behind Act of 2001, 2008; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010b). In addition, one of the main goals of NCLB was to close the mathematics achievement gap (Shuler, 2012). The AYP requirement and the goal of closing the mathematics achievement gap put extra pressure on school leaders as administrators strove to improve the achievement disparity between subgroups while working with limited budgets (Buchan, 2008; Helmrich, 2010). As a result, some school music lessons were cut so that additional funding to increase instruction in mathematics was available (McMurrer, 2008).

Every Student Succeeds Act (ESSA)

President Obama asserted that the goals of NCLB were correct as they related to high standards, accountability, and closing the achievement gap; however, in practice it failed, as it did not consider the unique needs of individual schools and communities. In December 2015, President Obama signed the Every Student Succeeds Act (ESSA). ESSA replaced NCLB. According to President Obama, the main difference between ESSA and NCLB is that the goals of NCLB were right, but the one-size fits all framework denied teachers, schools, and states the tools they needed to meet the goals. ESSA does not require AYP in the same format as NCLB;

however, it does require an accountability system that measures school performance, and schools are mandated to show annual improvement. Each state is required to design its own accountability system, which is submitted to the Secretary of Education to ensure the State's plan is consistent with the law. The accountability plan must incorporate graduation rates, proficiency on annual assessments in reading and mathematics, and English language proficiency. Schools must also include other measures in assessing school performance, such as access to and completion of advanced coursework, school climate and safety, and student and teacher engagement; however, the required measures, related to academic achievement, must outweigh the other factors in the plan (The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press Secretary, 2015b).

Closing the achievement gap is also a central part of ESSA. ESSA require states that receive Title I funds to test at least 95% of students in third through eighth grades annually in mathematics and reading and at least 95% of high school students in mathematics and reading at least once in ninth through 12th grades. Science is also a required test subject, but only has to be tested three times: once in third through fifth grade, once in sixth through ninth grades, and once in 10th through 12th grades. Students in the state's lowest performing 5% of schools, schools with high achievement gaps, and schools with less than a one-third graduation rate are expected to show annual improvement in student learning under ESSA, but unlike the disciplinary consequences schools faced under NCLB when failing to meet AYP, ESSA does not include disciplinary consequences when progress is not met. When progress is not met, schools are required to work with stakeholders to create a plan for improvement and are monitored by the district and state. A central component of ESSA related to academic achievement not originally

included in NCLB, is to ensure that all students are ready for a career and college when they graduate from high school (The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press Secretary, 2015b).

Like NCLB, ESSA also includes music as a core component of the curriculum. Both music and arts are listed in the "well-rounded education" provision, which was formerly known as "Core Academic Subjects." The "well-rounded education" provision contained in ESSA identifies subjects that are considered critical in providing students with an enriched and vast educational experience (Louisiana Music Association, 2016; Every Student Succeeds Act of 2015, 2015). According to the Louisiana Music Association (2016), including music in the provision highlights music as being an important component of every student's education. The inclusion is an extraordinary advancement for music education, as "well-rounded" is referenced in an assortment of additional essential provisions throughout ESSA.

Problem Statement

While there have been studies related to the effect music has on academics, most of the previous research focused on early childhood, high school, or college-age students (Bloor, 2009). *Music Perception* was first published in 1983. Tirovolas & Levitin (2011) conducted a documentation of the "longitudinal course of empirical studies in the journal" (p. 23) from 1983 to 2010. The researchers claimed that only 8% of the articles utilized child participants compared to 95% of the articles that reported the use of adult participants (the total is higher than 100% due to coding in more than one area and because some studies used both children and adults). This study, Comparing the Effects of Elementary Music and Visual Arts Lessons on Standardized Mathematics Test Scores, focused on the potential benefits of music in upper elementary grades

and added to the growing body of research that demonstrated the non-musical benefits of music as related to mathematics test scores and provided a framework for designing and improving curricula, preparing students for the 21st century workforce, and making schools a safer environment. Because the research focused on upper elementary students, the research helped eliminate the void regarding this particular age group. In addition, while there have been studies related to the effect music has on academics, there have been very few studies comparing the effects of music and visual arts on academics. This study compared two different types of arts, visual arts and music, to support the theory that music has a more positive effect on mathematics test scores when compared to visual arts. If the research discovered that one type of art was more beneficial to a specific subject more than another, than curricula can be designed to integrate and emphasize the specific type of art that best compliments the subject.

Schellenberg (2006) and Zafranas (2004) claimed that educators in the field of music have consistently advocated that music instruction is necessary in the overall development of a child. In addition, as an effort to keep music programs in the curriculum, many have supported and/or promoted the theories related to the power music has in increasing cognitive abilities in other subjects beyond music. Most of the educator's claims have been based on observations and empirical knowledge as opposed to support from statistical data. How knowledge transfers between one subject area and another has yet to be determined. It has only been recently that researchers have begun to conduct studies that provide quantitative data to support these qualitative assertions (Schellenberg, 2006; Zafranas, 2004).

Purpose Statement

The purpose of this causal comparative, quantitative study was to compare the effect elementary school music and visual arts lessons had on third through sixth grade standardized

mathematics tests in a North Alabama school district. The independent variables in this study were music and visual arts lessons. The dependent variables were the students' scores from the standardized achievement tests, Stanford Achievement Test 10th edition (SAT-10) and Alabama Reading and Math Test (ARMT). All variables used in the study were nominal variables. By determining if a statistically significant difference was found between the test scores in favor of students exposed to school music lessons compared to school visual arts lessons, the theory that music positively affects mathematics would be strengthened.

When making budget and scheduling decisions, school officials must decide if music education should be included in a school's curriculum. Understanding if and to what extent music positively affects students can assist administrators in their ability to make an informed decision. In addition, teachers and administrators may think music is beneficial but not know why it is beneficial or how to use music effectively. Before administrators, school board members, and others delete or reduce the amount of music instruction offered in the school environment, an extensive review of current and past research needs to be done. When schools determine what classes to offer, the decisions might be based on opinions and perspectives of parents, students, teachers, and administrators; however, before making final decisions, board members and administrators may prefer to see quantitative evidence, usually in the form of academic test scores, which correlate and support the opinions.

Significance of the Study

This study sought to provide additional data supporting the positive effects music lessons have on mathematics. In addition, as the study focused on upper elementary grades, the study assisted in bridging the gap between related studies that primarily focused on early childhood, high school, and college-age students.

Research Questions

RQ1: Does participation in elementary school music lessons have a greater positive effect on the proportion of third through sixth grade students who score Level III and Level IV on the ARMT mathematics test compared to third through sixth grade students participating in elementary school visual arts lessons?

RQ2: Does participation in elementary school music lessons have a greater positive effect on the mean SAT-10 mathematics test scores of third through sixth grade students compared to third through sixth grade students participating in elementary school visual arts lessons?

Null Hypotheses

$H_0$1: There will be no statistically significant difference in the proportion of students who scored Level III and Level IV on the ARMT mathematics test for third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

$H_0$2: There will be no statistically significant difference in the mean SAT-10 mathematics test scores of third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

Definitions

1. *Adequate yearly progress (AYP)* - AYP is determined by students showing growth in the four required subject areas tested as part of NCLB; it is the measure of accountability of students' academic progress as defined under NCLB (Cornett, 2011; NCLB, 2004; NCLB Act of 2001, 2008; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010a).

2. *Arts or the arts* - The four areas of performing and visual arts as identified by the Consortium of National Arts Education (under the supervision of the National Committee for Standards in the Arts). The areas are music, visual arts, dance, and drama; these are the areas included in the National Standards for Arts Education (Consortium of National Arts Education Associations, 1994).
3. *Arts education* - The teaching and learning of skills related to the four art disciplines defined by the Consortium of National Arts Education (1994).
4. *Brain-based research* - Comprehensive research based on neuroscience (the brain and mind) (Association for Supervision and Curriculum Development, 2016).
5. *Constructivism* - A philosophy focused on the brain's ability to create meaning by linking newly acquired information to existing knowledge and extending learning beyond the rote memorization of disconnected facts (Cornett, 2011; Emily-Jane, 2007; Isbell, 2012; Koutsoupidou, 2010).
6. *Diverse populations* - Subgroups referred to in NCLB including (a) economically disadvantaged, (b) minority, (c) English Language Learners (ELL) or English as a Second Language (ESL), and (d) special education students (Cornett, 2011; NCLB, 2004; No Child Left Behind Act of 2001, 2008; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010a).
7. *Elementary and Secondary Education Act (ESEA*) – ESEA is commonly referred to as *No Child Left Behind (NCLB)*; it was created in 2001 and signed into law 2002 by President George W. Bush. It identified the arts as a core subject (NCLB, 2004; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010a).

8. *Every Student Succeeds Act (ESSA)* - a reauthorization of the Elementary and Secondary Education Act of 1965; included music as part of the "Well-Rounded Education" provision (Louisiana Music Association, 2016; Every Student Succeeds Act of 2015, 2015).
9. *Hemispheres of the brain* - The hemispheres of the brain are halves of the brain (right and left parts of the brain). Each hemisphere is thought to process information differently (Flohr, 2010; Montinaro, 2010).
10. *Integration* - Integration is in relation to music integration; to add music to or combine with another subject to make learning more connected instead of being disconnected parts in order to allow the student to gain a comprehensive understanding between a variety of subjects (Public Schools of North Carolina, State Board of Education Department of Public Instruction, n.d.).
11. *Kinesthetic* - Kinesthetic is movement or physical activity; students who are kinesthetic learners learn best by moving as opposed to listening to lectures (Carleton College Science Education Resource Center, 2015).
12. *Multiple intelligences (MIs)* – Multiple intelligences were defined by Gardner (1983, 1993) as one of the eight ways people learn.
13. *Music lessons* - Music lessons include singing and exploring different instruments including woodwind (recorder) and precisions (T. Steward, personal communication, November 5, 2015).
14. *No Child Left Behind (NCLB)* - NCLB is the general name referencing the Elementary and Secondary Education Act (ESEA) created in 2001 and signed into law in 2002 by President George W. Bush. It identified the arts as a core subject (NCLB, 2004; No Child

Left Behind Act of 2001, 2008; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010a).

15. *Poverty levels* - Poverty levels are determined by number of students receiving free- or reduced-lunch (Fitzpatrick, 2006).
16. *Socio-economic status (SES)* - SES is the social standing of a group or individual; measured by combining level of education, occupation, and income (American Psychological Association, 2013).
17. *Spatial awareness or intelligence* - The ability to recognize and use patterns in both small and large places. Spatial awareness is having the mental ability to notice fine details, visualize items from different angles, and be aware of oneself in space in relation to other objects as well as understanding the placement of two or more objects in space and comprehend when there is a change in position (Gardner, 1983, 1993; Smith, 2008).
18. *Spatial-temporal tasks* - Tasks that require the capacity to visualize spatial patterns and maneuver the patterns mentally in a specific time ordered series of spatial alterations (Rauscher & Hinton, 2006).
19. *Visual arts* - Visual arts are produced for visual perception and range from painting, sculpture, drawing, and design to film, architecture, the decorative art, graphics, video, and folk arts (Consortium of National Arts Education Associations, 1994).

CHAPTER TWO: LITERATURE REVIEW

Introduction

Through the decades, numerous studies have asserted that participation in music lessons and activities can increase test scores and promote creative thinking and problem solving skills, such as those needed in the 21st century workforce (Campbell et al., 2007; Cornett, 2011). Studies have also claimed that participation in music lessons engage at-risk and disadvantage students, assist in the teaching of ESL/ELL students and other diverse learners, increase self-esteem, provide an aesthetic release for fears and stress, and promote a positive and cooperative environment, which contributes to safer schools (Campbell et al., 2007; Cornett, 2011; Cox & Stephens, 2006; Crncec et al., 2006; Fehr, 2007; Gullatt, 2007; Kokotsaki & Hallam, 2007). This literature review focused on recent studies related to music and mathematics; however, some earlier studies are included to provide background information and show consistencies in theories, changes in opinions, and research trends.

In 1994, the National Standards for Arts Education, developed by the Consortium of National Arts Education (under the supervision of the National Committee for Standards in the Arts), identified or divided the arts into four distinct categories: dance, visual, drama, and music. *The National Standards for Arts Education* is a manuscript that explains the fundamental arts learning outcomes that are essential to the comprehensive education of each American student in kindergarten through 12th grade (Consortium of National Arts Education Associations, 1994).

The Elementary and Secondary Education Act (ESEA), generally referred to as the No Child Left Behind (NCLB) act, was created in 2001. George W. Bush signed the NCLB act into law in 2002. NCLB required the use of high stakes testing in core academic subjects. While the arts were identified as a core subject in NCLB, no measure or testing accountability was required

in the arts in comparison to mathematics and reading which did require testing (NCLB, 2004; No Child Left Behind Act of 2001, 2008; USDOE, 2002; USDOE, Office of Planning, Evaluation and Policy Development, 2010a). Buchanan (2008) claimed that due to continued economic instability and school budget cuts, and because no accountability was required for the arts, many school art programs were underfunded or were being given very little curriculum time.

In December of 2015 President Obama signed the Every Student Succeeds Act (ESSA) into law. Like NCLB, the ESSA also includes music as a core component of the curriculum. Both music and arts are listed in the "well-rounded education" provision, which was formerly known as "core academic subjects." The "well-rounded education" provision contained in ESSA identifies subjects that are considered critical in providing students with an enriched and vast educational experience (Louisiana Music Association, 2016; Every Student Succeeds Act of 2015, 2015).

While ESSA does not require AYP in the same format as NCLB, it does require schools to show yearly progress in improving student learning, especially in at-risk and minority groups. ESSA specifically seeks to close the academic achievement gap, decrease the high school dropout rate, and increase the college enrollment in minority, low-income, at-risk, and disabled students (The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press Secretary, 2015b).

Arts Education in American Public Schools

At the beginning of the 21st century, the United States government released a report regarding arts education in public schools in the United States of American based on 1999-2000 data. Congress requested that the U.S. Department of Education conduct a study updating the decade old information. As a result, an updated study, based mostly on data collected during the

2009-2010 school year was released. The study included the extent students received arts instruction; resources and facilities available; work environment, preparation, instructional practices, and training of both art specialists and non-art classroom teachers; accessibility of curriculum-based arts instruction beyond the school environment; and existence of community-school arts partnerships (Carey, Kleiner, Porch, & Farris, 2002; Parsad & Spiegelman, 2012).

Music instruction during regular school hours was nearly universally offered in public elementary schools in the United States in both the 1999-2000 and 2009-2010 school years. Ninety-four percent of public American schools offered music lessons during both years the study was conducted; however, its availability varied depending on the poverty level of the school. In 2009-2010, music classes were offered at 89% of the elementary schools with the highest levels of poverty in comparison to 97% of the schools with the lowest levels of poverty (Carey et al., 2002; Parsad & Spiegelman, 2012).

Among the schools that offered music instruction during the 2009-2010 school year, 93% of the schools offered music lessons the entire school year with the average student receiving music instruction at least once a week; however, this percentage once again varied according to poverty levels. Ninety-three to 96% of schools with the lowest poverty levels offered music the entire school year, while only 89% of the schools with the highest levels of poverty offered music classes the entire school year (Carey et al., 2002; Parsad & Spiegelman, 2012).

Theoretical Framework

Philosophers, researchers, and scholars throughout the world have contended "music, like language and possibly religion, is a species-specific trait of humankind" (Blacking, 1973, p. 7) Other researchers claim that the presence "of music specific neurons in the brain indicate that music is a fundamental and essential aspect of being human" (Nelson & Bloom, 1997, p. 974).

Research has also shown that parents value music education and consider it to be important in promoting self-regulation, cognitive skills, musical abilities, and the acquisition of language (Adessi, 2009; Barrett, 2009; Hendricks & McPherson, 2010; Koops, 2011; Magsamen, 2011; Valerio, Reynolds, Morgan, & McNair, 2012).

Constructivism

Some researchers, including Isbell (2012) and Koutsoupidou (2010), claim that music education is grounded in constructivism. The philosophy of constructivism is validated by over 30 years of research and psychological theories encouraging educators to think of education beyond the rote memorization of disconnected facts. Constructivism focuses on the brain's ability to create meaning by linking newly acquired information to existing knowledge (Cornett, 2011; Emily-Jane, 2007; Isbell, 2012; Kindall-Smith, 2010; Koutsoupidou, 2010) based on "the premise that all knowledge, including that derived from the arts, exists in an interconnected and interdependent web used to interpret and order our experiences" (Cornett, 2011, p. 31). Research validating the value of constructivism in supporting the achievement of diverse populations is growing. Constructivist views supported by music education include communication, meaning at the core, personal meaning-making, ways of knowing, processing of parts and wholes, response and transformation, desire for independence, unconscious and conscience learning, intrinsic motivation and depth of learning, and social influences (Cornett, 2011).

Music integration as a teaching tool in the classroom to improve cognitive skills, promote social skills, citizenship, morals, and values (which promote a safe environment), and prepare children for the adult workforce is not new to the 21st century. The need for music education can be traced as far back as Socrates and Plato (Emily-Jane, 2007). For centuries educators have recognized the need for hands-on, active, and differentiated learning activities that include

sensory experiences and capitalize on a child's natural tendency to enjoy music and movement by making it a key component of the curriculum as a form of natural, hands-on, sensory learning. Experts note that babies learn via sensory experiences, and sensory experiences continue to be an important part of cognitive and intellectual development in early childhood and elementary school years (Blair, 2009; Florh, 2010; Harms, Cryer, & Clifford, 2007; Martorell, Papalia, & Feldman, 2014; Schwarz & Luckenbill, 2012; Wan & Schlaug, 2010).

Gardner's Theory of Multiple Intelligences

The Standard Intelligent Quotient (IQ) only measures one type of learning; however, according to Gardner (1983, 1993), there is more than one type of intelligence, which means people learn information and solve problems in different ways. Gardner's research involved eight multiple intelligences (MIs): (1) linguistic, (2) logical-mathematical, (3) musical, (4) bodily-kinesthetic, (5) spatial, (6) interpersonal, (7) intrapersonal, and (8) naturalist. Gardner defined intelligence in two different ways: problem solving abilities and the ability to create items that are important in community or cultural environments. Gardner proposed each person has a different profile of intelligence, and the stronger a person's intelligence is in one area defines the person's preferred learning style (Cornett, 2011; Gardner, 1983, 1993).

Research has shown that the different types of intelligence are centered in a particular hemisphere of the brain, right or left (Al Ghraibeh, 2012); however, musical intelligence spans both hemispheres (Flohr, 2010; Gardner, 1993; Montinaro, 2010). One example is that a student may use the left hemisphere to analyze verbal language when conducting a musical analysis, but the same student may use the right hemisphere for music appreciation (Al Ghraibeh, 2012). According to Gardner (1983, 1993), some students with severe cognitive disabilities who are limited in speech have the ability to masterfully play an instrument. Although this may indicate

that musical intelligence is located in the right hemisphere, research has found that brain damage in either the right or left hemisphere of the brain can negatively affect music cognition. This indicates that music in not localized in a single area of the brain (Gardner, 1983, 1993).

Musical intelligence is considered to be the first type of intelligence to emerge, usually around the age of three (Al Ghraibeh, 2012). Gardner (1993) claimed musical intelligence is almost structurally parallel to linguistic intelligence. Additional studies have indicated that musical intelligence interacts with other types of intelligences, including logical, linguistic, spatial, and bodily (Al Ghraibeh, 2012; Gardner, 1983, 1993). This interaction may explain why a relationship between music and academic achievement possibly exists. Some students may learn via musical intelligence, but because musical intelligence interacts with other types of intelligence, the interaction may strengthen their abilities in other areas (Al Ghraibeh, 2012; Hall, 2007; Simpson & Keen, 2010). There are also sublevels of cognition within each of these intelligences, which allow music to interact with other types of intelligences. For example, sublevels assist the brain in creating a notation system that give meanings to symbols in music notation, reading, and mathematics (Hall, 2007).

The identification of a student's learning style is determined by the student's type of sensory perception (Filimon, n.d.) and is "based on the predominance of one of the receptor organs in the learning process" (p. 81). Learning styles reveal the ways in which students gain and transmit skills and knowledge. Theories related to learning style, which include the multisensory approach, have existed for many years and were originally used as an alternative teaching method for children who did not respond to traditional teaching methods (Filimon, n.d.). Traditional teaching methods, including lectures and worksheets, mostly appeal to students who posses strong linguistic or logical-mathematical intelligences. Music education and

integrating music into academic subjects give equal attention to students who show talents in other intelligences. Students whose individual ways of learning that are not addressed in the classroom may end up being labeled as having a learning disability, being ADD/HD, or as underachievers, making them at-risk students (Armstrong, 2013). Music appeals to multiple learning styles, so it may assist schools in meeting the needs of low achieving and at-risk students and increasing their academic achievement (Al Ghraibeh, 2012; Gardner, 1983, 1993).

Brain-Based Research

The brain plays an important role throughout the entire body. Along with the spinal cord, the brain makes up the central nervous system. The central nervous system is one part of the body's nervous system. Peripheral nerves make up another part of the nervous system. These nerves act as messengers, sending and receiving messages between the brain and muscles, glands, and other systems within the body. The brain also releases hormones into the bloodstream. The combination of these factors demonstrates that the brain's effect stretches throughout the body (Flohr, 2010; Johns Hopkins Medicine, n.d.; National Institute of Neurological Disorders and Stroke, 2013).

For centuries the brain has fascinated philosophers and scientists. Since the early Greeks, the brain has been known to be the locus of intelligence that interprets the senses, controls behavior, communicates with other glands and organs to keep them functioning, and initiates body movement. While the brain used to be a mystery that was nearly incomprehensible, new technology developed in the last 20 years has allowed brain research to make great advances in understanding how the brain functions (Cornett, 2011; Florh, 2010; National Institute of Neurological Disorders and Stroke, 2013). Magnetic resonance imaging (MRI) and positron emission tomography (PET) have allowed neuroscientists to view brain development and

growth. Neuroscientists have viewed a significant correlation between enhanced cognitive abilities and engagement in arts education (Cornett, 2011; Montinaro, 2010).

These advancements have promising potential for music education; however, a gulf exists between research conclusions and classroom applicability. In addition, neuromyths hinder endeavors in applying brain-based research to music education (Cornett, 2011; Florh, 2010). "Neuromyths is used to describe misinformation, oversimplication, or overinterpretations of findings in brain research" (Florh, 2010, p. 14). Neuromyths may not be untrue, but their findings have yet to be replicated in studies involving people (Florh, 2010). An example of a neuromyth is that listening to Mozart's music makes you smarter.

Plasticity, structural changes, and localization. Although the brain is more pliable in the first decade of life, research has shown that the brain continues to be malleable throughout life (Wan & Schlaug, 2010). A child's brain and an adult's brain are different, with significant development taking place in early childhood and adolescence; however, the brain continues to change throughout adulthood. Negative or positive experiences at any point in life can alter the function and structure of the brain. Studies have now shown that physical structures of the brain change and adapt, referred to as plasticity, based on experiences. This discovery has changed the previous notions of the way a person grows, learns, and develops (Cox & Stevens, 2006; Cornett, 2011; Florh, 2010; Montinaro, 2010; Wan & Schlaug, 2010).

Some of the changes in views and new discoveries in brain research are applicable and important for music education. Research has shown that music activities can affect the brain's structure. For example, a study of professional keyboard musicians discovered that the keyboard players had significantly more gray matter in comparison to amateurs and non-musicians. Other researchers have claimed that musicians displayed structure changes in multiple area of the brain

including the cerebellum, the corpus callosum, and the parietal, temporal, and frontal lobes. Researchers concluded that it should not be surprising that music could enhance motor functions, reasoning, computations, coordination, and auditory discernment (Cox & Stevens, 2006; Divitiis, 2010; Helmrich, 2010; Montinaro, 2010; Wan & Schlaug, 2010).

Another study showed that musical experiences are not limited to a single hemisphere of the brain, as previously thought, but that musical experiences span both the right and left hemispheres (Flohr, 2010; Montinaro, 2010). Instrumental music education uses synapses in all cortical locations of the brain (Helmrich, 2010). The claim that music education can improve intellect makes sense in light of this new discovery. If multiple areas of the brain are used in music instruction, possibly two or three areas that affect other types of learning, such as mathematical or spatial tasks are activated (Flohr, 2010).

Neurons, synaptogenesis, and connections. The brain contains neurons. Beginning in infancy, as a person engages in sensory experiences, the neurons connect together to create synapses. Connections within the brain are both genetic and environmental, meaning that the brain is capable of making new connections based on environmental stimuli throughout life (Florh, 2010; Wan & Schlaug, 2010).

In the past, researchers thought that a person was born with all the brain cells he or she would ever process; however, new studies have shown that while most synapses are formed in early childhood, the brain can continue to grow and make new connections throughout life. The brain contains approximately 100 billion neurons at birth that eventually create more than 50 trillion synapses. By the time adulthood is reached, more than 100 trillion neurons are present (Wan & Schlaug, 2010). The processing of musical and mathematical activities accesses the synapses in the parietal lobe and prefrontal cortex (Schmithorst & Holland, 2003, 2004).

Researchers have suggested that music activities very likely strengthen the synapses that control mathematics computation and reasoning (Helmich, 2010).

Research History

Investigations conducted during the first decade of the 21st century have caused the importance music should play in school curricula to become a controversial issue (Schellenberg, 2006; Zafranas, 2004). When school budgets are decreased, music programs are often the first classes to be eliminated, "as most colleges do not require music credits for entrance" (Cox & Stephens, 2006). In addition, NCLB, which was law for almost 13 years (2002-2015), did not involve proficiency tests related to elementary music instruction. As a result, the role of music and its place in the education system was a topic that was often re-examined by school boards, principals, and administrators (Schellenberg, 2006; Zafranas, 2004).

For almost 200 years, music educators and those in support of music education have had to justify its role in the public school curriculum (Birge, 2007). In 1837, Lowell Mason persuaded the Boston School Board to fund a music teacher by advocating the moral, physical, and intellectual benefits of music (Birge, 2007). In the last two centuries, music educators have been in a constant struggle to keep music in the schools, and as a result, have developed a variety of philosophical reasons for why music education should be a standard component of every child's education. This struggle tends to increase when school budgets tighten, and sometimes embellished claims regarding the power of music result (Hodges & Luehrsen, 2010). According to Hodges and Luehrsen (2010), music educators have three "weapons in their arsenal" (p. 71): (a) philosophical statements, (b) advocacy statements, and (c) research.

Interestingly, the first known United States' research study related to music education was conducted in 1837, the same year Mason succeeded in convincing the Boston School Board

to make music a part of the public school curriculum. The study surveyed Connecticut teachers regarding their level of musical abilities (Hodges & Luehrsen, 2010). Music education research started seriously with the publication of the Music Journal of Research in Music Education in 1953. Even though research should play a more important part in policy decisions, Hodges and Luehrsen (2010) offered the following reasons for why it does not: (a) lack of targeted and sufficient funding, (b) absence of tradition, and (c) absence of prospects within the discipline to engage in advanced studies concerning educational policy. Research for music education is seldom supported to the degree that promotes the opportunity to embark on major projects (Hodges & Luehrsen, 2010).

The National Association of Music Merchants

The National Association of Music Merchants (NAMM) Foundation, a division of NAMM: The International Music Products Association, began a major research program in 2005, called Sounds of Learning (SoL): The Impact of Music Education. The Sounds of Learning's steering committee established four key areas as a guide for sponsoring research in the field of music: (a) the effect of music training on student achievement and school success, (b) the applications and roles of music in daily life, (c) the applications and roles of music in the school, home, and community environments, and (d) the effects of music training in all areas of a child's growth and development. One of the main goals of the program was to provide sustained funding to music education researchers to encourage "a new tradition of inquiry and analysis" (Hodges & Luehrsen, 2010, p. 72) in the field of music education and help music researchers have stronger representation in debates about policies related to the effects of music education, therefore, allowing music educators and researchers to make significant contributions to music education policies based on research instead of opinions (Hodges & Luehrsen, 2010).

In February 2007, under the facilitation of NAMN, was the first time music education researchers were provided the opportunity to make federal legislators responsible for making educational policies aware of the detailed effects and outcomes music education had on children. Although it is difficult to know what effect these testimonies might have had or will have on federal legislative policies related to music education, the need for quality research about the functions and benefits of music education is needed (Hodges & Luehrsen, 2010; Shorner-Johnson, 2013) as a vital aid in encouraging a public policy agenda designed to make music education and its benefits and power as a learning tool accessible to all children; furthermore, it is important that the research be published "in rigorous, peer-reviewed, scientific journals" (Hodges & Luehrsen, 2010, p. 78).

The Mozart Effect

In 1993, Rauscher et al. released the results of a study in *Nature* that claimed university students scored higher on standard tests measuring spatial abilities after listening to a Mozart sonata for 10 minutes in contrast to sitting in silence or listening to relaxation tapes (Rauscher et al., 1993, 1995). This effect became known as the Mozart Effect and resulted in the popular trend that "music makes you smarter" (Vitale, 2011, p. 317). Books were published with information for parents on how to stimulate their child's brain using Mozart music to guarantee above average IQs. The selling of dozens of different compact discs (CDs), records, and tapes of Mozart music was a result of the media's reports that exposing a child to Mozart music will enhance his or her IQ. Special videos and tapes were even created for babies and infants in the womb to listen to. The peak of the fad was the issuing of a free Mozart CD to the mothers of all infants in Georgia by then Governor Zell Miller in 1998 as a tool to ensure the IQs of Georgia

children would grow to be above average (Pietschnig, Voracek, & Formann, 2010; Taylor & Rowe, 2012).

The experimentation of this theory actually started in 1990 when the researchers discovered the brain, in a way, created its own music. Using a computer-generated model that employed the firing of neural patterns (electric brain activity), the researchers ran a variety of:

> Brain patterns through a synthesizer and heard different styles of music emerging from the machine. Styles of the music heard included Baroque, Eastern, and Folk. In other words, the communicating neurons (nerve cells) played music. The researchers formed a hypothesis that music itself might also make the brain neurons communicate. (King, 2003, p. 13)

While the Mozart Effect created a renewed interest in researching the non-musical benefits of music as related to cognitive functions (Thompson et al., 2001), the Mozart Effect also led to controversy and confusion regarding the benefits of music education and caused doubts about the need for school music instruction. Despite explanations of the original researchers, the Mozart Effect created the notion that simply listening to music made you smarter or improved general intelligence, which was proven untrue and led to greater controversy regarding the value of music in terms of educational or cognitive benefits (Pietschnig et al., 2010; Rauscher & Hinton, 2006; Taylor & Rowe, 2012; Vitale, 2011).

It is important to note the Mozart Effect confused two distinct areas of research: (a) how music instruction affected cognitive performance and (b) how listening to a certain Mozart sonata affected spatial-temporal abilities. Some researchers claimed that while studies related to the Mozart Effect have little educational value, studies related to music instruction showed more potential benefits for education. The researchers indicated that tasks related to spatial

performance and music shared common traits and may be neurologically and psychologically connected (Rauscher & Hinton, 2006).

Thompson et al. (2001) have also conducted studies related to the possible benefits of music. In one of their studies, while they agreed that participants who listened to Mozart showed higher achievement on spatial tasks, they also discovered that those same participants had higher scores on positive mood and arousal ratings. Based on these findings, Thompson, et al. (2001) suggested the Mozart Effect may be an artificial consequence of heightened arousal and mood rather than the music of Mozart.

A separate study conducted by Hope, Henley, and Markley (2007) used computer games to verify Thompson et al.'s (2001) mood and arousal theory. They hypothesized that if mood and arousal were the real causes of the Mozart Effect, then the level of performance by participants playing computer games would intensify based on the music the participants listened to while playing the computer games. Hope et al. (2007) believed that the more the subjects liked the music they were listening to, the higher their scores on the computer games would be. Their research results supported their hypothesis.

Rauscher et al. (1995) supported the theory that improved performances occur from neurophysiological priming, while others argued any performance differences observed may be contributed to enhancements in arousal and mood (Pietschnig et al., 2010; Steele, Bass, & Crook, 1999; Sittiprapaporn, 2010; Tesoriero & Rickard, 2012). In 1998, Rauscher and Shaw released a paper explaining why the results of different studies that attempted to replicate their findings pertaining to the university students who scored higher on spatial-temporal tasks after listening to Mozart for 10 minutes varied. Rauscher and Shaw (1998) proposed that variety of choice of the dependent measures offered by the researchers may be the reason for these different results.

In addition, they suggested that including a distracter chore, the order the conditions were presented in, and the musical composition choice could also be contributing factors to the assorted results.

During the 1990s and early 2000s, the failure of some researchers to replicate the Mozart Effect (Steele, 2003, 2006) caused staunch supporters of the Mozart Effect to extend, reply, and attempt to add to the research supporting the Mozart Effect (Rauscher & Hinton, 2006). When considering the validity of the Mozart Effect, Rauscher et al. (1993, 1995) stated that the Mozart music only created temporary effects in the increases in the students' abilities to execute spatial-temporal tasks. In the past 10 years, studies related to the Mozart Effect have decreased. Studies related to why, if, and how Mozart or music in general affects people emotionally, cognitively, and socially have increased (Hodges & Luehrsen, 2010; Schellenberg, 2006; Taylor & Rowe, 2012; Zafranas, 2004); however, Taylor and Rowe (2012) conducted a more recent study in an attempt to prove or disprove that the Mozart Effect did have the potential to improve mathematics test scores by changing the testing environment.

Taylor and Rowe (2012) concluded that students scored significantly higher on mathematics assessments completed while Mozart music was played in the background. One hundred twenty eight undergraduate aviation students participated in the study. The participants were enrolled in three different sections of the same trigonometry class. Six trigonometry assessments were administered during the course. While the tests were administered, 59 of the participants were tested in silence, and 69 of the participants listened to 12 different Mozart pieces during the testing period. The researchers obtained Scholastic Achievement Test scores of college entrance exams for as many of the participants as possible to assess the homogeneity of the groups. No significant difference in the means of the Scholastic Achievement Test scores

between the two groups was noted. The same professor taught all participants. All participants took the same six tests and were assigned the same homework.

The study concluded that playing Mozart during the trigonometry assessments did improve the students' scores, as a statistically significant difference was noted in the mean scores. The mean of the group that listened to Mozart was 82.66; the mean of the group that tested in silence was 77.80. The researchers mentioned that although the study did not determine why listening to Mozart improved mathematics test scores, it did prove that the Mozart Effect was more than a lab experience and that listening to Mozart has the potential to help students perform at a higher level while taking mathematics assessments. More research needs to be done to determine why the Mozart Effect works, as the effect could be contributed to the reduction of anxiety, the priming of cortical firing patterns, and/or as a result of arousal and mood (Taylor & Rowe, 2012).

Smith, Waters, and Jones (2010) also conducted a recent study that attempted to replicate the Mozart Effect. Twenty-four undergraduate students, with a mean age of 20, from Cardiff University participated in the study. The study included a component related to mood in an attempt to prove or disprove mood arousal was part of the Mozart Effect. Participants rated their moods at the beginning and end of each testing session and during the testing session, immediately after the condition manipulation. Visual analog rating scales developed by Smith, Sturgess, and Gallagher (1999), which measured anxiety, hedonic tone, and alertness were used. The Revised Minnesota Paper Foam Board (RMPFB) test was used to measure spatial-temporal processes. The three independent test variables were (a) listening to Mozart, (b) "reading positive mood statements" (Smith, et al., 2010, p. 241), and (c) silence. The study showed that participants answered more questions and had more correct answers on the RMPFB test when

listening to Mozart in comparison to the other two groups. After reviewing the mood ratings, the researchers concluded that the positive effects of spatial-temporal abilities were due to the listening of music instead of mood arousal.

Pietschnig et al. (2010) conducted a meta-analysis of literature regarding the Mozart Effect. Using an assortment of electronic databases and different search terms (including but not limited to "Mozart AND effect, "Mozart AND effekt," and "music and cognit,") to find studies in both the German and English language, the researchers coded almost 40 studies (over 3000 subjects). The project included a variety of unpublished research reports. The studies were coded according to publication status, conditions used in the study, and lab affiliation.

After reviewing the studies, researchers concluded that listening specifically to Mozart does not affect spatial tasks more than listening to other types of music; however, the meta-analysis does support the theory that music in general enhances spatial abilities, as the study found that participants listening to either Mozart or other music performed significantly higher on tasks than those that did not listen to any music. The researchers contributed this to the arousal theory (Pietschnig et al., 2010).

21st Century Career Preparation

According to Buchanan (2008) and Schuler (2012), due to continued economic instability, school budget cuts, and the lack of accountability required for the arts, many school art programs are underfunded or are being given very little curriculum time. In an effort to keep art programs in schools and educate the public and policy makers about the value of arts education, both independent and government affiliated organizations, were formed. The National Association for Music Education, Music Teachers National Association, Americans for the Arts, Arts Education Partnership, and the Kennedy Center's Partners in Education are some

examples of the numerous associations that have formed to support and promote art education (Buchanan, 2008; Cornett, 2011). The National Coalition for Core Arts Standards (NCCAS) is another alliance of nine national education and arts organizations that have combined efforts to advance art education. The NCCAS is dedicated to the voluntary development of updated arts education standards based on research and built on the foundation of existing standards, supporting students and teachers' needs in the 21st century, making certain that all students are career and college ready, and sustaining the position the integration of the arts as part of a balanced core curriculum (Fehr, 2013).

Because the arts support creative thinking, arts education has also been recognized by businesses as being essential in preparing students for the 21st century workforce. Science, Technology, Engineering, and Math (STEM) supports preparing students for the 21st century workforce. Educators have found the combination of engineering and music activities offer experiences in problem solving at a higher cognitive level (Kirk, 2011). Forward thinkers agree that youth need the creativity and other skills developed through arts education to prepare for the demands of future employment. As a result, these forward thinkers "suggest policy makers add A for arts to STEM to create STEAM" (Shuler, 2012, p. 8). The National Governors Association (2002) report, The Impact of Arts Education on Workforce Preparation, also concluded that skills developed in the arts offer a viable advantage in the workplace. Arts education cultivates skills that are valuable in the 21st century workplace including interpersonal skills, problem solving, creativity, and flexibility. In the past, lucrative careers could be obtained by memorizing facts and applying rigid formulas. Some schools continue to encourage students to use these techniques; however, jobs requiring these skills are quickly being replaced by automation and outsourcing. Many of the fastest growing jobs in the 21st century and emerging

industries require employees to be creative and conceptualize new scenarios, think unconventionally, and produce innovative solutions for problems (Arts Education Partnership, 2009; Hetland, 2008).

According to Boston (1996), CEOs and business leaders have expressed concerns over a creativity crisis and have mentioned that the success of United States' businesses is dependent on new ideas. A powerful reason for education programs that are based on the arts is that the arts expose students to new technologies and engage students in the process of creative problem solving, which in turn prepares students for the workforce in an ever-changing world (Art Education Partnership, 2009; Deasy, 2008). With the arts becoming an essential means to supply future creative industries, more than 578,000 art-centric companies that employ approximately three million workers have emerged. Researchers predicted through statistics that approximately one third of the current student population will have future employment in an arts-related occupation (Cornett, 2011).

Additionally, in an effort to achieve President Obama's goal that all students will be prepared for careers and college when graduating from high school, the administration added the requirement for schools to integrate college and career-readiness standards into the curriculum. These standards were originally outlined in a blueprint for the reauthorization of the ESEA. The new requirement, to add college and career-readiness standards, not only applied to high schools, but it also applied to elementary schools (USDOE, Office of Planning, Evaluation and Policy Development, 2010a; USDOE, Office of Planning, Evaluation and Policy Development, 2010b). The career and college readiness standards were restated as requirements in the ESSA. In a report about the ESSA, President Obama stressed the importance of improving graduation rates, decreasing drop-out rates, setting higher academic standards, and training and providing

excellent STEM teachers to all students as ways to meet his career and college readiness goals. In addition, President Obama emphasized the need to make sure everything possible is being done to help all students master problem solving and critical thinking skills, develop and use creativity, and learn adaptability and collaboration skills. President Obama stated that these traits reach beyond the basics of what was expected from schools in the past and are needed for students to be successful and prepared for the 21st Century (Every Student Succeeds Act of 2015, 2015; The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press Secretary, 2015b).

As research has shown, the arts can be a valuable asset in helping school authorities prepare students for 21st century careers. Arts education is an essential part of the balanced and rich curriculum students need to prepare them for the ever-changing and unpredictable 21st century employment demands (Shuler, 2012).

Music and School Safety

In addition to ensuring students meet ESSA's academic requirements and ensuring students are prepared for college and the 21st century workforce, schools are also responsible for keeping the school environment safe. Studies have shown that bullying and violence in schools have a negative effect on learning. Researchers have confirmed that music education can reduce stress, create positive emotions, promote community bonding, and encourage empathy, which all play a part in supporting positive behaviors in students, decreasing violence and juvenile delinquency, and promoting a safer school and community environment (Cornett, 2011; Creedon, 2011; Flohr, 2010; Hampshire & Matthijsse, 2010; Kim & Kim, 2014; MacDonald, Kreutz, & Mitchell, 2012; Majno, 2012; Rabinowitch, Cross, & Burnard, 2012).

In order to make sure schools are safe environments for students to learn, school officials must understand that many interconnecting environmental issues affect the health and safety of students. As a result, school officials must be aware of the problems and conditions within their communities and create intervention and prevention plans to counteract at-risk behaviors in students. School engagement, which includes the extent students participate in school activities such as music programs, is an important component in creating a safe school environment. Research has shown that incidence of violence related to weapons decreased in schools with higher levels of school engagement. School engagement is defined as the quality of relationships between administrators, teachers, parents, and students, and also includes student participation in school-related activities (USDOE Office of Safe and Drug-Free Schools, 2010). Arts education programs are a type of school-related activity in which students can engage. Research showed that when students engaged in arts education, specifically music education (music classes, band, and choir), the risk of violence in schools and communities decreased (Cornett, 2011; Creedon, 2011; Flohr, 2010; Hampshire & Matthijsse, 2010; Kim & Kim, 2014; MacDonald et al., 2012; Majno, 2012; Rabinowith et al., 2012).

Music Research on Academics and Cognitive Skills

Music can assist in the transition of information between the hemispheres of the brain (Stein, 2004). While researchers have been aware "that the brain is the locus of cognition" (Cornett, 2011, p. 38) since the early Greeks, it is not until recently with tools such as magnetic resonance imaging (MRI) and positron emission tomography (PET) that neuroscientists have been able to view the growth and development of the brain (Cornett, 2011; Dana Foundation, 2013). Studies have shown that brain synapses fire at a noticeably faster rate when students are

playing music. It is theorized that this type of music exposure promotes the development of spatial reasoning, which is transferred to understanding mathematics (Hall, 2007).

Researchers have noticed a strong correlation between participation in the arts and enhanced cognitive aptitude. The Dana Foundation (2013), which brought together neuroscientists to study why arts education promotes increased academic achievement, concluded that (a) connections between music training and a student's skill to manipulate information in both long-term and short-working memory exists, and the connections extend beyond the musical domain; (b) children display distinct connections between geometrical representation and the practice of music; and (c) associations are present between music education and both sequence learning and the acquisition of reading (Cornett, 2011).

Because this review focused mainly on the effect music had on mathematics scores, specifically when compared to visual arts, most of the information in the review focused on music and the effect it had on academic achievement, particularly in relationship to mathematics; however, information about other possible effects music may have were included to show trends in arts education research and how music instruction can make schools a safer place, benefit at-risk students, and help prepare students for the 21st century workforce.

Music and IQ, Standardized Tests, and Academic Achievement

Through the years, various studies related to the effects of music on IQ, standardized tests, and academic achievement in general have been conducted. Some of these studies looked at the over-all impact on academics, while others honed in on a specific subject (e.g. mathematics, reading, and science).

Early childhood. Various studies and claims have been made in the last few decades regarding the early academic benefits of music in the pre-school curriculum. Southgate and

Roscigno (2009) conducted a study examining the effects of music involvement in early childhood and adolescence in the areas of reading and mathematics achievement. The study measured music participation outside of school, in school, and parental involvement. Parental involvement was defined as attending music concerts. The study drew data from the National Educational Longitudinal Survey (NELS: 88) and the Early Childhood Longitudinal Survey (ECLS-K). After controlling for class, race, gender disparities, home educational differences (e.g. number of books in the home and education level of parents), the researchers concluded that music does make a difference in school achievement. School music involvement was a positive predictor of reading achievement for both young children and adolescents. Although parental involvement did not appear to have an effect on reading achievement in adolescents, involvement in music lessons outside of school did have a positive effect on adolescent reading scores. In relation to mathematics achievement, school music participation and parental involvement enhanced abilities in early childhood. A more significant, positive effect was noted between recent music participation and mathematics achievement in adolescents.

Elementary. A group of researchers from the Jutus-Liebig University in Germany, Dege, Kubicek, and Schwarzer (2011), studied the effects of music on intelligence and five executive functions in 90 (49 girls and 41 boys) nine to 12 year old students with different amounts of music lessons. The five executive functions studied were (a) selective attention, (b) set shifting, (c) fluency, (d) inhibition, and (e) planning. The students represented a wide variety of music experience: 32.6% received no music instruction beyond those offered as part of the general school curriculum, 50% of the students took one to four years of instrumental music lessons, and 17.4% had more than four years of instrumental music instruction. The study concluded that the number of months music lessons were taken correlated significantly with IQ:

the more music lessons the higher the IQ. The measures of inhibition and selective attention had the greatest effect; therefore, researchers claimed that the positive affect music instruction had on executive functions may be one explanation for how music lessons improved performance on IQ tests.

This study maintains that music instruction improves IQ by strengthening the executive functions in children and that music lessons are an indirect influence rather than a direct influence on IQ. This is consistent with Schellenberg's (2004, 2006) claims that music instruction does not affect certain components of IQ but has a more general effect; however, Schellenberg's (2011a) research does not support the theory that executive functions act as a mediator between the correlation of IQ and music instruction. Dege et al. (2011) claimed this may be because their study used a continuous measure versus a categorical measure, and they considered individual differences in the number of months music lessons were taken. In addition, they used a neuropsychological assessment specifically designed for children compared to Schellenberg's (2011a) use of a neuropsychological test originally designed for adults.

Wetter, Koerner, and Schwaninger (2009) compared the annual reports of the average marks of 134 third through sixth grade students in two schools, one in the city and one in the suburbs, of Bern, Switzerland. The reports were compared to determine if music improved school performance. The students were divided into three groups: (a) 53 students who took music at school and at home, (b) 67 students who did not take music lessons or participate in the school's optional handicraft class, and (c) 14 students who did not take music lessons but did take handicraft.

The study found that students who played an instrument achieved significantly higher grades than the other two groups of students in all subjects except sports. Students enrolled in

handicraft scored significantly lower than the other two control groups. The evidence showed that the duration of music instruction was relevant to achievement. In the third grade, in which children are less likely to have as much music training, there was not a large difference in academic achievement between students who played an instrument and those who did not; however, in the sixth grade, consisting of students that were more likely to have had more musical training, academic achievement was noticeably higher in the group that took music lessons than the other two groups that did not have music training. Researchers concluded that sustained musical training increases intellectual achievement (Wetter et al., 2009).

High school, college, and adults. Schellenberg (2011b) studied the effects music training had on both IQ and emotional intelligence (EI). One hundred six undergraduate students (52 females and 54 males) ranging in age from 17 to 26 were divided into two groups: those who had at least eight years of private music instruction outside the school setting and those that had no lessons. The music group reported a mean average of 10.2 years of music instruction and an average of 11.8 years of regular music playing. The study discovered that participants with music training had a higher IQ composite score and higher scores in the nonverbal and verbal subtests than those without music training; however, no statistically significant differences were noted between the scores on the EI tests between the two groups. The results suggested that associations between musical training and achievement are limited to intellectual skills and not emotional intellect.

Recent empirical research has revealed that significant differences exist between students who elect to take high school music classes and those who do not. These differences include gender, socioeconomic status, race, native language, ethnicity, education level of parents, and academic achievement before music participation (Elpus & Abril, 2011; Kinney, 2010). Some of

the studies conducted that show differences in achievement scores do not take into account these factors. More research controlling these preexisting differences needs to be conducted regarding the effect music had on academic achievement in order to understand if, how, and why music is beneficial in order to achieve the most benefit from music participation.

Music and Mathematics

Although music is classified as a separate intelligence (Gardner, 1993), studies have shown that there is a high correlation between the areas of music and mathematics (Harris, 2008). Hirsh (2010) claimed that mathematics classes that still rely heavily on rote memorization of facts, textbooks, workbooks, following teacher-given directions, working problems on a board in front of the class, and reinforcing the traditional methodology of memorization in general are not preparing students for the 21st century. If educators continue to support and use methods that require students to only memorize and regurgitate information, advancements in mathematics, technology, engineering, science, and business will not occur (Hirsh, 2010). Current mathematical instruction needs to reflect society's increasing necessity for superior problem solving abilities to prepare today's students to handle future environmental, humanitarian, economic, and economic crises. Creative problem solving must be a key component of mathematics classes, as current opinions consider creativity to be "the cultural capital of the twenty-first century" (Sheridan-Rabideau, 2010, p. 54) and "among the most important and pervasive of all human activity" (Simonton, 2000, p. 151). Creativity is highly valued in most professions, as it is an essential part of problem solving, brain storming, and strategizing (Cornett, 2011; Hirsh, 2010). Because creativity allows for experimenting, exploring, the forming of new hypotheses, and expanding new possibilities, it is compatible with

mathematics skills and instruction (Christensen, Johnson, & Horn, 2008; Cornett, 2011; Gardner, 2009; Hirsh, 2010).

Students who struggle in mathematics tend to dislike mathematics classes that focus on traditional, rote memorization and regurgitation teaching methods. For students that do not understand a concept the first time they hear it, repeating the same information back to them in the same modality will not make any more sense than the first time it was stated and can lead to confusion and frustration for the student. When music and games are integrated into mathematics classes to appeal to different learning styles, struggling students tend to enjoy mathematics more (Hirsh, 2010). Studies have shown that when students feel a greater sense of success and enjoy class, their self-esteem increases, and they are more motivated to pay attention and try in class (Cornett, 2011).

Junior high and high school. Helmrich (2010) conducted a study consisting of 6,026 ninth graders from six Maryland school districts to determine if synptogenesis that occurs during early adolescence presented a favorable time in junior high for music to strengthen and create lasting, neural connections between the cortical regions of the brain that musicians process music and those in which pubescent youth process algebra. Helmrich (2010) reviewed test scores from the 2006-2007 Maryland Algebra/Data Analysis High School Assessment. The study showed that students enrolled in formal school music classes, either choral or instrumental, outperformed students not enrolled in school music classes.

Music composition is an integral part of music education that fosters creativity and musicianship abilities. Although music composition is a required component of the United States' National Standards for Music Education, music educators have reported using it infrequently. Twenty-eight students from two sixth grade classes in the Southeastern United

States participated in a program designed to study the effects of the Composers in Public Schools (CiPS), a composition program that was offered for a semester. Participation in the study was limited to students with no previous history of formal music instruction. The students were divided into two groups. One group was assigned to take CiPS the first semester with the other group assigned to physical education. At the end of the first semester, the students swapped and took the other course so that all students participating in the study took the CiPS course one semester and physical education the other semester. The study measured the effect music composition training had on verbal fluency, music reading, vocabulary performance, processing speed, and mathematical computation. The results showed that students participating in the CiPS course achieved statistically significant higher scores on the Wechsler Intelligence Scale for Children IV (WISC-IV) arithmetic subtest, but there were no noticeable differences in other cognitive areas (Bugos & Jacobs, 2012).

Adults. Haimson, Swain, and Winner (2011) conducted a study designed to determine if mathematicians have stronger music skills. The researchers constructed a self-reporting survey, administered via Survey Monkey, that required participants to rate themselves on a five-point Likert scale related to their musicality (aptitude to perceive and recall music) and musicianship (aptitude to create and perform music) skills. A modified random sampling of 2009 members of the American Mathematical Society (AMS) and the Modern Language Association (MLA) who were listed in the 2009 on-line membership directories served as participants.

The study concluded that mathematicians were not more skilled in music abilities when compared to language/literature scholars. The researchers pointed out that the music training measurements methods used in the study were indirect, as they were based on self-reported responses. Another limitation was that since some research has shown that music and language

art skills are related (Patel, 2010; Strait & Kraus, 2011; Tsang & Conrad, 2011), comparing mathematicians to language/literature scholars may not have been the best choice. The researchers also noted that they did not address the relationship between musical training and ability to mathematics aptitude; they studied the effect of music ability and training as related to mathematics achievement (Haimson et al., 2011).

Meeting the Needs of All Students

All students start school with some level of musical aptitude. Everyone is born with musical aptitude, regardless of their race, socioeconomic status (SES), the language they speak, or mental abilities; however, the extent to which and how musical aptitude is used depends on both the environment and instruction or nature and nurture (Cornett, 2011; Dodge, Colker, & Heroman, 2008; Schwarz & Luckenbill, 2012).

NCLB put pressure on educators by requiring equitable AYP for all students including subgroups such as (a) economically disadvantaged, (b) minority, and (c) English Language Learners (ELL) or English as a Second Language (ESL) (Cornett, 2011; NCLB, 2004; No Child Left Behind Act of 2001, 2008; USDOE, 2002, 2010). While ESSA does not require AYP in the same format as NCLB, ESSA does place a high emphasis on improving learning in at-risk and minority groups and closing the achievement gap (The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press Secretary, 2015b). Research has shown that music education is beneficial in decreasing the achievement gap in at-risk, minority, ELL/ESL students, and students with special challenges (Buchanan, 2008; Cornett, 2011; Helmrich, 2010; Shuler, 2012).

McMurrer (2008), in a national report for the Center on Education policy, claimed that 45% of the school districts that responded to the report had increased the amount of time spent

teaching mathematics in elementary schools by decreasing the amount of time spent teaching other subjects. Sixteen percent of the schools reported that the increasing of the teaching of mathematics was at the expense of teaching music classes. Despite the increases in mathematics instructional time, the National Assessment of Educational Progress (NAEP) showed that an achievement gap between 13-year old White students and 13-year old African American students stayed relatively the same (Lee & Bowen, 2006).

Whitehurst (2008) discovered similar results in Reading First schools, which limited the teaching of reading to vocabulary, phonics, and fluency while increasing the amount of time spent teaching reading. Despite billions of dollars spent in materials and professional development, the students showed no significant gains in reading comprehension. Using only low-level reading components and no cross-curriculum integration did not provide the students with opportunities to develop the problem-solving abilities needed for reading comprehension (Cornett, 2011).

Studies have shown music education to be most beneficial in strengthening cognitive abilities in these subgroups; therefore, the task of providing free high-quality music education classes available to all students even more important, as the music training offered in the school environment may be the only training these subgroups receive. Studies have shown that minority, at-risk, and students in lower socioeconomic classes are less likely to take formal music lessons, especially those offered outside of the school environment (Helmrich, 2010; Schellenberg, 2011b; Southgate and Roscigno, 2009; Tsang & Conrad, 2011). Ethnicity, school size, and SES affect students' access to music programs (McCarthy, 2007). Taking music out of the school deprives some students of the very tool that allows them to gain problem solving skills, provides social opportunities, and serves as motivation to try and achieve. Music allows

for self-discovery and for meaningful learning to occur (Magsamen, 2011) in at-risk and struggling students. Music education is vital in developing youth to become well-rounded citizens that are engaged in the world (Doyle, 2014). For these reasons, music education opportunities for youth in inner-cities needs to be appraised and any deficiencies and disproportions must be corrected (Doyle, 2014; Shuler, 2012).

Music lessons in school can serve as a solution for the problem of motivation in students who may not be thriving academically with the goal being that the motivation to do well in music and musical successes will increase self-esteem and motivate students to want to continue trying in other academic subjects. Block (2012) claimed that schools with strong arts education programs showed improved attendance rates. Better attendance and more time in class generally leads to improved academics.

At-Risk Students

At-risk students often feel unsuccessful in academics endeavors. The use of music in meeting the needs of students with challenges has been shown to be effective as it allows opportunities for remediation, enrichment, and interpretation. The variety of opportunities offered by music allows a greater chance for all students to learn and feel successful in the school environment. Feelings of success are an important motivator in a student's attempt and desire to learn concepts and skills that may be more difficult for him or her. Studies have validated that arts education, which includes music, benefits at-risk students as it reduces the risk of violence and facilitates significant improvements in over-all grade point average, self-esteem, and other types of educational achievements (Cornett, 2011; Flohr, 2010).

The National Endowment for the Arts conducted a study that was published in 2012 entitled, *The Arts and Achievement in At-Risk Youth*. It included findings from four longitudinal

studies and included participants ranging from kindergarten to the mid-20s. Three of the databases used in the study were sponsored by the U.S. Department of Education: (a) the National Educational Longitude Study of 1988 (NELS: 88), (b) the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-K), and (c) the Education Longitudinal Study of 2002 (ELS: 2002). The U.S. Department of Labor sponsored the fourth database, the National Longitudinal Survey of Youth of 1997 (NLSY97). These large longitudinal databases allowed the researchers to follow a nationally representative sample of youth over long periods. All the surveys included numerous waves across diverse age groupings and years. Another advantage the databases provided was current up-to-date information, as all of the longitudinal studies are on-going and continue to collect data except for the NELS: 88, which concluded in 2000. The study focused on the effects arts experiences had on students from low SES backgrounds. The conclusions compared the differences between groups from within low SES backgrounds (Catterall, Dumais, & Hampden-Thompson, 2012).

The research found that the amount of experiences in the arts corresponded to academic achievement in young adults and teens of low SES backgrounds. The students who had more in-depth arts experiences performed better academically, earned higher grades, and had higher rates of college enrollment. A specific example is that eighth grade students who experienced a high level of arts education starting in kindergarten and spanning the elementary years had better test scores in writing and science than low SES peers who had less engagement in the arts during the same time frame. Students who experienced strong arts involvement in high school were more likely to finish a calculus course and had higher GPAs overall, especially in mathematics, in comparison to their peers who were lacking in arts-rich experiences. The study also found that high school students who earned numerous arts credits were five times more likely to graduate

when compared to students who earned no or few arts credits. Both high school students and eighth graders that had high levels of arts experiences were more apt to seek a college education than their counterparts with less arts experiences. Ninety-four percent of the group with high-arts experiences attended a four-year college compared to 76% of the low-arts groups, and the high-arts group was three times more likely to earn a bachelor's degree. The high-arts groups also consistently earned more A's during college (Catterall et al., 2012).

The students with strong arts backgrounds were nearly five times more likely to have participated in extra-curricular activities, including participation in student government and service clubs. As they matured to young adults, the higher the arts experiences in high school the more likely the young adults were to vote, show interest in current affairs, engage in politics, and volunteer. A difference was also noted between students from low SES groups with strong arts experiences versus those with weaker arts experiences in job preparation and employment. More than twice as many college students that experienced strong arts programs in junior high and high school selected a major aligned with a professional career (29.7% vs. 13.5%). By the age of 30, 50% of the students with strong arts backgrounds expected to be employed in a career defined by the U.S. Bureau of Labor Statistics as *professional*. Only 21% of the group with a low arts background anticipated working a *professional* job (Catterall et al., 2012).

Rocco Landsman stated, "Art works. I have been saying that ever since I was sworn in as Chairman of the National Endowment for the Arts, and it remains an absolute truth . . .Let's make sure it works for our students" (Catterall et al., 2012, p. 5). He also claimed that the outcome of music classes should only be measured by whether the young person had the opportunity to enjoy, understand, and create music; however, he also stated that due to arts

education having to compete for sparse funding, there is value in highlighting that investing in the arts will produce numerous, far-reaching dividends (Catterall et al., 2012).

Minority Students

Southgate and Roscigno (2009) drew data from ECLS-K and the NELS: 88 to study the effects of music in early childhood and adolescence. The study looked at in-school and out-of-school music participation as well as parental involvement, defined as attending music concerts. The study showed that participation in music did increase achievement in both reading and mathematics. The study concluded that "music is a form of cultural capital" (Southgate & Roscigno, 2009, p. 19) that seems to supply social and cognitive means that help children in successfully navigate in the educational environment. Noticeable differences in school music involvement were found between social classes in adolescents but not in young children. Almost all young children were placed in music lessons in school, but school music lessons were generally a choice in adolescence so all adolescents did not take music lessons. The researchers theorized that one reason for this was due to resource inequalities between social classes, as there is usually a cost associated with music lessons in junior high and high school (Southgate & Roscigno, 2009).

Southgate and Roscigno (2009) claimed a social class bias existed in music participation, and the increased gains in reading and mathematics achievements in both high school and early childhood resulted in White students benefiting the most. Part of this difference was possibly due to how leisure time is scheduled by parents for young children based on the child-rearing practices of the middle-class. Researchers theorized that for adolescents, both the adolescents and the parents determine how leisure time is spent, as some high school students have jobs and can support their interest in participating in band or other school music lessons. These claims led

researchers to conclude that music participation is effected by culture, and the higher the family's socioeconomic status is the more music appreciation increases; therefore, the parents are more likely to introduce and use music in the home. Hispanics, African Americans, and Asian children were generally less involved in musical activities than White children. Adolescent African American students had less participation in all three areas studied: parental involvement, in-school music lessons, and out-of-school music lessons (Southgate & Roscigno, 2009).

A study conducted by Helmrich (2010), consisting of 6,026 ninth graders from six Maryland school districts, showed that students enrolled in school music classes, choral or instrumental, outscored their peers not enrolled in school music lessons on the 2006-2007 Maryland Algebra/Data Analysis High School Assessment. The largest mean difference between non-musical and musical students occurred in the African-American population. There was a statistically significant difference on the assessment between the students who took choir lessons and those who did not; those who took choir lessons outperformed those who did not take choir lessons. The greatest difference was noted between those who took instrumental music lessons and those who did not. The students who took the instrumental music lessons outperformed those who did not.

The study also found that formal music lessons had a greater effect on the algebra scores of ninth grade African American compared to accelerated eighth grade students. Helmrich (2010) claimed that in order to understand this effect, one must be aware of the reasons for the documented achievement gap of minority students. African American students have provided the following reasons: (a) shortage of effort, (b) not having motivation, (c) peer pressure, (d) the concerns or abilities of teachers, (e) students' attitudes toward non-importance of tests, and (f)

low parental expectations. Because Helmrich's (2010) study looked at the effects music instruction has on neuroplasticity, and found positive evidence that music does increase neuroplasticity, the researcher suggested that this effect might help minority students' abilities to overcome negative outside pressures and achieve. The study concluded that formal school music lessons might help lessen achievement gaps.

Socioeconomics

Music can be beneficial in increasing achievement in students who are disadvantaged socioeconomically; however, in the determination of access to music programs, SES is the most significant factor (Buchanan, 2008; Fitzpatrick, 2006; Southgate & Roscigno, 2009). Music programs in economically disadvantaged schools are frequently removed and replaced with an increased amount of time spent teaching reading and mathematics. Buchanan (2008) reported that schools with high numbers of students living in poverty have been shown to spend five times more time teaching reading than they do teaching the arts. Despite this attention being given to academics, many of these students continued to score lower than average on state and national achievement tests, and the schools they attended did not meet AYP requirements. As a result, the schools were still labeled as needing improvement under NCLB (Kinney, 2008; USDOE, 2010).

While the decrease in time spent experiencing musical activities may be damaging for all students, schools with high levels of poverty may have more students that are unsuccessful in the traditional classroom environment and academics, yet they may flourish or have the potential to flourish in music. Participation in music activities can increase retention rates in schools with high rates of poverty by allowing students to feel more supported and attached to the school.

Supporting these musical abilities can assist both the students and the school as a whole in improving in all areas (Buchanan, 2008).

Buchanan (2008) reported that participation in chorus and band increases academic achievement. Socioeconomically disadvantaged students who participate in music generally score significantly higher on measures of academic achievement when compared to other improvised peers who do not participate in music. In addition, some studies claim that these students have closed the achievement gap that exists between disadvantaged and non-disadvantaged students.

Fitzpatrick (2006) compared proficiency test results for fourth, sixth, and ninth grade students in Ohio to determine the effect instrumental music lessons had on achievement. The study began by accessing the 2003-2004 state scores for more than 15,000 ninth grade students and dividing them into groups according to those taking school instrumental music lessons and those not taking instrumental music and SES. SES was determined by paying full-price for lunch or receiving free or reduced-priced lunch. The fourth and sixth grade test results for these same students were also retrieved. Twelve tests in the areas of citizenship, mathematics, science, and reading were a part of the study. Overall, students who took instrumental music lessons scored higher in all subjects compared to students who did not participate in instrumental music lessons. The study supported that music can be a useful tool in closing the academic achievement gap that exists between different socioeconomic groups.

Richard Riley, former U.S. Secretary of Education, explained how at-risk youth are succeeding academically due to strategically placed arts education programs in rural and urban communities. Riley claimed that the arts give students the first step needed in learning, which is desire (Cornett, 2011). Students participating in the programs also validated their success in

decreasing the use of drugs and other harmful behaviors. A former student participant who went on to attend college shared, "While other kids were getting high on drugs, I was getting high playing my flute" (as cited in Cornett, 2011, p. 3). A National Longitudinal Study of 25,000 students found that high school students with high arts involvement scored higher on academic achievement tests, watched less television, did more community service, felt less bored in school, and had a lower dropout rate. These findings held true for socioeconomically-challenged students who were involved in arts education, contradicting those that claim SES, instead of the arts, contributes to increases in academic achievement (Cornett, 2011).

In a study of 106 undergraduate students to determine the effects music had on IQ and emotional intelligence, Schellenberg (2011b) also found considerable differences between SES and music instruction. After dividing the students into two groups, those with musical training and those without, he noted that the parents of musically trained students on average had a higher level of education than students without musical training. The family income level was also higher in students with musical training and the musically trained group has less ELL/ESL students.

Tsang and Conrad (2011) found similar results when studying the connections between reading and music training in 69 children ages five to nine years. SES was based on the mother's level of education. There was a significant difference found between children who participated in formal music lessons and those that did not. Children whose mother had completed an undergraduate degree were more likely to have had formal music training.

English Language Learners (ELL) or English as a Second Language (ESL)

The diversity of populations in American classrooms is increasing. Researchers Kranzler, Flores, and Coady (2010) and King,(2012) reported that from 1972 to 2007

ethnic/racial minority students enrolled in kindergarten through high school has increased from 22% to 44%. According to 2007 statistics, as the fastest growing minority group, Hispanics make up 21% of public school enrollment. The National Center for Education Statistics (Kranzler et al., 2010) reports that the number of students receiving English as a Second Language services between 1994 and 2000 has risen from two to three million. In 2004, the number rose to 3.8 million students. In 2007, approximately 20% of students ages five to 17 had some difficulty speaking English and when at home spoke a language other than English (King, 2012; Kranzler et al., 2010).

Music is a powerful tool in the acquisition and learning of language skills. Those attempting to learn a second language, such as ESL/ELL students, cannot learn the additional language the same way they learned their native tongues. English Language Learners or English as a Second Language students rely on interactions with others that provide opportunities to experience and practice voice inflections, expression, repetition, and expansion, which helps them acquire the new language (Fonseca-Mora, Toscano-Fuentes, & Wermke, 2011; Logue, Robie, Brown, & Waite, 2009; Tsang & Conrad, 2011). Music activities not only provide interactions, but they can also be a vehicle in assisting ESL/ELL students in the acquisition of academic skills. In a review of Georgia state standardized tests, Huber (2009) found that middle school ESL/ELL students that participated in chorus and band scored higher. Using songs can help students learn new vocabulary and aid in the memorization of other academic concepts such as mathematics formulas, the alphabet, and more. Additionally, music lessons can assist students in feeling a connection to the school by creating a cultural relevance in the learning environment (Fitzpatrick, 2011).

An empirical study attempted to determine if the use of music as a teaching tool accelerated the learning of French. Legg (2009) hypothesized that learning key words and phrases in the context of a song with an appealing turn would improve the ability of teens to memorize and understand key French vocabulary terms. Two year eight classes at a school in southern England were selected as participants in the study. The 56 students, ranging in age from 12 to 13 years, were enrolled in their second year of French and were divided into two groups. One group (29 students) was taught French using the standard national foreign language curriculum. The other group (27 students) was taught using a combination of both the standard national curriculum and by listening, learning, rehearsing, and performing a song containing key vocabulary words and phrases (Legg, 2009).

Pre- and post-tests were used to assess students' abilities. Data analysis showed that the music students had significantly higher scores on their post-tests compared to non-music students. This supported previous theories that integrating music in the form of songs fosters the acceleration of student achievement in the acquisition of a new language. Legg (2009) concluded that while the study only looked at the short-term effects music had on language acquisition, there was no reason why the positive effects would not extend into long term.

Background Music and Learning

Background music is a part of life. Background music may be played at the office, in the home, when driving, in classrooms, on public transportation, in elevators, in doctors' waiting rooms, while on-hold when making a phone call, in restaurants, in stores, and many other places (Bloor, 2009; Kampfe, Sedlmeier, & Renkewitz, 2011). Listening to music while performing other tasks is considered multi-tasking which can cause decreases in performance. Examples of multi-tasking related to music include listening to music while studying or driving. Teens and

young adults are especially prone to listening to music while studying and driving due to their extensive use of MP3 players. Because background music can affect studying and other cognitive abilities, it is important to understand how and why background music affects cognitive functions (Thompson, Schellenberg, & Letnic, 2012).

Through the years, studies have been conducted to determine the effect background music has on various behavioral, cognitive, and psychological activities and skills. Research has shown that background music can be detrimental, beneficial, or have no effect. Results have been inconsistent (Bloor, 2009; Kampfe et al., 2011). Most of the research related to background music has been related to older students and adults, despite young students being the ones most likely to be exposed to background music via its playing in the general classroom (Bloor, 2009).

Forty-seven students in three year five elementary classes in three different schools located in a west London neighborhood were administered four tests. Two were mathematics tests and two were reading tests. One mathematics test was administered in silence and music was played during the administration of the other mathematics test. These same conditions were repeated with the reading tests. The study concluded that the playing of background music had a positive effect on the reading test scores but it had a negative effect on the mathematics test scores (Bloor, 2009).

Musicians and non-musicians, 36 of each for a total of 72, participated in a study designed to compare the effect music has on the cognitive performance of non-musicians and musicians. Musicians were defined as having had at least 10 years of music instruction, started before the age of 13, and achieving a minimum grade five from the British Royal Schools of Music in voice, theory, and the playing of an instrument. Non-musicians were defined as having less than four years of music instruction. There were not significant differences noted between

the groups' cognitive abilities. In addition, exclusion criteria ensured that all participants had normal hearing, did not suffer from color blindness or epilepsy, had not experienced a serious brain injury, and that English was their first language (Patston & Tippett, 2011).

The goal of the research was to assess if the processing of language and music functions separately in musicians compared to non-musicians. The participants' abilities on a visual task (visuospatial search) and a language task (sentence comprehension) in three different conditions were reviewed. The three conditions were (a) music being played correctly, (b) music played that contained errors, and (c) silence. The study found that when background music was played, the ability of the musicians to appraise and process the grammaticality of sentences was significantly impaired. This impairment increased when the background music contained errors. The playing of background music with or without errors did not affect the musicians' abilities on the visuospatial task. The playing of either type of background music did not have an effect on the non-musicians' abilities on either task. Regarding over-all achievement, the research revealed that the musicians scored higher on both tasks in comparison to non-musicians. This was attributed to a universal cognitive advantage or the augmentation of more particular cognitive abilities related to processing speed or executive functions (Patston & Tippett, 2011).

A meta-analysis study of the effects of background music on adults indicated that background music had a positive effect related to emotional reactions and sports' achievements but was a distraction in the reading process. The study also indicated minute, unfavorable effects on memory. Different types of music, including instrumental and vocal, with varying tempos, were also compared. Research revealed that the tempo of the background music affects the speed of the activities being conducted while exposed to the music and that reading might be more hindered by one type of background music than another (Kampfe et al., 2011).

A different study examining the effects of background music on reading comprehension backed up Kampfe et al.'s (2011) findings that the disruption of reading comprehension may be based on the type of background music played versus the playing of background music. After conducting two pilot studies, the researchers recruited 25 undergraduate students, nine males and 16 females, ranging from 17 to 26 years old. Musically trained participants were defined as having had at least two years of music instruction. Non-musical participants were defined as having had practically no instruction. During the study, participants wore headphones. During the administration of four reading comprehension tests, music was played via the headphones. The intensity and tempo of the music were manipulated to create the following four testing conditions: (a) slow/quiet, (b) slow/loud, (c) fast/quiet, and (d) fast/loud (Thompson et al., 2012).

Performance was similar in the first of the three conditions listed; however, performance was significantly poorer when the music was fast and loud. Researchers concluded that background music that is slow and quiet does not negatively affect reading comprehension. Results also showed that participants with musical training outperformed non-musicians overall, which is consistent with other research concluding that musical training provides intellectual advantages (Thompson et al., 2012).

Health Benefits

An additional consideration in measuring the value of music instruction as part of the elementary curriculum is the benefits music provides beyond the cognitive realm. Cox and Stephens (2006) cautioned administrators, school boards, and teachers that before deleting music education from the school curriculum, they should conduct their own research and examine the impact music programs have on both the academic achievement and the morale of their students. Because self-esteem, health and fitness, emotions, and morale are closely linked to academic

achievement, it is important to note how music affects these areas in order to understand how to best meet the needs of a diverse student population. Understanding how music benefits these areas can assist administrators in providing a safer school environment that allows for increases in all students' cognitive abilities while preparing them for 21st century careers.

Physical Benefits

The power of music is recognized in the medical field as being beneficial in a variety of ways. For example, music can promote mental and physical health (Brandes, Fischer, & Taghian, 2012; Cornett, 2011; Yamasaki et al., 2012), and some affiliates in the field of medicine acknowledge the profound effect music has on students' memorization skills and their abilities to recall information (Foran, 2009).

For more than 50 years music has been used as a form of therapy for drug addiction, anorexia, and other illnesses. Music has also been recognized as having the capacity to lower stress hormones, boost healing antibodies, and increase the immune system. Respiration rates and blood pressure have been known to react to the tempo of music, which subsequently can cause a lowering of the heart rate. In addition, music encourages smiling and laughter, leading to the release of endorphins and a change in brain waves. Music has even been known to assist patients with Parkinson's in regaining cadence-walking rhythms when used as a scaffold (Cornett, 2011).

Mental, Social, and Emotional Benefits

Music is a type of cerebral priming that enhances the brain's ability to multitask. In addition, music can be used as a coping mechanism and provide mental peace. Humming, singing, and listening to music has been used to calm children, provide solace during funerals, make the time performing unpleasant tasks pass more quickly, and ease fears. For this reason,

some businesses intentionally use music to energize employees, increase production, and create a positive work environment, which in turn improves attendance. Music can provide these same benefits in school environments, making them safer, calmer, happier, and more productive (Cornett, 2011).

Creedon (2011) reported that stress is linked to health problems, juvenile delinquency, and school failure. Creedon (2011) asserted that art education, which has been shown to reduce stress levels and promote positive emotional well-being and includes music lessons, is especially beneficial in inner-city neighborhoods and schools with increased stress levels caused by high rates of violence. He stated that art education not only enhances a student's cognitive aptitude, but it also supports the physical and emotional needs of youth in stressful inner-city settings. For this reason, Creedon (2011) explained that we cannot wait until our youth are emotionally troubled or in prison to provide them with the positive emotional and mental benefits of a well-rounded, art education program. He claimed that denying inner-city youth of art education is "social child abuse" (p. 36). Furthermore, he explained that people who think art education is not affordable should be reminded of how much it costs society to support a child that drops out of school or is incarcerated.

In order for a student to experience success in school, the student needs to feel safe and secure in the school environment. This relates to the social and emotional well being of a student. Studies have shown that music can be beneficial in reducing stress levels and creating feelings of calmness. Studies have also shown that music can influence a person's behavior (Bensimon, 2009; Cornett, 2011), and that when children experience success in music activities and feel a feeling of achievement, their self-esteem and self-confidence increase (Jacobi, 2012).

Research confirms that group music lessons can increase a class's social cohesion and teamwork and promote greater self-reliance, more positive attitudes, and an increase in both self-esteem and the awareness of others among individual members (Campbell et al., 2007; Jacobi, 2012; Kokotsaki & Hallam, 2007). Upitis (2001) explained that the social benefits group singing provides are apparent to the children who participate, as they often display a higher understanding of the interconnection between music and social interactions.

Music can aid in the cultivation of positive behaviors within a classroom setting when used as a tool to help children learn to express feelings and moods (such as anger, happiness, and fear) in positive ways; furthermore, the emotional release gained from the positive expression of feelings reduces overall feelings of stress and provides benefits in the area of mental wellbeing. Expanding on the idea that music can help in creating a positive classroom environment, music activities which include opportunities for participants to work with others in large groups, small groups, or as partners while singing songs, creating dances, and playing various music games, require interactions between group members and allow children the opportunity to communicate and cooperate. Music activities, therefore, provide practice for the participant regarding taking turns, negotiating, sharing, and respecting personal space, which are all important etiquette skills in the arena of social development and career preparation (Jacobi, 2012).

Dunbar, Kaskatis, MacDonald, and Barra (2012) conducted research to explore what effect music has on endorphins by studying pain thresholds. They sought to determine if the music itself caused the release of endorphins or if participation in music activities caused the release of endorphins. All participants in the study were adults ranged in age from 20 to 73. The researchers concluded that simply listening to music does not trigger the release of endorphins; however, actively participating in music activities does. The researchers explained that this

information could be important in understanding how group participation in music activities can promote community bonding. Although this study was conducted with adults (20 to 73), (Dunbar et al., 2012) research has suggested that children who participate in group music lessons form a community bond (Kim & Kim, 2014).

Researchers Kim and Kim (2014) conducted a three-year study of primary youth ages seven to 12 who attended 13 Community Child Centers in poverty-stricken areas of South Korea to identify youth exposed to ongoing maltreatment and poverty and to determine their needs. The study was advertised as a music therapy project related to poverty and child abuse. The results concluded that youth who took music lessons had higher self-esteem when compared to youth who did not take music lessons. Teachers reported that youth who played musical instruments were less aggressive and delinquent in comparison to youth who did not play musical instruments. The study also concluded that youth who listened to music when feeling sad were less withdrawn than youth who did not. Researchers theorized that listening to and playing music may have a positive effect due to the release of endorphins, as previously claimed by Dunbar (2012), and improved social bonding between participants, and therefore generated a sense of community which detours negative behavior (Kim & Kim, 2014).

Kim (2015) conducted a separate, pilot study, also designed to measure the effects of music therapy on children living in poverty in South Korea who suffered from child abuse. Forty-two impoverished children were originally identified in the location the study was being conducted in as having suffered abuse. Four children were randomly selected from the identified group of 42 children and received music therapy once a week for 15 weeks. There were obvious variabilities in individual scores that contradicted the group scores; however, the overall group results showed improvement in the externalizing and internalizing of behavior problems.

Rabinowitch, Cross, and Burnard (2012) conducted a study of children 8 to 11 in 4 primary schools located in the UK to determine the effect group musical interactions had on empathy. According to the latest reports, the schools were similar in school aptitude ratings and socioeconomics. They study contained three groups for comparison: (a) students who participated in a one-hour a week musical lesson that included activities that required group interactions, (b) students who participated in a class that included interaction activities without music, and (c) students who did not participate in either class. The classes took place during school hours in a designated room. Three independent measures, *matched faces*, *index of empathy*, and *memory task* were administered to participants at the beginning and end of the study.

Results concluded that students who participated in the music lessons had higher emotional empathy scores at the end of the study when compared to the other two groups of students who did not participate in the music lessons. Researchers explained that empathy is important to society as some consider it to be the main factor for altruism and crucial to the development of pro-social behaviors, specifically cooperation and patience. Empathy and feelings of concern precede acts of sharing, comforting, and helping. Researchers also explained that those who score higher on empathy rating scales tend to be more likely to help others who are being bullied (Rabinowitch et al., 2012). These characteristics are essential in promoting and maintaining a safe environment in both the community and school.

Bensimon (2009) conducted a study exploring the effect different genres of singing had on intergroup dynamics during the disengagement of Israel from the Gaza Strip. After interviewing 14 protestors and 14 members of the security force, Bensimon (2009) concluded that the type of song the protesters sang had an effect on the proximity or conflict within the

group. When the Israeli protestors sang *Shirei Hitnatkut* (protest songs composed specifically for the disengagement), *Shirei Eretz Israel* (Israeli folk songs), and Jewish religious songs they created negative feelings in members of the security force which resulted in increased conflicts between the two groups. These three genres of singing filled the Gaza Strip with feelings of rage, aggression, emotional detachment, rejections, threats, and dehumanization causing tensions to rise between the protestors and members of the security force.

When the protestors sang spiritual songs that were slower and quieter in nature, members of the security force displayed feelings of empathy. These types of songs were sung near the end and during the evacuation of the Gaza Strip. The songs encouraged members of the security force to identify with the pain, despair, sense of crisis, and helplessness the protestors were feeling as they cried out for help from God. Members of the security force actually hugged protestors and cried with them, providing the protestors a feeling of satisfaction and perhaps a small victory. The feelings of empathy developed toward the protestors made it difficult for some security force members to carry on the evacuation (Bensimon, 2009).

Studies related to music therapy, the healing powers of music, the emotional effects of music, and music and medicine are increasing (Brandes et al., 2012; Cornett, 2011; Yamasaki et al., 2012) as researchers seek to understand the power of music and how to best use it. Understanding how music effects students and teachers socially, emotionally, and behaviorally can help schools in providing safe and secure environments, build a sense of community, and establish trust, which are all important in helping students achieve.

Music Aligns American Education

"If you can see things out of whack, you can see things in whack" (Dr. Seuss as citied in Cornett, 2011, p. 357). Many advocates of arts education, general educators, business leaders,

and others consider America's public school system to be out of whack with reality and that it is not preparing students for real life because it does not promote problem solving and creativity to their fullest. The solution they offer is arts education, which includes music education (Cornett, 2011).

When considering the effect music may have on cognitive development and its applicability to the education arena, educators need to consider that while many studies mention a connection between music and cognitive abilities, it would be inappropriate to assume that only listening to a certain type of music will solve a child's problems, academic or otherwise. There are many other factors that contribute to a child's success. Some of these include environmental, parental support, effective teachers, and motivation (Vail, 2008).

Teachers across America feel pressured to increase test scores. Some assert they cannot afford to take time away from mathematics and reading for arts instruction: however, substantial research has concluded that "schools cannot afford NOT to embrace the arts" (Corbett, Wilson, & Morse, 2005, p. 43). Before administrators, school board members, and others delete or reduce the amount of music instruction offered in the school environment, an extensive review of current and past research needs to be done. Mounting research continues to show a strong positive connection between music and cognitive and academic abilities, creativity, emotional growth, social bonding and skills, problem solving, motivation, and self-esteem, all contributing to a student's success in both school and life. Music empowers teachers to be able to reach all students, those not thriving in the traditional school routine and those who are already succeeding. Regardless of a student's starting point, music instruction can assist them in achieving his or her potential. Every student in America should have access to free music

instruction throughout his or her school experience in order to ensure America's future success, as today's students will be tomorrow's leaders.

Summary

Although there have been many studies through the years related to music, some have been misinterpreted or misunderstood, creating more questions than answers regarding the effect music has on cognitive development. Some studies have shown contradictory results. Because research has indicated music positively affects cognitive development and career preparation and can contribute to a safer school environment (Campbell et al., 2007; Cornett, 2011; Cox & Stephens, 2006; Crncec et al., 2006; Fehr, 2007; Gullatt, 2007; Kokotsaki & Hallam, 2007), more studies need to be conducted to understand how and why music affects these factors in order to allow educators to determine how to best integrate music into school curriculums. Valuable learning time and opportunities can be wasted by not understanding music and how to use it in the most advantageous way.

Most of the studies related to the effect music has on academics have focused on early childhood, high school, or college-age students (Bloor, 2009). Tirovolas and Levitin (2011) reported that only eight percent of the articles published in *Music Journal* between 1983 and 2010 included child participants. In addition, very few studies have compared the effect music has on different subjects, such as reading and mathematics. This study focused on the effect of music and visual arts instruction on mathematics achievement in fourth through sixth grades. The study added to the growing body of research about the effect music has on mathematics achievement and provided a framework for designing and improving curriculums in order to better prepare students for the 21st century workforce and improve self-esteem and school morale, which leads to a safer school environment, therefore encouraging achievement.

Additionally, because this study compared the effect two different types of art had on mathematics, it provided a base to determine if one type of arts education, specifically visual arts or music, is more beneficial than another type of arts education in relation to a specific subject.

CHAPTER THREE: METHODS

In 1993 researchers Rauscher et al. asserted that listening to music increases the intelligence of listeners. The study, first published in an article in *Nature*, claimed that university students scored higher on standardized tests of spatial abilities after listening to 10 minutes of a Mozart sonata in contrast to sitting in silence or listening to relaxation tapes. This became known as The Mozart Effect and created a renewed interest in researching the non-musical benefits of music as related to cognitive functions (Thompson et al., 2001).

Through the years, various studies related to the effects of music on IQ, standardized tests, and academic achievement in general have been conducted. Some of these studies looked at the over-all impact on academics, while others honed in on a specific subject (e.g. reading, mathematics, and science). While studies have been done on the effect music has on academics, there have been very few studies comparing the effects of different types of the arts on specific subjects. The purpose of this study was to compare the effect elementary school music and visual arts lessons had on third through sixth grade standardized mathematics tests. Specifically, the study sought to determine if elementary school music lessons had a greater positive effect on third through sixth grade standardized mathematics test scores than visual arts lessons. By comparing the two types of arts, if a statistically significant difference between the test scores in favor of students exposed to school music lessons compared to school visual arts lessons was found it could indicate that music positively affects mathematics more than visual arts. In addition, by comparing the effects of different types of arts on mathematics, a base was established for future research to determine if one type of art is better suited for a specific subject when compared to another type of art, and therefore, allow the best match between art types and subjects to be connected in order to allow maximum student benefit.

Design

This research project utilized a causal-comparative design to compare the students' mathematics test scores. A causal-comparative design uses objective historical numeric data of multiple groups to compare the same variable measure (Fraenkel & Wallen, 2016). The independent variables, school music and visual arts lessons, were not manipulated, and there was no random assignment of participants. The most common type of analysis used in causal-comparative studies is *t*-tests (Fraenkel & Wallen, 2016); however this study utilized both a *t*-test and a *z*-test due to the way the test scores were reported. ARMT scores are reported in proportion according to the number of students who scored in certain ranges (didn't meet, met, or exceeded standards), while SAT-10 scores are reported as a mean of participants' scores (A. Protos, personal communication, December 14, 2015). A z-test was used to analyze the ARMT data, and a *t*-test was used to analyze the SAT-10 data.

The study sought to determine if elementary school music lessons had a greater positive effect on SAT-10 and ARMT mathematics test scores than visual arts lessons for students in grades three through six who took visual arts and music instruction during the semester the state administered standardized tests. Inferential statistics were used to compare the differences between the means and proportions of mathematics standardized test scores. The means of the students' scores who took the SAT-10 while taking in-school elementary music instruction during the same semester state standardized mathematics tests were administered were compared to those who took in-school elementary visual arts instruction during the same semester SAT-10 standardized mathematics tests were administered. The proportions of students who scored Level III and IV while taking the ARMT who took in-school elementary music instruction during the same semester ARMT state standardized mathematics tests were administered were

compared to those who took in-school elementary visual arts instruction during the same semester standardized mathematics tests were administered. Scores from the ARMT and SAT-10 for third through sixth grades from seven elementary schools in one school district were compared.

The Alabama State Department of Education Data Center, a public data base, provided tests scores for the school district beginning in the 2001-2002 school year. Test results for the Stanford Achievement Test Ninth Edition (SAT-9) were available in the database starting with the 2001-2002 school year. The district began administering the Stanford Achievement Test Tenth Edition (SAT-10) during the 2002-2003 school year and continued administering the SAT-10 until the 2010-2011 school year. The district began offering the Alabama Reading and Math Test (ARMT) during the 2003-2004 school year and continued through the 2012-2013 school year (Alabama State Department of Education, n.d.b; B.Lipinski, personal communication, February 27, 2015).

When the district opened in 1998, it included five elementary schools. The district added a sixth elementary school during the 2004-2005 school year. A seventh elementary school was added in the 2009-2010 school year. The rapid growth in population (see Appendix B), which facilitated the need to open additional elementary schools, also contributed to the rezoning of school zones every one to two years. During this five-year period, teachers were transferred between schools, many new teachers were hired, and some students attended three different schools (S. Miller, personal communication, July 22, 2013). For consistency and validity, SAT-10 and ARMT mathematics test scores from the 2009-2010 and the 2010-2011 school years were analyzed in the study. These were the years in which all seven elementary schools took both tests and no rezoning of elementary schools occurred; therefore, the same groups of students

could be tracked (Alabama State Department of Education, n.d.b; B.Lipinski, personal communication, February 27, 2015).

Research Questions

RQ1: Does participation in elementary school music lessons have a greater positive effect on the proportion of third through sixth grade students who score Level III and Level IV on the ARMT mathematics test compared to third through sixth grade students participating in elementary school visual arts lessons?

RQ2: Does participation in elementary school music lessons have a greater positive effect on the mean SAT-10 mathematics test scores of third through sixth grade students compared to third through sixth grade students participating in elementary school visual arts lessons?

Null Hypotheses

$H_0$1: There will be no statistically significant difference in the proportion of students who scored Level III and Level IV on the ARMT mathematics test for third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

$H_0$2: There will be no statistically significant difference in the mean SAT-10 mathematics test scores of third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

Participants and Setting

Convenience sampling was used in this study. Convenience sampling, which consists of people who are easily assessable, is one of the primary types of non-probability sampling methods (Stat Trek, 2016). The ARMT and SAT-10 mathematics test scores for all students

enrolled in the third through sixth grades in the 2009-2010 school year and the 2010-2011 school year who took the ARMT and the SAT-10 were part of this research project. All participants were non-reactive subjects in this study, as the students were unaware of their participation.

There were 4,317 elementary students enrolled in the 2009-2010 school year during the two years the historical data were being studied. Two thousand five hundred thirty of those students were third through sixth graders. There were 4,305 elementary students enrolled in the 2010-2011 school year. Two thousand five hundred seventeen of those students were third through sixth graders (Alabama State Department of Education, 2014).

In the two year period the ARMT mathematics test scores were analyzed 1,888 students took the mathematics portion of the ARMT the same semester they took music, and 1,877 students took the mathematics portion of the ARMT the same semester they took visual arts. In the two year period, the SAT-10 mathematics test scores were analyzed 1,890 students took the mathematics portion of the SAT-10 the same semester they took music, and 1,881 students took the mathematics portion of the SAT-10 the same semester they took visual arts. The differences between the actual population and the number of students who took the tests varied for the following reasons: (a) Students moved in and out of the school district during the two years the research was conducted, (b) students were absent when the tests were administered, and (c) some students were exempt from taking the test for various reasons including being an ESL/ELL student or a student with a special need (B. Lipinski, personal communication, February 27, 2015; National Center for Education Evaluation and Regional Assistance, n.d.).

Although 1,890 participants were included in this study, relative to the overall population of third through sixth graders nationwide, this number was small. From the results of this study, a logical generalization was developed outlining the effects of school music lessons on

standardized mathematics test scores. All participants were enrolled in the same school district, which offered music and visual arts classes on a rotating semester basis. This population was a unique case; according to the Arts Education in Public Elementary and Secondary School 1999–2000 to 2009-2010 government report, 93% of public elementary schools in the United States offer music lessons the entire school year. The student participants whose test data were studied attended a school district in Alabama that offered visual arts lessons to elementary students one semester and music lessons to students the other semester. Each year the semesters changed as to what was offered between the fall and spring. For example, if students took visual arts lessons in the fall then they took music lessons in the spring. The following year, these students took music lessons in the fall and visual arts lessons in the spring. Regardless of which type of arts lesson (music or visual) was being taught, state standardized tests were always administered during the spring semester (Alabama State Department of Education, n.d.a). The manner in which these classes were rotated allowed for a more concise study of the effects music lessons and visual arts lessons had on standardized mathematics test scores.

For the purpose of this study, individual participants were not identified. Subjects were grouped together according to the grade and the school they attended at the time the tests were administered. Students were tracked and analyzed according to high school graduation years: Class of 2017, Class of 2018, and Class of 2019. Students in pre-school through second grade were not included in the study as the SAT-10 and ARMT were not administered until third grade (Alabama State Department of Education, n.d.a).

This research study was conducted using historical data from a school district located in an urban setting. The school district is located in North Alabama and occupies approximately 23 square miles. According to the 2010 Census, the city's population was 42,938, with 16,111

households and 11,770 families. The median age was 37. Seventy-four percent of the population was White; 14.6% was Black; 7% was Asian; and 4.3% was Hispanic. The city was recognized for its outstanding schools, high-tech businesses, and highly educated residents. Ninety-six percent of the population held at minimum a high school diploma; 70% held a Bachelor's degree, and 17% held a higher degree. The average income citywide was $107,330, with more than 58% of households having an income greater than $75,000. The unemployment rate was 4.4% ("About Madison", 2006-2015; City of Madison Industrial Development Board, 2015; United States Census Bureau, 2015).

The school district was established in 1998 and originally consisted of three elementary schools, one middle school, and one high school, which served approximately 5,626 students. The system experienced tremendous growth throughout the years and currently includes seven elementary schools, two middle schools, two high schools, and one alternative school. The school district served approximately 9,554 students in the 2013-2014 school year, increasing the population by 3,928 (70%) students since 1998 (Alabama State Department of Education, 2014). The district added the seventh elementary school in the 2009-2010 school year (M. Weaver, personal communication, July 22, 2013). The school system employed more than 600 certified staff members with an annual operating budget of over $60 million. The district's schools consistently scored above the national average on standardized tests and were recognized for outstanding scholastics at the local, state, and national levels ("About Madison", 2006-2015; City of Madison Industrial Development Board, 2015).

Instrumentation

The following instruments were used in this study: SAT-10, ARMT, IBM's Statistical Product and Service Solutions (SPSS) Statistics Desktop version 23.0 software, and Microsoft

Excel version 2007. The data collected were the ARMT and the SAT-10 mathematics scores for third through sixth grades during the 2009-2010 and 2010-2011 school years. Additional information about each instrument follows.

The Stanford Achievement Test (SAT), originally published by the Psychological Corporation, a brand of Harcourt Assessments, is one of the standardized tests that dominates the market in elementary reading and mathematics achievement tests (Neukrug & Fawcett, 2010). The SAT, "one of the oldest survey battery achievement tests" (Neukrug & Fawcett, 2010, p. 162), is an advanced battery of tests that has consistently demonstrated high levels of validity since the publication of its first edition in 1922. Pearson Assessments purchased Harcourt Assessments in 2008 and currently markets the SAT-10, the 10th edition of the SAT, which was published in 2003 (Kingston, Frey, & Moshirnia, 2010). Individual academic subjects included in the SAT-10 are vocabulary; reading and comprehension; mathematical concepts, computation, and application; science; and social sciences (Boylan, Kerstiens, & Appalachian State University, 1989). Alabama public school students were required to take the SAT-10 test in third through eighth grades from the 2002-2003 to 2010-2011 school years. The test was used in meeting state and national academic standards related to NCLB requirements (Alabama State Department of Education, n.d.a).

Kuder-Richardson Formula 20 (KR20)/coefficient alpha internal consistency estimates showed composite scores ranging from 0.86 to 0.97. The majority of the subtests' alpha reliability estimates were from the mid 0.80s to the low 0.90s; however, reliability estimates for the open-ended parts of the assessment were lower. Most were between 0.60s to 0.80s, but some were in the mid 0.50s. The over-all range for the subtests was 0.54 to 0.97. Only nine of the subtests' coefficient scores were below 0.70 with all matching scores from Forms D and E,

prewriting and compositing subtests of the Comprehensive Language domain. Specific reliability scores for the third through ninth grade mathematics assessment were the highest, ranging from 0.92 to 0.95 (Carney & Morse, 2005; Kingston et al., 2010; Neukrug & Fawcett, 2010).

According to Neukrug and Fawcett (2010), "Criterion-related validity was addressed by numerous studies and is thorough and reasonable" (p.162). During the development phase, content experts, editors, teachers, and measurement specialists provided evidence of content validity by comparing subtest scores and total test scores of the SAT-10 to the SAT-9 and Otis-Lennon School Ability Test (OLSAT) (Carney & Morse, 2005; Malone et al., 2010; Neukrug & Fawcett, 2010).

In comparing the SAT-10 to the SAT-9, assessment creators claimed most Pearson product-moment correlation coefficients ranged from 0.70s to 0.80s. The overall range was from 0.46 to 0.92. Correlations between scores on the OLSAT-8 and SAT-10 Forms A and D were also reported by assessment creators. The majority of coefficients between SAT-10 composite scores and OLSAT-8 verbal, nonverbal, and total scores ranged from 0.40s to 0.60s. The overall range was 0.35 to 0.83. Intercorrelations between SAT-10 subtest scores and the OLSAT-9 nonverbal, verbal, and total scores were similar to those found in comparing the SAT-10 to the OLSAT-8 (Carney & Morse, 2005; Malone et al., 2010).

In addition, state and national standards, major test book series in all subjects, state and school district content specific-curricula, and current trends in education (identified by professional national educational organizations) were reviewed during the development of the SAT-10. Test items were designed to align with standards-based national curriculum and to assess skills and concepts traditionally taught during the second semester of the school year, so it is administered in the first semester of the next school year. The developers of the SAT-10

recommend that the assessment be examined by the users to determine if the assessment aligns with their district's curricula and goals (Malone et al., 2010).

The ARMT is a criterion-referenced test that has a 100% alignment to the Alabama state content standards in reading and mathematics. Alabama public school students in third through eighth grades were required to take the test from the 2003-2004 to 2012-2013 school years, as results were used for accountability in meeting one of the requirements of the NCLB legislation. The ARMT included selected items from the SAT that matched Alabama state content standards in mathematics and reading. To ensure that all content standards were covered, additional test items were created, making the ARMT a combination of new items and the SAT. In order to obtain an ARMT mathematics score, a student must have taken the SAT Mathematics Procedures, the SAT Mathematics Problem Solving, and the ARMT Part 2 Mathematics subtest (Alabama State Department of Education, n.d.a).

Performance is reported in the following achievement levels:

Level I - Does not meet academic content standards

Level II - Partially meets academic content standards

Level III - Meets academic content standards (proficient or grade-level performance)

Level IV - Exceeds academic content standards (Alabama State Department of Education, n.d.a)

Discovery Education Assessment, a part of Vanderbilt University, provided information related to reliability and validity of several state benchmark assessments including the ARMT. Discovery Education Assessment (n.d.) claimed the ARMT:

> Has pioneered a unique approach to formative assessments using a scientifically research-based continuous improvement model that maps diagnostic assessments to each

> state's high stakes test. Discovery Education Assessment's benchmark tests are aligned to the content assessed by a given state test allowing teachers to track student progress toward the standards and objectives used for accountability purposes. The goal of our assessment products is to provide a steady stream of reliable and valid data capable of being integrated into instructional practices leading to an increase in the number of students scoring proficient on a state test. To do so, Discovery Education Assessment has carefully adhered to the criteria for scientifically-based research put forth in the No Child Left Behind Act of 2001. (p. 1)

Using Cronbach's alpha, Discovery Education Assessment (n.d.) reported the mathematical part of the ARMT test has a reliability range of 0.82 to 0.88 depending on the grade level. Discovery Education Assessment (n.d.) also claimed that the ARMT's validity is good as it measures what it is designed to measure.

IBM's Statistical Product and Service Solutions (SPSS) Statistics Desktop version 23.0 was used to analyze SAT-10 data and calculate the *t*-test. Microsoft Excel version 2007 was used to record and organize data. In addition, Microsoft Excel was used to analyze ARMT data, as SPSS does not calculate *z*-tests.

Procedures

Approval of this proposal by the dissertation committee and Liberty University's Institutional Review Board (IRB) was granted before beginning research. After approval was gained, the gathering and analyzing of data were completed. The Alabama State Department of Education Data Center was utilized to collect the test scores and population demographics needed to complete the study. The school district's central office and individual schools were

contacted to verify which semesters music and visual arts were taught at each school during the 2009-2010 and 2010-2011 school years.

The independent variables in this study were music and visual arts lessons. The dependent variables were the students' scores from the standardized achievement tests. The mean SAT-10 mathematics test scores were compared to determine if there was a statistically significant difference between the test scores in the semesters music and visual arts were taught with the administration of the standardized tests. The proportion of third through sixth grade students who scored Level III and Level IV on the ARMT mathematics test while taking elementary school music lessons was compared to third through sixth grade students participating in elementary school visual arts lessons.

Threats to validity included the possibility of the researcher not recording the data correctly. To decrease this threat, after recording the data from the publicly accessible database, the researcher asked two peers to verify if the information was correct. When entering the data into SPSS for analysis, to ensure the scores were entered correctly, the researcher ran the data several times to check for accuracy and consistency and asked two people experienced with statistics to verify the data were correct. The two people were an Advanced Placement high school statistics teacher with a Master's of Education degree and an engineer well versed in statistics. The engineer also held a master's degree.

Tracking and grouping the same students increased the validity factor by reducing the possibility of varying cognitive abilities. An additional threat to validity included the quality of the mathematics, visual arts, and music teachers varying between schools, grades, and years. Also, the mathematics, visual arts, and music curricula may have changed during the years

included in the study. In addition, some students may have taken music and visual arts lessons outside of the school environment.

While items that challenged the validity of the study could not be eliminated exclusively, by comparing the test scores in a variety of ways, as listed in the subsequent data analysis section, and looking for common trends, the possibility of any noted tendencies being caused by extraneous factors was reduced. Additionally, the relatively large size of the sample studied was helpful in maintaining validity (Illinois State University, n.d.).

Data Analysis

The study compared the test scores of third through sixth grade students who took school music lessons during the semester standardized mathematics tests were administered to those who took school visual arts lessons during the semester standardized mathematics tests were administered in an attempt to find statistically significant differences. To compare test results, a paired sample *t*-test and a two-proportion *z*-test were used.

A table was used to display the results of the statistical data comparing the scores in each part of the study. The test scores were averaged and compared in the following ways:

(a) A t-test was used to compare the mean of all third through sixth grade scores from the schools that took music the same semester as they took the SAT-10 to the mean of the scores from the schools that took visual arts the same semester as they took the SAT-10 for the 2009-2010 and 2010-2011 school years.

(b) A z-test was used to analyze ARMT test scores of all third through sixth grade students; however, these scores were not reported numerically, but according to the proportion of students who did not meet, partially met, met, or exceeded academic content. The proportion of third through sixth grade students who scored Level III and

Level IV on the ARMT mathematics test while participating in elementary school music lessons was compared to third through sixth grade students participating in elementary school visual arts lessons.

CHAPTER FOUR: FINDINGS

Chapter Four includes an overview of the study, a justification for the study's design, a description of data collection and data analysis procedures, and the results of the study. The purpose of this quantitative, causal comparative study was to compare the effect of elementary school music and visual arts lessons on third through sixth grade standardized mathematics tests in a North Alabama school district. Specifically, the study sought to determine if a statistically significant difference was found between the test scores in favor of students exposed to school music lessons compared to school visual arts lessons. This information will not only strengthen the theory that music positively affects mathematics, but it will also assist school officials when making budget and scheduling decisions regarding the inclusion of music in school curricula. In addition, teachers and administrators may think music is beneficial but not know why it is beneficial or how to use music effectively. By understanding how and to what extent music is beneficial in the school environment, techniques that maximize the benefits of music can be created and integrated into both the school environment and curriculum. Because this study compared two different types of arts, visual and music, it established a base for future research to determine if one type of art, specifically music or visual arts, is better suited for a specific subject when compared to another type of art and therefore, allows the best match between art types and subjects to be connected in order to allow maximum student benefit.

The independent variables in this study were school music and visual arts lessons. The dependent variables were the students' scores from the standardized achievement tests, the SAT-10 and ARMT.

Research Questions

RQ1: Does participation in elementary school music lessons have a greater positive effect on the proportion of third through sixth grade students who score Level III and Level IV on the ARMT mathematics test compared to third through sixth grade students participating in elementary school visual arts lessons?

RQ2: Does participation in elementary school music lessons have a greater positive effect on the mean SAT-10 mathematics test scores of third through sixth grade students compared to third through sixth grade students participating in elementary school visual arts lessons?

Study Overview

The data for this study were obtained from seven urban, public elementary schools in North Alabama. Test scores for third through sixth grade students grouped according their graduation years were analyzed. There were 2,530 third through sixth graders' test scores available for analyzing the 2009-2010 year and 2,517 third through sixth graders' test scores available for the 2010-2011 school year (Alabama State Department of Education, 2014).

Descriptive Statistics for Participant Demographics

Third through sixth grade test scores from the 2009-2010 and 2010-2011 ARMT and SAT-10 tests were analyzed from seven different elementary schools. To eliminate the possibility of varying cognitive abilities between classes having an effect on the research, the students were divided into three different groups according to their high school graduation year: Class of 2017, Class of 2018, and Class of 2019. Table C1 exhibits a population overview of each of the elementary schools by school year and grade.

Students in third grade during 2009-2010 and in fourth grade during 2010-2011 comprised the Class of 2019. The Class of 2018 was comprised of students in the fourth grade during the 2009-2010 school year and in fifth grade during the 2010-2011 school year. Students in fifth grade during 2009-2010 and in sixth grade during 2010-2011 comprised the Class of 2017.

The student participants in the study received visual arts lessons one semester and music lessons the other semester. Each year the semesters changed as to what was offered between the fall and spring. For example, if students received visual arts lessons in the fall, then they received music lessons in the spring. The following year, these students received music lessons in the fall and visual arts lessons in the spring. Regardless of which type of arts lesson (music or visual) was being taught, state standardized tests were always administered during the spring semester (Alabama State Department of Education, n.d.a). Table C2 displays the 2009-2010 and 2010-2011 schedules of music and visual arts lessons for each individual school included in the study.

ARMT data. ARMT scores are reported according to performance in the following achievement levels:

Level I - Does not meet academic content standards

Level II - Partially meets academic content standards

Level III - Meets academic content standards (proficient or grade-level performance)

Level IV - Exceeds academic content standards (Alabama State Department of Education, n.d.a)

Tables D1-D4 (see Appendix D) display the raw data for the ARMT scores for the years included in this study. Table D1 (see Appendix D) shows the overall data; Tables D2-D4 (see Appendix D) show the data broken down into groups by year of high school graduation.

Table D1 (see Appendix D) displays the percentage of students at each school who took the ARMT as well as the percentage of students who scored in Level III (meets academic content standard) and Level IV (exceeds academic content standards) for the 2009-2010 and 2010-2011 school years. Table D1 (see Appendix D) includes the summation of the students who scored Level III and Level IV.

Tables D2-D4 (see Appendix D) display data by the year of high school graduation. The population defines the number of students in the grade each year. Percent tested is the percent of students who were present the day the test was administered. The actual number to take the test is the product of population and percent tested. The proportion of students who scored Level III or Level IV was obtained from the State Department of Education website.

SAT-10 test data. Tables E1 through E4 (see Appendix E) display the raw data for the SAT-10 scores for the years included in this study. Table E1 (see Appendix E) shows the overall data; Tables E2 through E4 (see Appendix E) show the data broken down into groups by year of high school graduation. Table E1 (see Appendix E) displays the percentage of students at each school who took the SAT-10 as well as the average score for each school by grade.

Data Analysis

A causal comparative study was used to compare the students' test scores as the independent variable was not manipulated and there was no random assignment of participants. Convenience sampling was used. Because ARMT and SAT-10 test scores are reported differently from one another, two different types of statistical analyses were used. ARMT scores

are reported in proportion according to the number of students who scored in certain ranges (didn't meet, met, or exceeded standards), while SAT-10 scores are reported as a mean of participants' scores (A. Protos, personal communication, December 14, 2015). A two-proportion *z*-test was used to analyze the ARMT data, and a paired sample *t*-test was used to analyze the SAT-10 data.

Scores for each of the tests, ARMT and SAT-10, were obtained from the Alabama State Department of Education online database (n.d.b) and entered into Microsoft Excel worksheets. The scores from each test were divided according to the school, grade, and the year the tests were taken. The data were further manipulated to track test scores of students according to high school graduation year groups (see Tables D2-E4). The scores were divided into groups according to which semesters visual arts and music lessons were taught at each school (see Table C2,) before data analysis was performed. The ARMT *z*-test was calculated in Microsoft Excel utilizing a $p < 0.05$ level of significance in order to reject or fail to reject the null hypothesis. A paired sample *t*-test for the SAT-10 was calculated using IBM's Statistical Product and Service Solutions (SPSS) Statistics Desktop version 23.0 using a $p < 0.05$ level of significance in order to reject or fail to reject the null hypothesis.

To address Research Question One, ARMT scores were compared by combining test scores from all third through sixth grade students in the district during the years being researched. To address Research Question Two, the same methodology was used with the SAT-10 scores. The comparison of the ARMT and SAT-10 test scores indicated if there was a statistically significant difference in mathematics tests scores (dependent variables) based on the semesters school music and visual arts lessons were taught (independent variables) in third through sixth grades.

Results

Null Hypothesis One

$H_0$1: There will be no statistically significant difference in the proportion of students who scored Level III and Level IV on the ARMT mathematics test for third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

A two-proportion *z*-test was performed to determine if there was a statistically significant difference between the proportions of the independent variables, school music and visual arts lessons, to the dependent variables, third through sixth grade students' scores on the mathematics part of the ARMT. Before the *z*-test was performed, assumptions were checked to ensure accurate testing. The data were analyzed to determine if it was normally distributed using the Shapiro-Wilk test of normality, which is based on the connection between the data and the matching normal scores (Ghasemi & Zahediasl, 2012). According to Ghasemi and Zahediasl (2012), it is important that the normality assumption is included in research literature to show validation of the data presented. Test of normality "compare the scores in the sample to a normally distributed set of scores with the same mean and standard deviation" (Ghasemi & Zahediasl, 2012, p.88). In addition, Ghasemi and Zahediasl (2012) claim that the Shapiro-Wilk test, available in SPSS, is the best option, especially when the sample size is less than 50.

The proportion of students who scored a Level III or Level IV while taking school music lessons compared to the actual number of the students who took the test was determined by summing the results from all seven schools in the district. The same proportion was determined for the same students while they were taking visual arts lessons. The *z*-test was used to compare

these two scores and from these same two scores a probability value (*p*-value) was determined to indicate whether there was a statistically significant difference.

Level III refers to students whose scores met academic content standards, and Level IV refers to students who exceeded academic content standards. Scores from Levels III and IV were combined to determine if school music lessons had an effect on the proportion of students that met at least the minimum academic content standards. The proportion of students who scored Level III or Level IV combined for school music and visual arts lessons was compared using a two-proportion *z*-test.

The Shapiro-Wilk test of normality returned a value of 0.94 with a significance of 0.68 for students taking music lessons and a value of 0.94 with a significance of 0.61 for students taking visual arts lessons. Because the significance in both cases is greater than 0.05, the distributions are considered normal (see Appendix F).

The proportion of students who scored Level III or Level IV the semester they took both the ARMT and school music lessons was 89.41%, and the proportion of students who scored Level III or Level IV the semester they took both the ARMT and school visual arts lessons was 88.34%. The results of the *z* test, $z(12) = 0.65$, $p = 0.52$, were not statistically significant at $p < 0.05$. The researcher failed to reject $H_0 1$; however, the research did indicate that 1.07% more students scored Level III or Level IV while taking school music lessons the same semester they took the ARMT compared to students who took school visual arts lessons the same semester they took the ARMT (see Table 1).

Table 1

z-Test Results for Level III and IV ARMT

	M	Var.*	Observ**	*z*	*p* (one-tailed)	*z* critical one-tailed	*p*(two-tailed)	*z* critical (two-tailed
Music	89.41	15.71	7	.65	.26	1.64	.52	1.96
Visual Art	88.34	3.41	7					

*=Known variance, **=Observations

Null Hypothesis Two

$H_0$2: There will be no statistically significant difference in the mean SAT-10 mathematics test scores of third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

A paired sample *t*-test was performed to determine if there was a statistically significant difference between the dependent variables, third through sixth grade students' scores on the mathematics section of the SAT-10, depending on which independent variable, school music or visual arts lessons, was applied. Specifically, the mean test score of the students who took school music lessons was compared to the mean test score of students who took school visual arts lessons. Microsoft Excel version 2007 and SPSS were used to perform the calculations for analyzing the SAT-10 data.

Before performing the paired sample *t*-test, certain assumptions must be met in order to proceed with the analysis. The assumptions that must be tested are normality and outliers.

Using SPSS the assumption of normality was analyzed using the Shapiro-Wilk test of normality, and histograms were created for a visual reference. Histograms evaluate the contour of the sample distribution to the contour of a normal curve. The population from which the same came from is considered normally distributed if the sample is shaped normally. When this occurs, normality is assumed (University of North Texas, n.d.).

Additionally, boxplots were created to determine if outliers existed. Boxplots are a visual representation of five sample statistics (minimum, lower quartile, median, upper quartile, and maximum). The length of the box provides an indication of the sample variability, while the line crossing the box indicates where the sample is centered. The position of the line in the box and the position of the box in its whiskers shows if the sample is skewed (to the left or right) or symmetric. If the number of samples is large enough, boxplots can also give an indication of the shape of the sample, and therefore imply the shape of the population from which the sample was drawn (Stipak, n.d.).

While histograms and boxplots allow for visual examination of the data to assess normality, they are unreliable approaches when presented independently. For this reason, it is important that a test for normality, such as the Shapriro-Wilk test, be used in conjunction with the visual representations (Ghasemi & Zahediasl, 2012).

The Shapiro-Wilk test of normality returned a value of 0.90 with a significance value of 0.34 for students taking music lessons and a value of 0.96 with a significance value of 0.80 for students taking visual arts lessons. Because the significance in both cases is greater than 0.05, there is no significance which means the distributions are normal (see Appendix G). Histograms developed for the data from the students who took music lessons the same semester as they took the SAT-10 and from the students who took visual arts lessons the same semester as they took the SAT-10 indicated that the data appeared unimodal and relatively symmetric without skewness (see Figures 1 and 2). Boxplots developed for these data sets indicated that there were no outliers (see Figures 3 and 4). Both the normality and outlier assumptions were met.

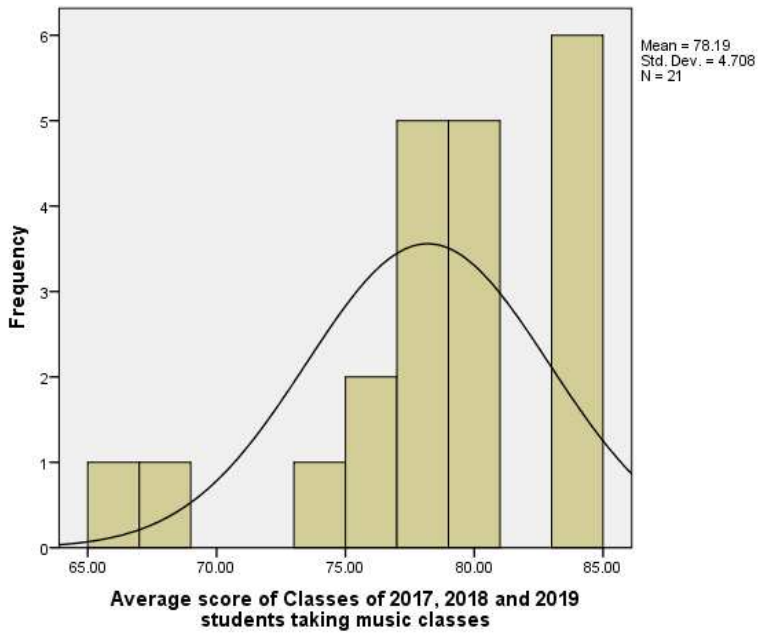

Figure 1. Histogram with normal distribution overlay for SAT-10 scores of students taking music lessons.

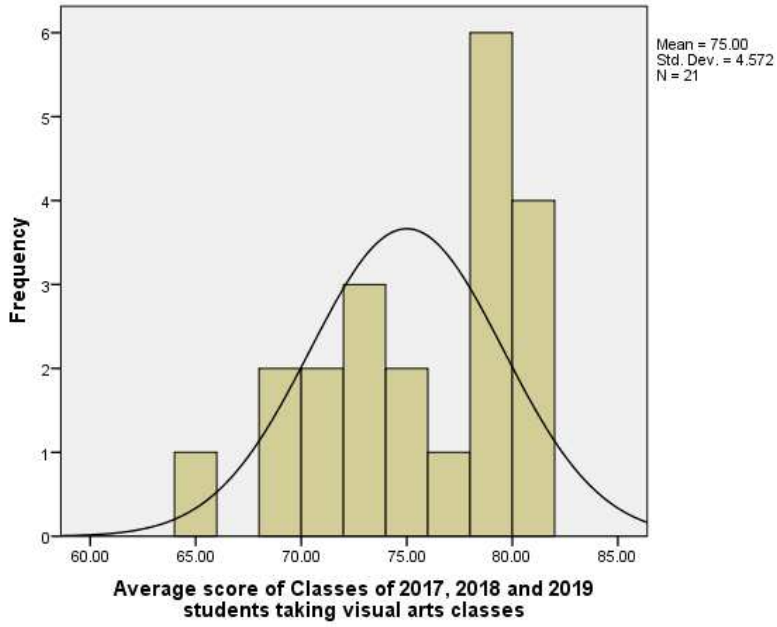

Figure 2. Histogram with normal distribution overlay for SAT-10 scores of students taking visual arts lessons.

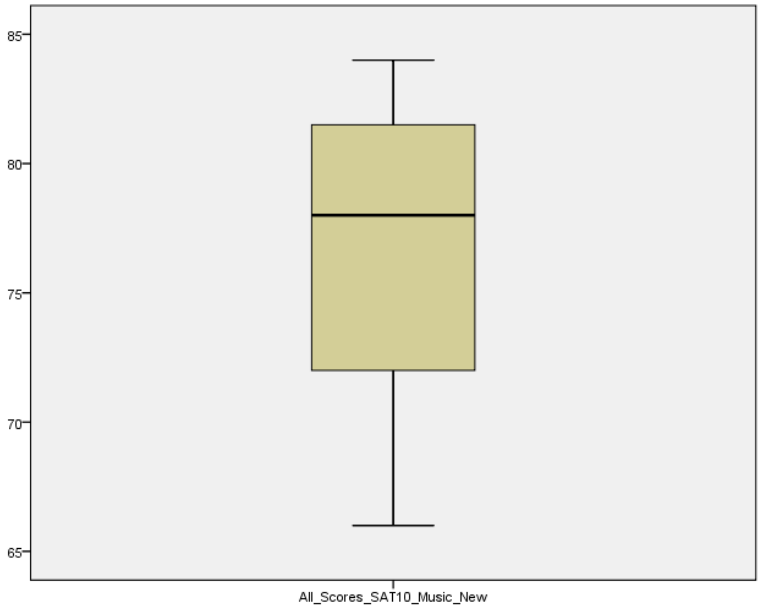

Figure 3. Boxplot for SAT-10 scores of students taking music lessons.

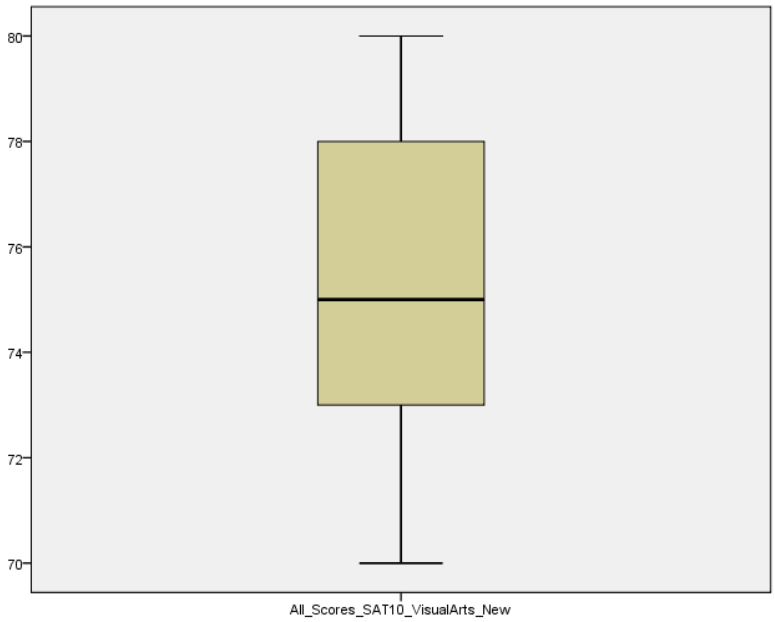

Figure 4. Boxplot for SAT-10 scores of students taking visual arts lessons.

The average SAT-10 mathematics score of all seven schools that offered music lessons the same semester the SAT-10 was administered were totaled and a mean was derived. The individual scores from each school were compared to the mean in order to create a standard deviation. The same process was repeated for all seven schools that offered visual arts lessons

the same semester the SAT-10 was administered. A paired sample *t*-test was used to compare the mean scores and from those two scores a probability value (*p*-value) was determined to indicate whether there was a statistically significant difference.

The results of the paired sample *t*-test were significant, $t(20) = 3.02$, $p = 0.007$, $\eta^2 = 0.20$, indicating that the mathematics scores were significantly higher the semester that the students took school music lessons ($M = 78.86$, $SD = 3.29$, $N = 21$)) than the semester that the students took school visual arts lessons ($M = 75$, $SD = 4.57$, $N = 21$) (see Table 2). The effect size was large based on Cohen's conventions (Illinois State University, n.d). Based on this information, the researcher rejected the null hypothesis (see Table 3).

Table 2

SAT-10 Paired Samples Statistics

	M	*N*	*SD*	*SEM*
Music	78.85	7	3.29	.72
Visual Arts	75.00	7	4.57	.99

Table 3

SAT-10 Results

	Paired Differences							
				95% Confidence Interval				
	M	*SD*	*SEM*	Lower	Upper	*t*	*df*	Sig*
Average score of SAT-10	3.86	5.86	1.28	1.19	6.52	3.01	20	.007

*Two-tailed

Summary

The purpose of this study was to answer the following questions: (a) Does participation in elementary school music lessons have a greater positive effect on the proportion of third through sixth grade students who score Level III and Level IV on the ARMT mathematics test compared to third through sixth grade students participating in elementary school visual arts lessons? and (b) Does participation in elementary school music lessons have a greater positive effect on the mean SAT-10 mathematics test scores of third through sixth grade students compared to third through sixth grade students participating in elementary school visual arts lessons? There was not a statistically significant difference in the analysis of the ARMT scores; however, the results showed that there were a higher proportion of students who scored better on the mathematical section of the ARMT when taking school music lessons compared to school visual arts lessons. When analyzing the results of the SAT-10 there was a statistically significant difference. The results showed that students scored significantly higher on the mathematical section of the SAT-10 when taking school music lessons versus school visual arts lessons.

CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

The purpose of this quantitative, causal-comparative study was to compare the effect elementary music and visual arts lessons had on third through sixth grade standardized mathematics test scores. Specifically, the study sought to determine if elementary school music lessons had a greater positive effect on third through sixth grade standardized mathematics test scores than visual arts lessons.

Numerous studies exist confirming the positive benefits of music and other types of the arts on academics, but the research is lacking in comparing if one type of the arts has a bigger impact on an academic subject, such as mathematics, when compared to another type of the arts. In addition, most of the previous research focused on early childhood, high school, or college-age students (Bloor, 2009). This study sought to fill the gap in the literature by comparing the effects of school music and visual arts lessons on mathematics standardized test scores in upper elementary grade levels. Ex post facto data were used to gain empirical evidence comparing the effects music and visual arts lessons may have on mathematical achievement.

The data for this study were collected from an urban school district in North Alabama. The district included seven elementary schools comprised of kindergarten through sixth grade, two middle schools covering grades seven and eight, and two high schools serving ninth through 12^{th} grades. Convenience sampling was used in the study. All students enrolled in the third through sixth grades in the 2009-2010 school year and the 2010-2011 school year who took the ARMT and the SAT-10 were part of this research project.

The following research questions were addressed: (a) Does participation in elementary school music lessons have a greater positive effect on the proportion of third through sixth grade

students who score Level III and Level IV on the ARMT mathematics test compared to third through sixth grade students participating in elementary school visual arts lessons? and (b) Does participation in elementary school music lessons have a greater positive effect on the mean SAT-10 mathematics test scores of third through sixth grade students compared to third through sixth grade students participating in elementary school visual arts lessons?

Current views of music education have emerged from the theories of Pestalozzi, Froebel, Montessori, Dewey, and others, who all advocated the importance of music education as part of a well-rounded curriculum fostering the concept of educating the whole child (Emily-Jane, 2007). According to Emily-Jane (2007), while some current educators tend to agree with the beliefs of early philosophers, the educators fail to acknowledge their values regarding music education as being essential. Music education allows students to flourish by prompting the use of the highest levels of cognitive abilities (Cornett, 2011).

The results of this research did support the theories (Rauscher et al., 1993, 1995; Rauscher & Shaw, 1998; Smith et al., 2010; Taylor & Rowe, 2012) that claim music can enhance academic performance; however, the results were limited in statistically significant differences. It is not appropriate to suggest that listening to a certain type of music or participating in music lessons or activities will solve a student's problems, academic or otherwise. There are many other factors that contribute to a student's success (including environment, parental support, and exposure to experiences); however, research has validated that participating in music can enhance a student's potential in several key areas (Brandes et al., 2012; Cornett, 2011; Fonseca-Mora et al., 2011).

Some of the key factors that may be present in music lessons that may enhance a student's potential in the learning environment are the positive interactions that may take place

between the student and the adult conducting the music lessons. In addition, music activities provide students the opportunities to explore, discover, and problem solve. Music training can be a positive outlet for the release of tension and emotions. It can enhance imagination, and depending on the activity, it can provide opportunities for physical exercise. Experiencing success in music activities can boost a student's self-esteem and increase his or her self-confidence (Bensimon, 2009; Cornett, 2011; Creed, 2011; Jacobi, 2012).

These characteristics are related to the theory of mood arousal, which claimed that the benefits derived from music activities do not come from the music itself but from the mood of the person participating being aroused. The mood arousal theory suggests the more the participants were enjoying any activity, including the inclusion of music or no music, the more positive effect it would have on the participants, as the activity has the potential to lower anxiety and increase alertness. Additional studies (Pietschnig et al., 2010; Steele et al., 1999; Sittiprapaporn, 2010; Tesoriero & Rickard, 2012; Thompson et al., 2001) have been conducted to determine if it was mood arousal or the music itself that helped students improve cognitively but were inconclusive. Some studies supported the mood arousal theory (Hope et al., 2007; Thompson et al., 2001), while others supported music as the standalone cause in improving cognitive function (Rauscher et al., 1993, 1995; Smith et al., 2010). This research, Comparing the Effects of Elementary Music and Visual Arts Lessons on Standardized Mathematics Test Scores, supported the theory that music improves academics, specifically mathematics, and did not explore the theory of mood arousal.

This study also supported theories discovered in brain-based research, specifically the connections between mathematics and music. Like the Mozart Effect, brain-based research also supported the theory that music can make you smarter. Brain-based research claimed that

instrumental music education used synapses in all cortical locations of the brain (Helmrich, 2010). The claim that music education can improve mathematical intellect makes sense in light of this discovery. If multiple areas of the brain are used in music instruction, areas related to mathematics may be activated (Flohr, 2010). The processing of both musical and mathematical activities accesses the synapses in the parietal lobe and prefrontal cortex (Schmithorst & Holland, 2003, 2004). Brain-based researchers have suggested that music activities very likely strengthen the synapses that control mathematics computation and reasoning (Helmich, 2010).

Two additional theories supported by this research included Gardner's (1983, 1993) MIs and constructivism. Both theories explained how people gain and transmit knowledge and how the brain connects and processes information. In common with brain-based research, Gardner (1993) claimed that musical experiences are not limited to a single hemisphere of the brain, as previously thought, but that musical experiences span both the right and left hemispheres and affect other types of learning, including mathematical (Flohr, 2010; Montinaro, 2010). Connections between this study and constructivist theories related to music and mathematics include personal meaning-making, ways of knowing, processing of parts and wholes, response and transformation, and unconscious learning (Cornett, 2011).

Null Hypothesis One

$H_0$1: There will be no statistically significant difference in the proportion of students who scored Level III and Level IV on the ARMT mathematics test for third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

There was not a statistically significant difference found when analyzing the ARMT data between students who took school music or visual arts lessons the same semester they took the

ARMT. The researcher failed to reject $H_0$1; however, there was an indication that a larger proportion of students scored higher on the ARMT while taking school music lessons the same semester they took the ARMT compared to students who took school visual arts lessons the same semester they took the ARMT.

Null Hypothesis Two

$H_0$2: There will be no statistically significant difference in the mean SAT-10 mathematics test scores of third through sixth grade students who participate in elementary school music lessons compared to elementary school visual arts lessons.

When analyzing the results of the SAT-10, the statistical data indicated that students scored significantly higher on the mathematical section of the SAT-10 when taking school music lessons; therefore, the results support previous research that music has a positive effect on mathematics.

Conclusions

Despite the identification of the arts as a required core subject in public schools in America by the ESSA (Louisiana Music Association, 2016; Every Student Succeeds Act of 2015, 2015) and the creation of national music standards (Consortium of National Arts Education Associations, 1994), the battle to keep music education in public schools, which has been ongoing for almost 200 years, continues to exist (Birge, 2007). As a result, in an effort to keep music in the public school curriculum, advocates for music education tout the benefits music provides beyond the musical realm. When school budgets tighten, the struggle tends to increase, and sometimes embellished claims regarding the power of music result (Hodges & Luehrsen, 2010). Continued relevant and valid research is needed to counteract embellished claims.

Due to schools needing to meet college and career readiness standards and academic standards required by ESSA and maintain a safe environment, more research needs to be done to determine how to best use music and other types of arts in the school environment to help meet these demands. The research can assist school officials when making budget and scheduling decisions regarding the inclusion of music in school curriculum. In addition, teachers and administrators may think music is beneficial but not know why it is beneficial or how to use music effectively. By understanding how and to what extent music is beneficial in the school environment, techniques that maximize the benefits of music can be created and integrated into both the school environment and curriculum.

This study focused on fourth through sixth grade students and assisted in filling the gap in the literature related to the effect music has on academics at the upper elementary level and added to the void regarding this particular age group. In addition, while there have been studies related to the effect music has on academics, there have been very few studies comparing the effects of music and visual arts on academics. Because this study compared two different types of arts, visual arts and music, it adds to the void in research investigating if one type of art is more beneficial than another type of art in relation to a specific subject. Based on inferential statistics, the researcher was able to support the theory that school music lessons have a greater positive effect on standardized SAT-10 mathematical test scores in third through sixth grades when compared to school visual arts lessons. The data analysis concluded there was a statistically significant difference in favor of music. There was no statistically significant difference in the analysis of the ARMT scores; however, the results did reveal that a higher proportion of students scored better on the mathematical section of the ARMT when taking school music lessons compared to school visual arts lessons.

Implications

Additional valid, scientific research is needed to understand the power of music and how its power can be utilized to help all students succeed at their highest levels of potential. This research can assist in changing the views of educators, parents, and legislators, who have influence in deciding how funds are spent and making public policies. Supporting music education and keeping music in our public schools is crucial to the success of future generations who will eventually become our country and world leaders. The collection of valid data that focuses on the outcomes of what music education can do for students is needed to provide a strong foundation in advocating for music education (Shorner-Johnson, 2013).

Music is one of the four types of arts identified in the *National Standards for Arts Education.* The *National Standards for Arts Education* asserts that music is an essential component to the comprehensive education of each student in the United States of America and has established and published national music standards for kindergarten through 12th grade (Consortium of National Arts Education Associations, 1994). In addition, the ESSA identified the arts as a core subject, therefore making the arts a required subject in public school curricula (Louisiana Music Association, 2016; Every Student Succeeds Act of 2015, 2015).

ESSA requires that schools show annual progress in academic performance. ESSA specifically seeks to close the academic achievement gap, decrease the high school dropout rate, and increase the college enrollment in minority, low-income, at-risk, and disabled students. As a result, ESSA asserts that each state's 5% lowest performing schools, schools with high achievement gaps, and schools with less than a one-third graduation rate must show annual improvement in student learning (The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press

Secretary, 2015b). Studies have shown music education to be most beneficial in strengthening cognitive abilities in these subgroups (minority, low-income, and at-risk); therefore, the task of providing free, high-quality, music education classes available to all students is even more important, as the music training offered in the school environment may be the only training these subgroups receive. Studies have also shown that minority, at-risk, and students in lower socioeconomic classes are less likely to take formal music lessons, especially those offered outside of the school environment (Helmrich, 2010; Schellenberg, 2011b; Southgate & Roscigno, 2009; Tsang & Conrad, 2011).

President Obama's goal for all students to be prepared for career and college when graduating from high school, originally outlined in a blueprint for the reauthorization of the ESEA and included in ESSA, added the requirement for schools to integrate college and career-readiness standards into the curriculum. The new requirement of adding college and career-readiness standards applies to elementary, junior high, and high schools (USDOE, Office of Planning, Evaluation and Policy Development, 2010a; USDOE, Office of Planning, Evaluation and Policy Development, 2010b; The White House, Executive Office of the President, 2015; The White House, Office of the Press Secretary, 2015a; The White House, Office of the Press Secretary, 2015b).

In order to meet President Obama's college and career readiness requirements and prepare students for the 21st century workforce, an increased amount of focus has been directed toward increasing the amount of Science, Technology, Engineering, and Math (STEM) activities and lessons offered to students. Researchers and educators have concluded that the combination of engineering and music activities offer experiences in problem solving at a higher cognitive level (Kirk, 2011). The National Governors Association (2002) report, *The Impact of Arts*

Education on Workforce Preparation, also concluded that skills developed in the arts offer a viable advantage in the workplace. Many of the fastest growing jobs in the 21st century and emerging industries require employees to be creative and conceptualize new scenarios, think unconventionally, and produce innovative solutions for problems (Arts Education Partnership, 2009; Hetland, 2008). Forward thinkers "suggest policy makers add A for arts to STEM to create STEAM" (Shuler, 2012, p. 8). President Obama's college and career readiness requirements make the need for effective music integration in school curricula even more valuable as studies have shown that music lessons promote creative thinking and problem solving skills, interpersonal skills, and flexibility, the same skills needed and valued in the 21st century workforce (Arts Education Partnership, 2009; Campbell et al., 2007; Cornett, 2011; Cox & Stephens, 2006; Crncec et al., 2006; Fehr, 2007; Gullatt, 2007; Hetland, 2008; Kokotsaki & Hallam, 2007).

Regardless of mandated requirements from federal and state programs, schools continue to be responsible for maintaining a safe and secure environment to meet the needs of all students. Studies affirm that group music lessons can amplify a class's social cohesion and teamwork and support greater self-reliance, increase positive attitudes, and facilitate a rise in both self-esteem and the awareness of others among individual members. Additionally, students have claimed that music classes can be a diversion from boredom. Participants have claimed the fulfillment of emotional needs, the release of tension and stress, a sense of achievement, and an increase in self-identity are some of the benefits gained by participation in group music lessons. Increasing confidence, developing physical coordination, and increasing self-discipline have also been reported as benefits of music participation. The positive effects of group music instruction were especially evident in children of low economic status and low ability (Campbell et al., 2007;

Kokotsaki & Hallam, 2007). These factors contribute to a safer school environment, which helps decrease the dropout rate and allows students to focus on learning. Studies have asserted that the safer a school environment is, the lees time administrators and teachers spend disciplining, and more time is allotted to teaching, which helps improve student learning (Campbell et al., 2007; Cornett, 2011; Cox & Stephens, 2006; Creedon, 2011; Crncec et al., 2006; Fehr, 2007; Florh, 2010; Gullatt, 2007; Hampshire & Matthijsse, 2010; Kim & Kim, 2014; Kokotsaki & Hallam, 2007; MacDonald et al., 2012; Majno, 2012; Rabinowith et al., 2012).

Some may consider another study about the effects music has on mathematical achievement to be outdated and unneeded. Studies have consistently shown that music can be beneficial in helping schools meet ESSA requirements and preparing students for the 21st century workforce in a safe environment. Very few studies, however, have compared the effects of different types of the arts on mathematical achievement.

The goal of this study was to compare the effect elementary music and visual arts lessons had on third through sixth grade standardized mathematics test scores, as the researcher was unable to locate studies comparing the effect different types of arts had on different subjects. Specifically, the study sought to determine if elementary school music lessons had a greater positive effect on third through sixth grade standardized mathematics test scores than visual arts lessons. The results did yield one statistically significant difference in the analysis of the data. The results showed that students scored significantly higher on the mathematical section of the SAT-10 when taking school music lessons versus school visual arts lessons. In addition, the proportion of students in third through sixth grade scored higher on the mathematics section of both the ARMT and SAT-10 when taking school music lessons compared to visual arts lessons. The results of the SAT-10 analysis support the literature that provides substantial evidence that

school music lessons are an essential and beneficial part of the school curricula that meets the needs of all students, assists in providing a safe environment, helps prepare students for the 21st century workforce, assists in closing the achievement gap, and helps meet ESSA requirements.

Assumptions and Limitations

Assumptions

The researcher assumed that the same music, math, and visual arts curricula were being taught in all the elementary schools included in the study, as the schools were in the same district. The researcher also assumed that the student body stayed relatively the same in the years being studied. A third assumption was made that standardized tests were conducted under the same conditions at all elementary schools included in the study during the years being researched.

While these internal threats to validity could not be avoided, steps were taken to minimize the effect they had on the research. All seven schools used the same music, mathematics and visual arts curricula. During the years the research was conducted, the school district did not rezone, so the population of students enrolled in the seven elementary schools did not change dramatically other than the expected number of students who may move in or out of the district (B.Lipinski, personal communication, February 27, 2015). The ARMT and SAT-10 have standardized directions and guidelines that are required to be used by all test administrators to make the test conditions as uniformed as possible (Alabama State Department of Education, n.d.a).

Limitations

There were several limitations observed during the study that threatened internal validity. It is possible that some students took music and/or visual arts lessons outside of the school

environment. Some students may have also received additional mathematics tutoring outside the school environment. In addition, the quality and abilities of mathematics, music, and visual arts teachers may have varied between the schools. Additional limitations noted in the study were that the teaching methods utilized and the students' cognitive abilities may have differed between groups. While limitations could not be eradicated exclusively, tracking and grouping the same students according to high school graduation years decreased the limitation of the possibility of varying cognitive abilities affecting the results.

An external threat to validity was the use of convenience sampling, limited to a single urban school district in North Alabama. Although 1,890 participants' test scores were included in this study, relative to the overall population of third through sixth graders nationwide, this number was small. This external threat to validity could not be eliminated in this study. The inability to control this external threat validates the need for additional research and the replication of this study in other locations and across genders, ethnicities, socio-economics, and environments.

Recommendations for Future Research

Although there have been many studies through the years related to music, some have been misinterpreted or misunderstood, creating more questions than answers regarding the effect music has on cognitive development. Some studies have shown contradictory results. Because research has indicated music positively affects cognitive development and career preparation and can contribute to a safer school environment (Campbell et al., 2007; Cornett, 2011; Cox & Stephens, 2006; Crncec et al., 2006; Fehr, 2007; Gullatt, 2007; Kokotsaki & Hallam, 2007), more studies need to be conducted to understand how and why music affects these factors in order to allow educators to determine how to best integrate music into school curricula.

Valuable learning time and opportunities can be wasted by not understanding music and how to use it in the most advantageous way.

Numerous studies have been done showing the positive affects the arts, including music, drama, visual arts, and dance, have on academics, but very little research has been done on the effects the different types of arts have on different subjects. More empirical evidence needs to be gathered on the effect the different types of the arts have on different subjects in order to assist school personnel in understanding if and to what extent the arts are beneficial in the school environment and integrate techniques that maximize the benefits of the arts in both the school environment and curriculum.

This study researched the effects school music and visual arts lessons had on ARMT and SAT-10 mathematical scores in third through sixth grades. Both tests also have reading sections. A study using the ARMT and SAT-10 reading scores instead of mathematical scores should be conducted using the same methods used in this study. Studies should be conducted comparing the effects the different types of arts have on other subjects besides mathematics and reading, such as science and history and using different standardized tests, including ACT Aspire and TerraNova. While this study analyzed group results, studies should be conducted to determine if the different types of arts affect individual test scores and subjects on tests such as the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) test and Renaissance Learning's STAR tests.

Recent empirical research has revealed that significant differences exist between students who elect to take high school music classes and those who do not. These differences include gender, socioeconomic status, race, native language, ethnicity, education level of parents, and academic achievement before music participation (Elpus & Abril, 2011; Kinney, 2010). Some of the studies conducted that show differences in achievement scores do not take into account these

factors. More research controlling these preexisting differences needs to be conducted regarding the effect music has on academic achievement in order to understand if, how, and why music is beneficial in order to achieve the most benefit from music participation. Also, a more in-depth study could be conducted in a school district that has had more stability over time and allow for tracking of individual classes or grade levels over a longer period of time.

In addition to studying if different types of the arts benefit one subject more than another, researchers need to determine how and why the arts affect different subjects. Researchers have not yet determined how knowledge transfers between one subject area and another (Schellenberg, 2006; Zafranas, 2004). While teachers may know this transfer exists based on observations, opinions, and experience, studies that provide quantitative data to support these qualitative assertions are needed. While this study looked at third through sixth grades, research comparing the effect the different types of arts have on different subjects needs to be conducted for all schools ages and grades, including pre-school through college.

As stated by Sloboda (2001):

> Thus, it is clear that music has a profound influence upon the academic life of a child and deserves equal status within the curriculum. The core question now becomes: Is the ability to learn enhanced when music, rhythm, and movement are added and the child is engaged? (p. 251)

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APPENDIX A

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

January 22, 2016

Molly King
IRB Application 2425: Comparing the Effects of Elementary Music and Visual Arts Lessons on Standardized Math Test Scores

Dear Molly,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Your study does not classify as human subjects research because it will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued non-human subjects research status. You may report these changes by submitting a new application to the IRB and referencing the above IRB Application number.

If you have any questions about this determination or need assistance in identifying whether possible changes to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerelv.

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
The Graduate School

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APPENDIX B: School District Population

Grade	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Pre K-12	5626	5816	5989	6328	6657	6891	7276	7789	8056	8298	8466	8654	8667
K-6	3067	3172	3280	3374	3539	3614	3800	4009	4115	4157	4209	4317	4305
3-6	1755	1903	1954	1987	2082	2105	2233	2372	2412	2426	2486	2530	2517

Note: Information obtained via the Alabama State Department of Education Data Center at http://web.alsde.edu/PublicDataReports/Default.aspx.

APPENDIX C

Table C1

Population Chart for Individual Schools, Grades 3-6, 2009-2010 and 2010-2011 School Years

		3rd Grade Students	4th Grade Students	5th Grade Students	6th Grade Students
School 1	2009-2010	118	125	103	105
	2010-2011	104	107	120	95
School 2	2009-2010	107	125	85	92
	2010-2011	101	112	125	91
School 3	2009-2010	78	68	83	102
	2010-2011	89	76	62	77
School 4	2009-2010	59	85	67	77
	2010-2011	67	56	74	64
School 5	2009-2010	82	95	106	82
	2010-2011	92	92	113	107
School 6	2009-2010	101	117	128	115
	2010-2011	94	107	124	134
School 7	2009-2010	49	55	67	54
	2010-2011	61	51	56	66

Note. Information obtained via the Alabama State Department of Education Data Center at http://web.alsde.edu/PublicDataReports/Default.aspx.

Table C2

Music and Visual Arts Classes Schedule

	2009-2010		2010-2011	
	1st Semester	2nd Semester	1st Semester	2nd Semester
School 1	Music	Art	Art	Music
School 2	Music	Art	Art	Music
School 3	Art	Music	Music	Art
School 4	Music	Art	Art	Music
School 5	Music	Art	Art	Music
School 6	Art	Music	Music	Art
School 7	Art	Music	Music	Art

Note. Information regarding schedules obtained and verified from the following sources: School 1 by email from C. Perry, January 26, 2016; School 2 by email from C. McQuity, January 26, 2016; Schools 3 and 5 by telephone from K. McKay, January 26, 2016; School 4 by email from K. Persons, January 26, 2016; School 6 by email from C. Moller, January 27, 2016; School 7 by email from K. Miller, January 26, 2016; and verification for all being correct by email from M. Schikner, Central Office, January 28, 2016.

Appendix D: ARMT Raw Data

Table D1

ARMT Scores for Individual Schools, Grades 3-6, 2009-2010 and 2010-2011 School Years

			3rd Grade	4th Grade	5th Grade	6th Grade
School 1	2009-2010	% Tested	91.82	97.54	97.94	100
		L3	21.78	24.37	27.37	31.31
		L4	58.42	68.07	63.16	63.64
		Total	80.2	92.44	90.53	94.95
	2010-2011	% Tested	96.12	95.19	99.18	100
		L3	10.1	24.24	20.66	41.49
		L4	80.81	61.62	77.69	53.19
		Total	90.91	85.86	98.35	94.68
School 2	2009-2010	% Tested	98.11	100	98.89	97.73
		L3	25.96	26.02	21.35	23.26
		L4	63.46	60.16	65.17	75.58
		Total	89.42	86.18	86.52	98.84
	2010-2011	% Tested	100	99.13	100	100
		L3	20	16.67	13.33	18.18
		L4	71	74.56	80	70.45
		Total	91	91.23	93.33	88.63
School 3	2009-2010	% Tested	98.70	100	100	100
		L3	28.95	21.31	16.46	35.71
		L4	51.32	68.85	74.68	54.08
		Total	80.27	90.16	91.14	89.79
	2010-2011	% Tested	100	100	100	100
		L3	34.88	16.46	27.94	31.33
		L4	55.81	65.82	64.71	62.65
		Total	90.69	82.28	92.65	93.98
School 4	2009-2010	% Tested	100	100	100	100
		L3	26.67	14.81	28.79	34.62
		L4	58.33	76.54	59.09	56.41
		Total	85	91.35	87.88	91.03
	2010-2011	% Tested	100	100	100	100
		L3	22.73	11.86	22.67	29.85
		L4	65.15	84.75	70.67	64.18
		Total	87.88	96.61	93.34	94.03
School 5	2009-2010	% Tested	100	100	100	97.65
		L3	28.92	20	28.44	16.87
		L4	57.83	64	58.72	74.70
		Total	86.75	84	87.16	91.57
	2010-2011	% Tested	100	100	100	99.07
		L3	26.88	18.95	21.93	38.32
		L4	61.29	71.58	71.93	47.66
		Total	88.17	90.53	93.86	85.98

School 6	2009-2010	% Tested	100	98.36	97.67	97.44
		L3	24.51	28.33	30.16	23.68
		L4	57.84	61.67	53.17	69.30
		Total	82.35	90	83.33	92.98
	2010-2011	% Tested	100	97.12	96.77	97.04
		L3	19.15	16.83	22.50	32.82
		L4	71.28	74.26	70.83	58.02
		Total	90.43	91.09	93.33	90.84
School 7	2009-2010	% Tested	100	100	100	100
		L3	23.91	14.81	23.44	27.45
		L4	65.22	70.37	56.25	68.63
		Total	89.13	85.18	79.69	96.08
	2010-2011	% Tested	100	100	98.18	100
		L3	31.15	23.53	20.37	43.48
		L4	50.82	64.71	70.37	40.58
		Total	81.79	88.24	90.74	84.06

Note. Information obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/Accountability.asp.

Table D2

ARMT Level III and Level IV Scores for Class of 2019

School	Visual Arts					Music				
	Population	% Tested	# to take test	% Scored L3 or L4	# Scored L3 or L4	Population	% Tested	# to take test	% Scored L3 or L4	# Scored L3 or L4
School 1	**118**	**91.82**	**108**	**80.20**	**87**	107	95.19	102	85.86	87
School 2	**107**	**98.11**	**105**	**89.42**	**94**	112	99.13	111	91.23	101
School 3	76	100	76	82.28	63	**78**	**98.7**	**77**	**80.27**	**62**
School 4	**59**	**100**	**59**	**85**	**50**	56	100	56	96.61	54
School 5	**82**	**100**	**82**	**86.75**	**71**	92	100	92	90.53	83
School 6	107	97.12	104	91.09	95	**101**	**100**	**101**	**82.35**	**83**
School 7	51	100	51	88.24	45	**49**	**100**	**49**	**89.13**	**44**

Note. Bold face data represent 2009-2010 school year. Non-bold data represent 2010-2011 school year. The population, percent tested, and percent scored L3 or L4 were obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/Accountability.asp.

Table D3

ARMT Level III and Level IV Scores for Class of 2018

School	Visual Arts					Music				
	Population	% Tested	# to take test	% Scored L3 or L4	# Scored L3 or L4	Population	% Tested	# to take test	% Scored L3 or L4	# Scored L3 or L4
School 1	**125**	**97.54**	**122**	**92.44**	**113**	120	99.18	119	98.35	117
School 2	**125**	**100**	**125**	**86.18**	**108**	125	100	125	93.33	117
School 3	62	100	62	92.65	57	**68**	**100**	**68**	**90.16**	**61**
School 4	**85**	**100**	**85**	**91.35**	**78**	74	100	74	93.34	69
School 5	**95**	**100**	**95**	**84.00**	**80**	113	100	113	93.86	106
School 6	124	96.77	120	93.33	112	**117**	**98.36**	**115**	**90**	**104**
School 7	56	98.18	55	90.74	50	**56**	**100**	**55**	**85.18**	**47**

Note. Bold face data represent 2009-2010 school year. Non-bold data represent 2010-2011 school year. The population, percent tested, and percent scored L3 or L4 were obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/Accountability.asp.

Table D4

ARMT Level III and Level IV Scores for Class of 2017

School	Visual Arts					Music				
	Population	% Tested	# to take test	% Scored L3 or L4	# Scored L3 or L4	Population	% Tested	# to take test	% Scored L3 or L4	# Scored L3 or L4
School 1	**103**	**97.94**	**101**	**90.53**	**91**	95	100	95	94.68	90
School 2	**85**	**98.89**	**84**	**86.52**	**73**	91	100	91	88.63	81
School 3	77	100	77	93.98	72	**83**	**100**	**83**	**91.14**	**76**
School 4	**67**	**100**	**67**	**87.88**	**59**	64	100	64	94.03	60
School 5	**106**	**100**	**106**	**87.16**	**92**	107	99.07	106	85.98	91
School 6	134	97.04	130	90.84	118	**128**	**97.67**	**125**	**83.33**	**104**
School 7	66	100	66	84.06	55	**67**	**100**	**67**	**79.69**	**53**

Note. Bold face data represent 2009-2010 school year. Non-bold data represent 2010-2011 school year. The population, percent tested, and percent scored L3 or L4 were obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/Accountability.asp.

Appendix E: SAT-10 Raw Data

Table E1

SAT-10 Scores for Individual Schools, Grades 3-6, 2009-2010 and 2010-2011 School Years

		3rd Grade		4th Grade		5th Grade		6th Grade	
		% Tested	Score	% Tested	Score	% Tested	Score	% Tested	Score
School 1	2009-2010	91.82	70	97.54	81	97.94	70	100	81
	2010-2011	96.12	82	95.19	75	100	79	100	76
School 2	2009-2010	98.11	72	100	69	100	78	97.73	89
	2010-2011	100	80	99.13	80	100	83	100	84
School 3	2009-2010	98.70	64	100	83	100	80	100	73
	2010-2011	100	75	100	78	100	78	100	78
School 4	2009-2010	100	65	100	73	100	72	100	81
	2010-2011	100	72	100	83	100	78	100	83
School 5	2009-2010	100	69	100	80	100	74	97.65	86
	2010-2011	100	77	100	80	100	77	99.07	78
School 6	2009-2010	100	70	98.36	74	97.67	68	97.44	84
	2010-2011	100	74	97.12	80	96.77	76	97.04	80
School 7	2009-2010	100	71	100	79	100	66	100	87
	2010-2011	100	68	100	78	98.18	79	100	75

Note. Information obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/Accountability.asp

Table E2

SAT-10 Scores for Class of 2019

Music				Visual Arts			
School	Population	% Taken	Score	School	Population	% Taken	Score
School 1	**107**	**95.19**	**75**	School 1	118	91.82	70
School 2	**112**	**99.13**	**80**	School 2	107	98.11	72
School 3	78	98.7	64	**School 3**	**76**	**100**	**78**
School 4	**56**	**100**	**83**	School 4	59	100	65
School 5	**92**	**100**	**80**	School 5	82	100	69
School 6	101	100	70	**School 6**	**107**	**97.12**	**80**
School 7	49	100	71	**School 7**	**51**	**100**	**78**

Note. Bold face data represent 2009-2010 school year. Non-bold face data represent 2010-2011 school year. The population, percent tested, and the average score were obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/ Accountability.asp.

Table E3

SAT-10 Scores for Class of 2018

Music				Visual Arts			
School	Population	% Taken	Score	School	Population	% Taken	Score
School 1	**120**	**100**	**79**	School 1	125	97.54	81
School 2	**125**	**100**	**83**	School 2	125	100	69
School 3	68	100	83	**School 3**	**62**	**100**	**78**
School 4	**74**	**100**	**78**	School 4	85	100	73
School 5	**113**	**100**	**77**	School 5	95	100	80
School 6	117	98.36	74	**School 6**	**124**	**96.77**	**76**
School 7	55	100	79	**School 7**	**56**	**98.18**	**79**

Note. Bold face data represent 2009-2010 school year. Non-bold face data represent 2010-2011 school year. The population, percent tested, and the average score were obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/ Accountability.asp.

Table E4

SAT-10 Scores for Class of 2017

Music				Visual Arts			
School	Population	% Taken	Score	School	Population	% Taken	Score
School 1	**95**	**100**	**76**	School 1	103	97.94	70
School 2	**91**	**100**	**84**	School 2	85	100	78
School 3	83	100	80	**School 3**	**77**	**100**	**78**
School 4	**64**	**100**	**83**	School 4	67	100	72
School 5	**107**	**100**	**78**	School 5	106	100	74
School 6	128	97.67	68	**School 6**	**134**	**97.04**	**80**
School 7	67	100	66	**School 7**	**66**	**100**	**75**

Note. Bold face data represent 2009-2010 school year. Non-bold face data represent 2010-2011 school year. The population, percent tested, and the average score were obtained via the Alabama State Department of Education Assessment reporting system at http://www03.alsde.edu/Accountability/ Accountability.asp.

APPENDIX F: ARMT Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
AG_ARMT_Visual_Arts_L3_L4	.185	7	.200*	.936	7	.607
AG_ARMT_Music_L3_L4	.150	7	.200*	.944	7	.679

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

APPENDIX G: SAT-10 Tests of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
All_Scores_SAT10_VisualArts_New	.204	7	.200*	.958	7	.804
All_Scores_SAT10_Music_New	.190	7	.200*	.901	7	.339

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.