

The Impact of Music on Student Achievement in the Third and Fifth Grade Math Curriculum

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by

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## APPROVAL PAGE

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## **Abstract**

Research indicates students who engage in music exhibit improved cognitive development. The quantitative study was conducted in a large suburban school district in Southeast Georgia. This study investigated the impact of music on student achievement when music is incorporated with the core academic subject of mathematics at the elementary level. This goal was accomplished by using a pretest-posttest control group design with a population of 51 third grade students and 51 fifth grade students through a series of analysis of covariance tests (ANCOVA). The t-test results showed statistically significant difference when comparing the experimental and control groups:  $t(26) = 6.11, p <.000$ ,  $t(23) = 3.73, p <.001$ ,  $t(26) = 6.01, p <.000$ ,  $t((23)) = 7.30, p <.000$ . Analysis of Covariance (ANCOVA) was used with the data to answer Research Question 2. Both groups showed significant difference. White students in both the control and experimental group outperformed black students in the experimental and control groups,  $F(7, 94) = 5.47, p <.000$ . In answer to Research Question 3, when comparing the high socioeconomic group to the low socioeconomic group we find that many of the low socioeconomic groups scored higher than the high socioeconomic status groups  $F(7,94) = 6.03, p < .000$ . It is recommended that future studies incorporate a power analysis to ensure sufficient sample size. The findings benefit teachers and students by presenting data supporting how the use of baroque and classical music playing along with music integration into the math curriculum is an important role in increasing student achievement in mathematics.

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## Chapter 1: Introduction

The Music Educators National Conference (MENC) promotes music as an effective tool providing learning opportunities for students (MENC, 2007). These learning opportunities provide alternatives to trouble youth, develops America's creative industries and building a workforce capable of competing in an increasingly knowledge-based global economy (Weiss, 2004). Research has also shown students who participate in fine arts classes achieve higher academic ratings (Texas Education Agency, 2007).

This quantitative study investigated the impact of music on student achievement when music was integrated into the mathematics curriculum. Research points to various ways music has been used to develop cognitive and behavior skills necessary for success in math (Appel, 2006). The experimental group listened to baroque and classical music, and received math integrated into the music curriculum. The introduction chapter begins with a brief summary of the background, the nature of the study, the setting and participants involved in the study, and the significance of the problem to the field of education.

### Background

Research has shown there are significant gaps in mathematics achievement that have not closed in the last three decades (Flores, 2007). In some states the achievement gap in mathematics is as large as 20 points (Center of Education Policy, 2009). As a consequence, federal guidelines in the No Child Left Behind (NCLB) Act set high expectations for student achievement and educators are held accountable for making them a reality (NCLB, 2002). Third, fifth and eighth grade students promotion to the next grade level depends on students meeting or exceeding state standard most importantly in the areas of mathematics and

language arts (Georgia Department of Education, 2009). The National Center for Educational Statistics (NCES) reported student math scores in Georgia are still below the National Average (NCES, 2009). Educators are continuing to seek new instructional strategies to improve student performance in the area of mathematics (Rabkin & Redmond, 2006).

In 2006, sixty-six middle school students were involved in a study to determine if music could be used as an avenue to improve student achievement (Respress and Lutfi, 2006). All participants were at-risk students. The results showed statistically significant improvements in self-esteem, school achievement and grade point averages. Music integrated programs appear to have more powerful effects on the achievement of struggling students than regular music education programs do (Rabkin & Redmond, 2004).

There are numerous math concepts that are relevant to music (Schmidt-Jones, 2005). Two of the most basic elements of music are rhythm and pitch (Schmidt-Jones, 2005). Rhythm and pitch can be used to teach basic math concepts. Music entails ratios, regularity, and patterns all of which are similar mathematical concepts (Harris, 2008). Arithmetic progressions can be used to teach geometric progressions in math (Cox & Stephens, 2006). Rhythm can be used to teach fractions (Schmidt-Jones, 2005). Therefore, research has shown music can be used to teach mathematical concepts.

### **Problem Statement**

The problem addressed in this study is the need to increase student achievement in mathematics. Traditional ways of teaching (i.e., working from a textbook, designing quiz, and assigning seatwork) are sedentary techniques that are ineffective in teaching students (Baines and Slutsky, 2009). The No Child Left Behind (NCLB) Act established guidelines

for states to follow to measure how well students acquire skills and knowledge (NCLB, 2001).

Approximately 5 to 7% of school-aged children have difficulty in math achievement (Proctor, Floyd and Shaver, 2005). This may mean traditional ways of teaching mathematics are ineffective (Baines & Slutsky, 2009). This presents a challenge for society that demands at least minimal math proficiency (Proctor et al., 2005).

The achievement gap has been defined as the difference between the average score for Black students and the average score for White students (National Assessment of Educational Progress, 2007). The achievement level of mathematic students in the United States, fall far behind those of other developed nations. Students who are falling behind come predominantly from high-poverty and high-minority areas. Research has shown national and international comparisons of student achievement indicate that it is between fourth and eighth grade when students fall rapidly behind desired levels of achievement (Balfanz and Bynes, 2006).

The 2007 National Assessment of Educational Progress (NAEP) report in mathematics showed the average scale score for fourth-grade students in Georgia was 235. This score was lower than the national average score of 239. Black students had an average score that was lower than that of white students by 24 points. Students who were eligible for free/reduced school lunch , an indicator of poverty, had an average math score 23 points lower than that of students who were not eligible for free/ reduced school lunch. To address the achievement gap, there is a need to design a curriculum which allows all students to be successful in mathematics.

## Purpose

The purpose of this quantitative study was to demonstrate the impact of baroque and classical music on student achievement in elementary mathematics. All third and fifth grade students are required to meet or exceed standards on the state standardized test in mathematics for promotion. The sample group consisted of 51 third grade students and 51 fifth grade students. Students were divided into two groups: the experimental group and the control group. A quantitative pretest-posttest control group design was utilized.

The independent variables of baroque and classical music were played during math class of the experimental group. The dependent variable was the quarterly benchmark assessments in mathematics. Descriptive statistics of this study was based on the results of the quarterly benchmark assessment in mathematics for the school year of 2010-2011. There was a comparison of how participants performed based on gender, race, and socioeconomic status. The setting for this study was a large suburban school district in Southeast Georgia. This study is intended to determine if listening to baroque and classical music in the math class, along with math integration into the music curriculum, increases student achievement in math.

## Theoretical Framework

The theoretical foundation for this study is centered on two theories: multiple intelligences and constructivism. Multiple intelligence theory was founded by Howard Gardner (Sabine, 2006). There are eight basic multiple intelligences: linguistic (word smart), mathematical (number/reasoning smart), spatial (picture smart), bodily-kinesthetic (body smart), musical (music smart), interpersonal (people smart), intrapersonal (self smart), and

naturalist (nature smart) (Gardner, 1983; Helding, (2009). Gardner believes humans are capable of many different and discrete qualities of cognition. Thus, humans display different types of intelligences which can be measured, fostered, and evaluated as isolated faculties of the mind (Gardner, 1983). Cognitive science differentiates between tacit knowledge and propositional knowledge. Reports have shown cognitive science differentiates between tactic knowledge and propositional knowledge (Helding, 2009). Gardner's term for the two forms of knowledge is "know-how" and "know-that". Tactic knowledge (know-how) is the knowledge a person is born with, and propositional knowledge (know-that) refers to an acquired, or more scientific knowledge of how these activities are actually carried out (Helding, 2009). Gardner's argument was he believes no intelligence exists alone (except for those people with severe learning disabilities) and people possess strengths in combinations of multiple intelligences (Gullatt, 2008). Gardner supports the view of these intelligences being strongly rooted in the arts. Based on these intelligences, there are multiple entry points in which students are able to be engaged in making connections across the curriculum (Gullatt, 2008).

The second theoretical foundation for this study is centered on constructivist teaching strategies. The classroom is made up of active engaged students who are seen as collaborators (Grier-Reed and Conkel-Ziebell, 2009). Within the constructivist paradigm, emphasis is on the learner rather than the teacher (Thanasoulas, 2009). Constructivist teaching strategies have a great effect on students both cognitively and socially (Powell and Kalina, 2009).

Cognitive constructivism was constructed by the French Swiss developmental psychologist Jean Piaget. Piaget's constructivism is based on his view of the psychological

development of children (Slavin, 2003). Piaget believes providing classroom situations and activities promoted individual learning (Powell and Kalina, 2009). Piaget also believed children first workout cognitive structures by interacting with real things and people then create increasingly internal, theoretical structures (Slavin, 2003).

Social constructivism is effective in teaching all children, and social constructivism incorporates collaboration and social interaction (Powell and Kalina, 2009). Lev Vygotsky is known as the founding father of social constructivism who believes that social interaction and cultural influences have a vast effect on a student and how learning occurs (Raines, Kelly and Durham, 2008). Vygotsky also believed when children understand themselves, they are then able to begin learning the curriculum (Woolfolk, 2004). Developing tools that can be used in the classroom that secure inquiry and social interaction, along with cooperative skills and individual discovery learning helps teachers produce an effective constructivist environment (Powell and Kalina, 2009).

## **Research Questions and Hypotheses**

The following questions together with the associated null ( $H_0$ ) and alternative ( $H_a$ ) hypotheses are intended to review the relationship between music and student achievement.

1. What effect, if any, does baroque and classical music have on student achievement in mathematics when integrated into the third and fifth grade math curriculum?

**$H_{10}$ :** There will be no statistically significant difference in student achievement when baroque and classical music has been integrated into the third and fifth grade math curriculum.

**$H_{1a}$ :** There will be a statistically significant difference in student achievement

when baroque and classical music has been integrated into the third and fifth grade math curriculum.

2. What will be the effect of baroque and classical music on student achievement based on race, when integrated into the third and fifth grade math curriculum?

**H2o:** There will be no statistically significant difference in student achievement, based on race, when baroque and classical music is integrated into the third and fifth grade math curriculum.

**H2a:** There will be statistically significant difference in student achievement, based on race, when baroque and classical music is integrated into the third and fifth grade math curriculum.

3. What effect, if any, does baroque and classical music have on achievement of low-income students in a third and fifth grade math classroom?

**H3o:** There will be no statistically significant difference in student achievement of students who receive free/reduced lunch, when music is integrated into the third and fifth grade math curriculum.

**H3a:** There will be statistically significant difference in student achievement of students who receive free/reduced lunch, when music is integrated into the third and fifth grade math curriculum.

## Nature of the Study

This study explored the impact of listening to baroque and classical music along with the integration of mathematics into the music curriculum on student achievement in the elementary math class. Students in the control group will not listen to music or have ..

mathematics included into the music curriculum. A quantitative, experimental, pretest-posttest design method was used to answer questions proposed for this study. The population consisted of 51 third grade students and 51 fifth grade students. First a two-tailed independent sample t-test compared the mean scores of the experimental group to the mean scores of the control group. The groups were administered the quarterly benchmark assessment in mathematics by the classroom teachers. Secondly, an Analysis of Covariance test was done to compare the mean test scores of students by the following factors: gender, race, lunch program status.

Research has noted how listening to baroque and classical music improves cognitive skills (Schellenberg, 2005). Therefore, classroom teachers agreed to play a CD of baroque and classical music (independent variable) when students are in math. The quarterly benchmark assessment in math (dependent variable) was used to evaluate student achievement. The music teacher, (researcher) incorporated math into the music curriculum. Interpretive data was used to determine the relationship between music and student performance. Descriptive statistics was used to determine participants who did not meet, met, or exceeded standards. Descriptive statistics was also used to analyze the mean scores of the pretest and posttest of the experimental and control groups.

## **Significance of the Study**

During the early years of a young child's' life neural connections are being made at a rapid rate (Sousa, 2006). Music activities engage all the senses and wire the brain for learning. Maglione (2006) noted how the effects of music on the brain vary. Classical music has the positive effect of increasing cognitive skills by increasing short and long term

memory. Baroque music affects the amplitude and frequency of brain waves causing the person to relax (Maglione, 2006). Therefore, the brain begins to concentrate more easily and assimilate more information in less time. A study was conducted on the effects of listening to music in children (Schellenberg & Hallam, 2005). The study showed listening to pleasant and enjoyable music has a positive impact on the listener's emotional state which improves cognitive performance.

Furthermore, the information from this study is used to expand the literature regarding how music can be used to increase student performance in math at the elementary level. Specific information concerning the relationship of the selected variables and student achievement in math for elementary students is valuable to schools for making data-based decisions on student performance. Improvements in curriculum methods for increasing student achievement in math can be shared with other teachers and expanded to other core academic subjects. The results of the study are of particular importance to school districts across Georgia and the United States who are interested in increasing student achievement in mathematics.

### **Definition of Key Terms**

**Annual Yearly Progress.** An annual measure of student participation and achievement in statewide assessments and other academic indicators set forth by the No Child Left Behind Act. This testing is aligned with standards and measures students' achievement based on the standards. By Annual Yearly Progress (AYP), each local school district and school is held accountable for the academic success of all students (NCLB, 2001).

**Arts-integrations.** An approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objectives in both (www.kennedy-center.org).

**Baroque Music.** A style of Western European classical music extending from 1600-1750 (Schirmer, 1995).

**Benchmark Assessment.** An interim assessment created by districts that can be used both formatively and summatively. It provides local accountability data on identified learning standards for district review after a defined instructional period and provides teachers with student outcome data to assess instructional practice and implement intervention before annual state summative assessments. In addition, a benchmark assessment allows educators to monitor the progress of students against the state standards and to predict performance on state exams (National Center for Education Evaluation and Regional Assistance, 2007).

**Classical Music.** A Western European musical style referring to music written between 1750-1820 (Schirmer, 1995).

**Early Intervention Program (EIP).** This program provides additional instructional resources to help students who are performing below grade level to obtain the necessary academic skills to read at grade level performance in the shortest possible time (Georgia Department of Education, 2009).

**Gifted Education Program.** This program serves students with outstanding talent who perform or show the potential at remarkably high levels of accomplishment when compared with others of their age, experience, or environment (National Society for the Gifted and Talented, 2009).

**Inclusion.** This program allows children with learning disabilities and other types of disabilities to be educated in the regular education classroom (Logsdon, 2009).

**State standards.** A standard is an established rule for measuring of quantity, state, extent, value or quality. A standard defines the broad expectations for an area of knowledge in a given domain and may include an expectation of the degree to which a student expresses his or her understanding of that knowledge (Georgia Department of Education, 2009).

## **Summary**

There is a need to increase student achievement in math. Traditional ways of teaching are ineffective in teaching students (Baines and Slutsky, 2009). Statistics has shown approximately 5 to 7% of school-age children who meeting or exceeding standards in the area of math, and presents a challenge for society that demands at least minimal math proficiency (Proctor et al., 2005). This proves there is more of a need to create a curriculum which can be used to close the achievement gap.

The theoretical foundation for this study is based on two theories: multiple intelligences and constructivism. In the theory of multiple intelligences, Howard Gardner argues there are

numerous cognitive abilities and none of these intelligences exist alone (Gardner, 1983).

Gardner supports the view of these intelligences being strongly rooted in the arts. Thus, based on the intelligences, there are multiple access points in which students are able to be engaged in making connections across the curriculum.

The second theoretical foundation for this study is constructivism. Constructivist teaching strategies places more emphasis on students as collaborators (Grier-Reed and Conkel-Ziebell, 2009). Teaching strategies based on the constructivist theory effect students cognitively and socially (Powell and Kalina, 2009). Lesson should be designed to aid students to secure inquiry and social interaction, cooperative skills and individual discovery learning (Powell and Kalina, 2009). The researcher included math into the music curriculum to allow students to engage in making connections across the curriculum to provide for individual learning.

It is important to begin using scientifically research-based methods that are proven to be effective in increasing student achievement. Research has shown how classical and baroque music can be effective in helping children to concentrate easily and assimilate more information in less time (Maglione, 2006). Finding ways to improve curriculum methods are of particular importance to school districts, the state of Georgia and the United States if we are to increase students' achievement in mathematics.

## Chapter 2 Literature Review

This study investigated the impact of baroque and classical music on student achievement in mathematics. The quarterly benchmark assessment in math was used to collect data of student performance based on gender, race, and performance of students who receive free/reduced lunch (an indicator of poverty). This investigation will take place in a suburban school district in Southeast Georgia.

The literature review was designed to include the following information: the achievement gap in math based on national and state test data, non-school factors that affect the achievement gap in math, the achievement gap between black and white students, the benefits of music and how music affects cognition and learning, the Mozart Effect, and the importance of music integration. Lastly, the literature review will include how quarterly benchmark assessments can be used by teachers to assess student achievement. References are cited from numerous resources, including textbooks, peer-reviewed journals newspapers, Internet sites, magazines, governmental reports and studies and various other forms of research done on the topic. The chapter ends with a summary of the chapter.

### **The Achievement Gap in Math**

In the past decade, the achievement gap in math on national and state test have narrowed between economically disadvantaged and non-disadvantaged students (Sawchuck, 2009). Research has shown there are significant gaps in mathematics achievement that have not closed in the last three decades (Flores, 2007). A report from the Center on Education Policy (CEP) reveals the disparities appear to be narrowing because of the accelerated achievement of lower performing groups. However, in some states the achievement gap remains as large

as 20 points (CEP, 2009). There is a need to design a research-based curriculum that will assist in closing the achievement gap.

Research constantly supports the existence of an achievement gap in mathematics, and researchers are currently attempting to identify reasons for the gap (Cooper and Schlessner, 2006). Some researchers have found the achievement gap begins universally for all children, before kindergarten, and is found to be compounded outside of school as children move through the grades (Evans, 2005). Data specifically shows how some groups of students are not learning as much in schools as students from other groups (Flores, 2007). Studies have shown there are a number of variables that can cause the achievement gap in mathematics.

Researchers in the area of education economics have focused on knowing what the influencing factors of student academic performance (Lui & Lu, 2008). Many of these studies are based on the effects of family socioeconomic status (SES) on student academic performance. Black students have lower levels of parent availability than white students or Asian American students (Evans, 2005). Only 38% of black students live with two parents versus 75% of white students. Many black students are living with single mothers and in poverty, a combination that puts children from any ethnic group at risk for achievement problems. Secondly, between first and third grades, 27% of black students and 25% of Hispanic students change schools three or more times, while just 13% of white students change schools as often.

There are three main factors that lead to research on the effects of family socioeconomic status (SES) on student academic performance (Lui & Lu, 2008). A child's first education is received from the family. Parents' investment in their children, whether materialistic or mental, has an impact on the child. A family's structure, living environment, and other

factors might also influence children's growth. Next, researchers believe a student's family SES must be considered in order to provide fair methods and results. Lastly, the schooling process of a child is a productive process, and the beginning stages of basic education, family education and school education are incorporated.

There are many educational disparities among children from diverse racial and ethnic backgrounds. When compared to white children, children in black families are twice as likely to have repeated a grade, and 23% are less likely to be doing advanced work in any subject or attending special classes for gifted students. Twelve percent of Hispanic children are more likely to have repeated a grade and 40% are less likely to be doing advanced work in any subject or attending special classes for gifted students. There are many factors that contribute to the disparities (Kaushal & Nepomnyaschy, 2009).

Limited family resources may influence a child's well-being in many ways. Low-income families may find it difficult to meet the nutritional, educational and developmental needs of their children. Researchers have discovered that poor families are less likely to invest in educational items (e.g. educational toys, books, participation in educational activities) which are associated with the cognitive development of children (Kaushal & Nepomnyaschy, 2009). Family resources affect a child's well-being by influencing their developmental and learning environment. They also found low-income families experience increased household stress levels, resulting in parental depression, which has been found to be associated with poor parenting. Research has found that parents who are unemployed or on welfare may have lower self-esteem and greater levels of psychological-stress (Kaushal & Nepomnyaschy, 2009). These factors may affect the self esteem of children and their learning environment.

Researchers have paid extensive attention to SES as a reason for achievement and have excluded wealth in conceptualizations of this factor. Income, educational attainment and professional status have been viewed as adequate indicators of economic well-being and social status. In recent years, wealth has been viewed as an important factor of SES and as sufficiently different from income to demand our attention when discussing important educational outcomes (Orr, 2003).

For many years, researchers have been looking for reasons as to why blacks, on average, have lower achievement than do whites. Orr (2003) reported these findings in an early study in the area of education economics; it was found wealth had significant effect on several academic outcomes including educational attainment (high school graduation and college completion), the risk of expulsion, and the risk of being held back a grade. The study also implied there was a possible connection between academic achievement and wealth.

A recent study of nontransient 6<sup>th</sup> and 8<sup>th</sup> grade students from an urban middle school was investigated (Southgate & Roscigno, 2009). The achievement test scores were examined before fourth grade and during the 6<sup>th</sup> or 8<sup>th</sup> grade year upon enrolling in a performing ensemble. Students were grouped by those who participated in band, choir or none. Subject variables of socioeconomic status (SES) and home environment were included. The achievement test included Reading, Math, Citizenship and Science. The results showed significant differences yet small effect sizes of SES and ensemble participation. No significant main or interaction effects were evidenced for home environment. While other studies have suggested a correlation between parental involvement and student achievement, this investigation found no evidence to suggest that these were factors influencing academic achievement. Students from higher SES scored significantly higher on all subtest except 4<sup>th</sup>,

6<sup>th</sup> and 8<sup>th</sup> grade reading. Sixth grade band students scored significantly higher than choir students and nonparticipants on every subtest of 6<sup>th</sup> and 4<sup>th</sup> grade achievement tests. Eighth grade band students scored significantly higher than nonparticipants on 4<sup>th</sup> grade Reading and Math and every subtest of the 8<sup>th</sup> grade achievement test except Social Studies (Southgate and Roscigno, 2009).

There was an exploration by Kaushal & Nepomnyaschy (2009), to examine the extent to which disparities in wealth by race/ethnicity are related to gaps in children's educational outcomes, and to determine if family socio-demographics and parental resources account for a substantial proportion of black/white and Hispanic/white disparities in children's participation in gifted programs, extracurricular activities and grade retention. The sample for the study was limited to approximately 16,000 children between the ages of 6 and 17 in 9508 households. The household head was U.S. born and between the ages of 18 and 54. The household head was also established to be the mother of the children in the household or the father if there was no mother.

The findings of this study shows a fifth of white children are in gifted classes and over two-thirds are engaged in extracurricular activities. In comparison, 15% of black children and 14% of Hispanic children are in gifted classes and 50% of each group participates in extracurricular activities. Young children are less likely to participate in gifted classes than older children (ages 15-17). Boys are less likely to participate in gifted programs than girls. Education of the family head is also related to participation in gifted programs. Kaushal & Nepomnyaschy (2009) have discovered that young children (ages 6-8) are less likely than the oldest children (15-17) to participate in extracurricular activities while those aged 9-13 are more likely than the oldest age group. Children of older more educated parents and those

in a two-parent family are more likely to participate in extracurricular activities. There is no difference in participation by child sex.

White children are less likely to have repeated a grade, but are no less likely to have been suspended or expelled than Hispanic children. Children in black families are 6% more likely and children in Hispanic families are 3% more likely to repeat a grade than are children in white families. Young children are less likely to repeat a grade than those aged group 15-17, while boys are more likely than girls. Children in two-parent families are less likely to repeat a grade. This investigation shows the extent to which disparities in wealth by race/ethnicity are related to gaps in children's educational outcomes. The disparities in wealth far outweigh the disparities in income. Certain disadvantaged children in minority families' are strongly linked with income and wealth disparities.

Another factor that is believed to have an effect on student achievement in mathematics is gender stereotyping. In the past, mathematics has been stereotyped as a male dominate subject (Forgasz, Leder, Klousterman, Patrick, 2004). Early research associates boys as having higher to superior math ability. Some viewed a women's interest to be different from men. Some researchers believed women were incapable of the intellectual demand of mathematics yet there were some capable women who were able to excel in mathematics. The women's movement in the 1970's and 1980's, especially in Western countries, brought about an awareness of the widespread social and educational disadvantages experienced by women. Some researchers felt there was a need to create a variety of interventions to address female's disadvantages in the domain of mathematics (Forgasz et al., 2004). As a result, learning outcomes for women soon followed.

The Fennema-Sherman Mathematics Aptitude (MAS) Scale was published in 1976. This widely used scale has nine subscales. One subscale, mathematics as a male domain, has frequently been used to assess the extent to which mathematics has been stereotyped as a masculine realm (Forgasz, et al. 2004). Some researchers using the MAS have made modifications to suit the purpose of the studies. Their modifications were done by slight variations in the wording of items or the number of items used or by changing the response format. The Fennema-Sherman mathematics as a male domain subscale later was ruled as no longer being reliable. In research performed (Forgasz et al. 2004) the male domain subscale was found to be anachronistic and the scoring of the subscale did not allow for respondents to hold views that mathematics might be considered a female domain.

In recent studies, the attention changed from mathematics being a male dominant subject to wanting to know how boys and girls perform in mathematics. Studies in this area has shown there is no significant differences in understanding mathematical concepts and it is suggested that gender differences favoring males seem to be more evident in the area of problem solving. Females, especially in elementary school, outperform males in computation/arithmetic (Gherasim, Popa, 2009).

Stereotype threats relates to diverse groups to include women, ethnic minorities, and low socioeconomic and social status groups (Gherasim, Popa, 2009). When members of stereotyped groups take standardized ability tests, it is a chance their performance may be affected by situational or contextual factors. This may go far beyond established influences such as poverty, parental style or socialization. According to the researchers there is evidence supporting the assumption how negative stereotyping can bring about a threat experience. Researchers have found how stereotype threat has been manipulated in experimental settings

(Gherasim, Popa, 2009). They found some strategies used in these experimental setting include (a) participants being asked to note biographical information or the use of a demographic questionnaire either prior or after taking the test, (b) they may be introduced into the testing situation as analyzing their ability in certain domains, or their intelligence by specifications introduced through an instructional set, (c) or individuals may be targeted by charges of inferiority, and may be informed that members of the out-group, outperformed partakers in the in-group.

Another factor that is believed by researchers that can affect student achievement in math is not having experienced teachers working in low-income schools (Ingersoll, 2004). A 2007 report by the National Center for Education Statistics (NCES) found schools in high poverty minority neighborhoods frequently have the largest challenge to recruit and keep experienced teachers. Schools in low-income neighborhoods have difficulty attracting and retaining teachers, and as a result making it difficult to give children what they need to be high-performing schools. Children in low-income, minority neighborhoods face challenges affiliated with poverty, such as fewer enrichment opportunities. The significant achievement gap between African-Americans and white fourth- and eighth-graders can be solved by incorporating teachers who are committed to teaching in rural and urban public schools (NCES, 2007).

## **The Black/White Achievement Gap**

The racial achievement gap is a major concern of Americans and continues to persist despite efforts to eradicate the problem (Associated Press, 2009). The National Assessment of Educational Progress (NAEP) has defined the achievement gap as the difference between

the average score for Black students and the average score for White students (NAEP, 2007). Changes in the size of the achievement gap are based on both changes in the average scores for these students and the rate of change in the scores. The racial gap has been a major catalyst for federal education policy as exemplified in the No Child Left Behind Act of 2001. It has also entered into numerous state and local debates regarding school finance equalization, academic tracking, and school accountability programs (Clotfelter, Ladd, and Vigdor, 2009).

Since the Coleman Report in 1966, researchers have known the average achievement test scores of black students lagging well behind those of white students. The Coleman Report (1966) is also known as The Equality of Educational Opportunity Study (EEOS). This report was commissioned by the United States Department of Health, Education, and Welfare to assess the availability of equal educational opportunities to children of different race, color, religion, and national origin. The EEOS was in response to provisions of the Civil Rights Act of 1964. The EEOS also found black children start out trailing behind their white counterpart and essentially never catch up, even when their schools were as well as equipped as their predominantly white enrollments (Viadero, 2006).

According to the report by the National Assessment of Educational Progress (2009) math and reading scores for fourth and eighth grade students in public schools has improved nationwide. African-American students continue to lag behind their white classmates. The data is a federal measure of student achievement in math, science and reading. Based on the information in the report, African-American students scored on average 26 points less than white students on their reading and math tests. The scale used is based on a 500 point scale. In some states the achievement gap is narrowed. African-American students academically

improved more than their white counterparts, yet the gap still remains. The national reading average for African-American fourth-graders was 203 points compared to 230 points for white students. For eighth-graders, the national average was 244 points for African-American students and 270 points for white students. The national math average for African-American Fourth-graders was 222 points compared to 248 points for white students. The national average for eight-graders was 259 points for African-Americans and 290 points for white students. Some associate the achievement gap to several factors to include socioeconomic differences and the standard of quality education.

Clotfelter et al. (2009) performed a study that looked at racial/ethnic achievement gaps of students in grades three to eight. The data is linked to North Carolina's public school state's standards. The test score gap between black and white students was sizable, even after controlling for several important covariates. The data showed Hispanic and American Indian students also lag behind whites, but less dramatically. Asian students often scored higher than whites, especially in later grades. It was also found how the regression-adjusted mean test scores of minority groups other than blacks rose relative to white as students aged from grade three to eight. The regression-adjusted black white gap in math test scores declines by less than 1% between third and eighth grade but grew by about 11% in reading.

Researchers have found the black-white gap at fourth grade narrowed into the 1970s and into the 1980s, after which it languished or grew slightly (Phillip & Chin, 2004). In 2000, the gap was 0.90 of a standard deviation in math and 0.83 in reading. The corresponding gap for eight grade students was more than a full deviation (1.06) in math and 0.85 in reading. Many times socioeconomic characteristics such as income and parental education tend to be

correlated with race. It is likely that at least a portion of the observed gaps between racial and ethnic groups can be accounted for by nonracial factors.

In order to alleviate the achievement gap in math, it has been suggested that more scientific research based methods are needed (The Center for Comprehensive School Reform and Improvement, 2005). Scientific based research can become an essential component of school improvement. Music has been proven to be an effective tool in improving student achievement. Let's look at the benefits of music and the proven use of music and how it will be used to increase math achievement.

### **The Benefits of Music**

According to the Music Educators National Conference Organization (2007), there is an increase in the amount of evidence that demonstrate the role of music education and how it improves student achievement, offers positive alternatives to trouble youth, assist in developing America's creative industries and building a workforce capable of competing in an increasingly knowledge-based global economy. A Harris Poll (2001) proved American adults overwhelmingly view the arts as vital to providing children with a well-rounded education (Weiss, 2004). The Music Educators National Conference Organization (MENC) in 2007 affirmed in the opening statement of the document "*The Value and Quality of Arts Education: A Statement of Principles*," the ten most important educational organizations asserts, "Every student in the nation should have an education in the arts." (p.1)

Strong social skills are important for success in life. According to Gooding (2009), students with deficits in social and behavioral skills recurrently show higher rates of school dropout, impaired social relationships, unemployment or underemployment, substance abuse, unstable and unfulfilling personal lives, and a lack of postsecondary education and training.

Three specific social skills are needed in order for students to be successful in the classroom: skills that help them to relate to others (interpersonal behavior), skills that help children regulate themselves (self-related behavior) and skills that help children complete assigned tasks (task-related behaviors). Since social skills are a natural part of the music-making process, the music classroom can be a place where students can interact to learn these skills.

Music can provide effective learning opportunities to students producing increased academic performance, lessening absenteeism, and better skill-building (Music Educators National Conference, 2007). In exploring the relationship of fine arts participation to academic achievement, Texas schools, the Texas Coalition for Quality Arts Education, together with Texas Music Educators Association (a TCQAE participating organization) analyzed academic achievement ratings, dropout rates and fine arts enrollment data as reported by public schools across Texas from 2005-2007. The data was taken from grades (9-12) and middle schools grades (6-8). The data showed students who participated in fine arts classes achieved higher academic ratings, low dropout rates and their attendance rating were higher (Texas Education Agency, 2007).

At-risk students are more likely to suffer from having limited skills to be successful in life. Music can be used to increase self-esteem; lower crime rate; attain skills necessary for obtaining job skills and it can also help students become creative thinkers, develop problem solving and communication skills. Music-based education has also been successful with disadvantaged populations including at-risk and incarcerated youth.

For example, there was an investigation on the effects of music on self-esteem and academic achievement (Respress & Lutfi, 2006). These students participate in the Health, Education, in the Arts, Refining Talented Students (HEARTS) Project. This project is

sponsored by the Office of Minority Health of the U.S. Department of Health and Human Services. This organization seeks to provide engaging and academically enriching experiences, and is operated at Florida Agricultural and Mechanical University. The participants are African American middle school students who have the greatest risk and capacity for academic and social failure. The program is an important link between the school and community.

Emphasis is placed on each student's inherent talents, skills, interests, aptitudes, competencies, abilities, and endowments. The strengths of each student are addressed through utilization of the fine arts in the areas of music, art, drama and dance. The focuses on individual student's assets serve to reduce risk factors, increase positive factors, and establish and maintain positive changes. The music module exposes students to various forms of musical and vocal instruction. Students who participate in the program received music lessons based on their area of interest. Also, students who are interested in becoming professionals in the music field learn about all facets of music production. The sample group consisted of sixty-six middle school students in grades six through eight. Thirty-three students were placed in the participant group and thirty-three were placed in the comparison groups. The racial make-up of both groups was ninety-four percent African American, six percent bi-racial and one percent other. The students were between the ages of eleven and fourteen and were selected based upon baseline data regarding problem behaviors, grades, attendance, socioeconomic background, family problems and problems in the community (Respress & Lutfi, 2006).

A Quasi-Experimental Design was used to determine if students who received intervention strategies scored significantly higher on outcomes measured when compared

with students who did not receive intervention strategies. A pretest-posttest design was used to compare the participant group against the comparison group. The results of the study showed fifty-seven percent (57%) of the participant group had a .5 increase in their grade point average when compared to 11% of the comparison group. Sixty-three percent (63%) of the participant and comparison groups increased their Math grade level. There was not a significant difference between the scores. The participants increased their spelling grade level by one grade, whereas 48% of the comparison group showed an increase. Thirty-seven percent (37%) of the participants improved their total self-esteem scores whereas 7% of the comparison group showed an increase. The participants' reduction in violent index was lower than the comparison group. Thirty-three percent of the participant group increased their scores by 10% in School Involvement while 22% of the comparison group increased their scores by 10%. The results of this study supports the finding how the HEARTS Family Life Center has assisted participants in decreasing, maintaining control, fostering academic competencies, and feeling a sense of involvement towards and being engaged in their school. The various learning styles of students should be addressed in the classroom when replicating this study (Respress & Lutfi, 2006).

Many colleges believe music and art are important for middle-school age children. This is important especially for those students who are planning to obtain a college education. By participating in the arts, students receive a valuable experience in broadening their understanding and appreciation of the world around them. It is also recommended for college-bound high school students to receive one or two years of Visual and Performing Arts (Music Educators National Conference, 2007). According to reports by the College Entrance Examination Board (2009), students in the arts continue to outperform their non-

arts peer on the Scholastic Aptitude Test (SAT). In 2005, SAT takers with coursework/experience in music performance scored 56 points higher on the verbal portion of the test and 39 points higher on the math portion than students with no coursework or experience in the arts. Scores for those with coursework in music appreciation were 60 points higher on the verbal and 39 points higher on the math portion.

The arts instill critical analysis skills, the ability to deal with difficulty, solve problems, persevere, and instill a sense of excellence (MENC, 2007). These creative skills help children to develop new ideas, new experiences and new challenges along with personal satisfaction. President Bush and both Democrats and Republicans in Congress identify these skills as necessary for life, and purport that they can have a great influence on student achievement and motivation. This is why the arts are considered a core academic subject under the No Child Left Behind law of 2002 (Paige & Huckabee, 2005). There are some musicians who believe that in order to be successful in society, students must be successful in school. Some music educators as well as parents of music students say they believe music can be effective in helping children become better students. Researchers believe skills learned through music can be transferred to study skills, communication skills and cognitive skills that are necessary in every part of the curriculum MENC, (2007).

School Principals were polled nationwide concerning the effectiveness of school music programs. Ninety-six percent of the principals interviewed agreed how music education programs encourages and motivates students to stay in school. Fifty-five percent “strongly agree” with this idea. Eighty-nine percent of the principals believe a high-quality music education program contributes to their schools’ achieving graduation rates (Teaching Music, 2006).

A national study conducted (2006) showed schools that offer music programs have an increase in the number of students who graduate from high school (Johnson and Memmott). This is found especially among those schools that have music programs that are considered to be “excellent” or “very good.” This study looked at the relationship between participation in school music programs and standardized test scores. The participants were elementary students’ in grades three or four and middle school students in grades eight or nine. The participating schools in this study were from five states that represented the South, East Coast, Midwest and West Coast of the United States. Schools chosen for this study were to be as similar as possible. The total numbers of participants were 4,739. Schools chosen for this study were identified by university music education professors. These music education professors were all published and accomplished researchers who were familiar with the school districts in each geographical region and familiar with the quality of the music education program at each school. All participants took the state standardized test to meet Annual Yearly Progress (AYP) as required by the No Child Left Behind (NCLB) Act.

Students received music instruction in their school and were placed in one of two groups. Group 1 included students who attended a school where the quality of music instruction was considered exemplary. Group 2 included students who attended a school where the quality of music was considered less than ideal. The findings showed students in schools that have music programs are considered to be “excellent” or “very good,” scored higher on standardized test than those schools with deficient music education programs. These students scored 22% better in English and 20% better in math. Research has also shown that students who participate in lower-quality instrumental programs scored higher in English and Math than students who had no music at all.

The Music Educators National Conference (2007) states a child's intelligence is increased with music instruction. There are numerous statistical data of which supports music education as making students smarter (MENC). In recent years, there has been a combination of behavioral studies and neurological research showing how music can actively contribute to brain development (Shellenberg, 2004).

Groups of children (6 year-olds) participated in a study for 36 weeks in which they were either provided with lessons in keyboard, voice, drama or they received no lessons at all. The focus of the study was to uncover if music lessons have collateral benefits that extend to nonmusical areas of cognition. The hypothesis was tested with 144 children who were randomly assigned to one of four groups. Students who participated in this study received piano or voice lessons. The control group received drama lessons or no lessons. The IQ of the children was measured before and after the lessons. The WISC-III, (Wechsler, 1991), the Kaufman Test of Educational Achievement (K-TEA; Kaufman & Kaufman, 1985) and the Parent Rating Scale of the Behavioral Assessment System for Children (BASC; Reynolds & Kamphaus, 1992) were administered to the children.

At the end of 36 weeks, all four groups had significant increases in IQ. This increase was attributed to students entering grade school. The music group had consistently larger increase in full-scale IQ. The children in the control group had an average increase in IQ of 4.3 points, whereas the music groups had an average increase of 7.0 points. The conclusion is music lessons cause a small increase in IQ. The results showed there was an increase in the pre-lesson IQ scores of those students who had taken keyboard and voice more than the IQ scores of those students taking drama or no lessons (Schellenberg, 2004).

As parents, each of us would like for our children to be successful in school, in employment and through the social structures through which we move. Music education can bring endless benefits to each individual throughout life. Lastly, the study of music helps children succeed in life by allowing children to experience success psychologically, spiritually and physically (Music Educators National Conference, 2007).

### **The Mozart Effect**

Listening to music composed by Mozart that is used to improve cognitive skills is known as the Mozart effect (Barry, 2008). In this study, thirty-six college students were divided into three groups. One group listened to Mozart Sonata for Two Pianos in D Major, K488. The second group received relaxation instructions while the third group received silence. After receiving the treatment, one of the three abstract reasoning tests was taken from the Stanford-Binet Intelligence Scale. The task consisted of a pattern analysis test, a multiple-choice matrices test and a multiple-choice paper-folding and cutting test. The study resulted in the IQ scores of students participating in the music condition were 8 to 9 points above the other two groups IQ scores. Participants performed better on the abstract/reasoning test after listening to Mozart than after listening to the relaxation tape or listening to nothing. It was also found the effects of music treatment was temporary and did not extend more than 10-15 minute period while they were engaged in each spatial task (Rauscher, Shaw and Ky, 1993).

A second study on the effect of music composed by Mozart on cognition was performed (Rauscher, Shaw and Ky, 1995). This study was a follow-up of the first study conducted in 1993. This study used a larger sample. Seventy-nine students participated in a five-day study. All participants were given 16 Paper Folding and Cutting (PF&C) items on the first

day. Students were then divided into three groups: a silence group, a group who listened to the Mozart Sonata for Two Pianos in D Major, K 488, and a mixed group who listened to something different. Mozart was chosen for this study because of his ability to compose at the age of four, and the researchers expect Mozart was capitalizing on the inherent repertoire of spatial-temporal firing patterns in the cortex. All students were of equal abilities. Sixteen short-term memory items were issued to each participant. The PF&C of the Stanford-Binet's Intelligence Scale was chosen because it best fit the researcher's concept of spatial-temporal pattern development. Each item on the PF&C was projected for one minute. The three groups were separated on days 2-4 of the study. After 10 minutes of treatment, each group was tested on the Paper Folding and Cutting. As a result of the treatments, the Mozart group attained the highest scores on days 3-5. The mixed group scores were significantly below the other groups. The model predicted spatial-temporal patterns are enhanced by the Mozart sonata. Although the effect lasted for a brief period of time, the public wanted to know more about the results and social-policy changes were made.

Examiners of the Mozart effect believe the theory should be supported by empirical evidence, and educators should be cautious when using this theory as the basis for an educational practice (Waterhouse, 2006). The researcher believes educators should consider alternative explanations from neuroscientific and psychological literatures. Waterhouse states the Mozart effect has since proven difficult to replicate and cites a meta-analysis of 16 Mozart effect studies that found no change in the IQ or spatial reasoning ability. Another study cited was one by McKelvic and Low (2002) where there was no improvement in the spatial IQ scores of children. The participants listened to a Mozart sonata, popular children's

songs or relaxing music. The results showed no differences between conditions. The findings did reveal the children preferred listening to the popular music (Rauscher and Hinton, 2005).

Researchers have criticized the Mozart effect as: (a) being limited to the number of participants in the study; (b) having all participants to be psychology majors; and (c) measuring only spatial reasoning, only one-third of the Stanford-Binet IQ Test. Those in the scientific field who showed an interest in the Mozart effect was random in comparison to the interest found the media, policy makers, and the general public (Waterhouse, 2006). Many researchers have failed to duplicate the Mozart effect, but the Mozart effect has been duplicated in independent laboratories (Schellenberg & Hallam, 2005). This shows that the effect was real but only momentary. It has been suggested that the Mozart effect may be an example of the arousal and mood hypothesis. The arousal and mood hypothesis says there is a link between listening to Mozart and spatial-temporal abilities to be just one example of a pleasant stimulus that can improve a perceiver's emotional state, which can, in turn affect cognitive performance. It has been posed the link between music and cognition is mediated by changes in the listeners' arousal levels and moods.

Researchers found augmentation in spatial-temporal abilities has been observed after participants listened to music other than Mozart (Schellenberg & Hallam, 2005). The music included music by Schubert, Bach, and Yanni. In each instance, the comparison condition consisted of simply listening to nothing, or to relaxation instructions (sometimes in groups) which would be much less stimulating than listening to music. When the comparison condition involved listening to a nonmusical auditory stimulus of similar interest e.g. narrated story, the music advantage disappeared. It was found that the participants performed better after hearing the stimulus (music or story) they preferred. This is another study where

Waterhouse (2006) failed to cite. The findings demonstrated positive benefits of music listening on cognitive abilities when the music was enjoyed by the listener (Schellenberg & Hallam 2005).

There have been numerous studies analyzing the effect of classical music on spatial-temporal ability (Hui, 2004). Some investigations have been successful in reproducing the Mozart effect (Wilson & Brown, 1997; Hetland, 2000). Other studies have been unable to replicate the Mozart effect (Steele, Bass, and Crook, 1999a; McCutcheon, 2000). The majority of the studies involved college undergraduates as participants. A three year study was conducted in 2003 by Ruvinsheteyn and Parrino on the effects of baroque music played during a mathematics class to assist students enjoy class and retain more information (Orel, 2006). Two groups of college age students were used in the study. The instructor played baroque style music in the background during the first month of the semester. The second group was not given the treatment of music during the math class. Both groups were taught by the same instructor. Participants were surveyed after the first month. The survey showed students who listened to music were more likely to enjoy class (86 percent vs. 76 percent) and less likely to find mathematics challenging (33 percent vs. 46 percent). Results also indicated an improvement in student grades (Orel, 2006). Forty-one preschool children (16 females and 25 males) at a childcare center volunteered to participate in a study to determine the “Mozart effect” on preschool children (Hui, 2006). Participants were randomly assigned to six groups. Each group received three forms of inquiries in a unique order. One investigation was for participants to listen to the first movement of Mozart’s Piano Concerto in A Major (K488), the second was to listen to three pieces of typical popular children’s music and the third was silence. Each intervention lasted for 8 minutes and 20 seconds.

Participants attempted a series of pencil-and-paper maze tests which were based upon a recently expired version of the Wechesler Preschool and Primary Scales of Intelligence. At the end of the three day treatment, there were no statistically significant differences among the three interventions (Hui, 2006).

In another study on the effect of classical music on children's cognitive content of drawing, the group consisted of eighty-four 6-year-old children from a private kindergarten in Turkey (Gur, 2009). The students were from higher socioeconomic status. Students were divided into three groups. Group 1 was applied to free drawing with listening to classical program music. Group 2 was applied to free drawing program and group 3 was the control group. Turkish Form of Silver Drawing Test (Cognitive Corbent) was used as pretest and posttest for all groups. The program lasted for four weeks with each group receiving 30 minute sessions three times a week. The effects were analyzed. The results for the Silver Drawing Test (total) indicated there were significant differences between the groups. There is a positive effect of classical music on cognitive content drawing of the drawings of six year-old children from Turkey (Gur, 2009).

An investigation in 2001 examined the effect of background classical music on mathematics problem solving skills of third grade students in a computer lab setting (Fioranelli, 2001). Classical music was used as background music during the treatment groups computer lab sessions. The control group received no music. At the end of the study, Fioranelli found no significant differences between the mathematics problem solving skills of third grade students who listened to classical music and those who did not (Fioranelli, 2001). In a similar study it was found baroque music played when children are concentrating, increased memory by up to 26% (Van der Linde, 1999).

Cognitive neuroscientist suggests that much of what is learned in a classroom depends on a combination of procedural skill memory and declarative content memory (Waterhouse, 2006). Procedural skill memory is used for sequences of behaviors. An example, of procedural skill memory is knowing how to write words. Declarative content memory is used for knowledge. An example, of declarative content memory is knowing why bacteria are important. Researches in cognitive neuroscience have discovered six processes that influence the establishment of long-term procedural and declarative memory. These procedures are: (a) *repetition* of the procedure or information; (b) *excitation* at the time of learning; (c) association of *reward* with the material to be learned; (d) *eating* carbohydrates before or during learning; (e) sufficient *sleep* after a learning session; and (f) *avoidance of drugs of abuse and alcohol*. Researchers have also found evidence to suggest that significant cognitive skill improvement can take place without the memory enhancement processes of repetition of that skill or excitement associated with the skill activity (Yi & Chun, 2005).

Research has shown listening to music, especially to music one enjoys, is more arousing than sitting in silence and more likely to evoke a positive mood, but the associations between music lessons and intellectual development is different (Schellenberg, 2004). Musical training leads to improved performance on a wide variety of task involving music perception and cognition. Schellenberg (2004) reported studying music helps one to become a more experienced music listener. Schellenberg suggested that training in music is associated with specific sub areas of intellectual abilities, such as mathematical, spatial-temporal, or verbal abilities. Two correlational studies were used to examine the associations between music lessons and intellectual functioning. The studies are unique for at least four reasons: (a) the principal predictor variable was duration of musical involvement; it varied widely, (b)

potential confounding variables such as family income and parents' education were measured and held constant by statistical means, (c) the criterion variables included entire standardized IQ tests, which provide the most direct tests of whether music lessons are associated with intelligence, and (d) measures of academic achievement and social adjustment were included to examine whether observed associations between musical training and intellectual ability extend to applied measures but not to nonintellectual domains (Schellenberg, 2004).

A later study the participants ranged in age from 16 to 25 years old. This study examined the possibility of a long-term association between playing music and intellectual abilities even after music lessons had ended. Family background (family income, and parents' education) were taken into account. Both sample groups was diverse ethnically and economically. Both studies showed evidence that musical involvement had stronger associations with some aspects of cognitive ability (mathematical, spatial-temporal, verbal) than with others. These results indicate that formal exposure to music in childhood is associated positively with IQ and with academic performance and that such association are small but general and long lasting (Schellenberg, 2005).

### **The Effect of Music on Cognition and Learning**

Neuroscientist have found certain areas of the brain respond only to music while other areas of the brain are devoted to initiating and coordinating movement from intense running to the swaying of arms (Sousa, 2006). Researchers have also found clues as to how the mental and physical activities required for the arts are necessary for brain function. These cerebral gifts are the result of hundreds of years of interaction between humans and their environment, and the continued existence of these talents must link in some way to our

survival. In today's cultures, the arts are rarely thought of as survival skills but rather frills. Performing music can make distinctive demands on the nervous system involving the auditory system, the motor system and the brain regions involved in the sensorimotor integration as well as the connections between these areas (Azizi, 2009). Neuroimaging studies have demonstrated significant overlap between cortical regions that language and music activate. These neuroimages have shown listening, playing and practicing music activate selected ensembles of neurons and their connected regions repetitively in the manner of acquisition of learning and formation of memory.

Researchers have found skills learned through the study of music are exhibited in students through study skills, communication skills, and cognitive skills. A research team from the Stanford University School of Medicine (2007) performed a study of the brain's function. The main goal of the study was to see how the brain sorts out events. The study also discovered how musical techniques used by composers 200 years ago help the brain organize incoming information (Science Daily). According to Berger (2007), "The study suggests one possible adaptive evolutionary purpose of music. Music engages the brain over a period of time, and the process of listening to music could be a way that the brain sharpens its' ability to anticipate events and sustain attention." (p.2)

In the early years of a young child's life, neural connections are being made at a rapid rate. Singing, drawing and dancing are natural forms of art for young children (Sousa, 2006). These activities engage all the senses and wire the brain for accomplished learning. Sousa also believes the arts are not only expressive and affective, but they are also intensely cognitive. The arts assist in developing essential thinking tools such as (a) pattern recognition and development; (b) mental representations of what is observed or imagined; (c) symbolic,

allegorical and metaphorical representation; (d) careful observation of the world; and (e) abstraction from complexity.

Investigators in the field of music believe the ability to perceive and enjoy music is an inborn human trait (Sousa, 2006). The scientific reasoning for this belief is supported by the discovery that the brain has specialized areas which respond only to music and these areas provoke emotional responses. Brain scans show how the neural areas are stimulated based on the type of music that is played. Melodic tunes stimulate the areas that suggest pleasant feelings while dissonant sounds activate other areas in which produce unpleasant emotions. Studies have shown (a) listening to certain music stimulates parts of the brain that is responsible for memory recall and visual memory; and (b) listening to background music enhances the efficiency of those working with their hands. According to Sousa, studies have also shown how background music used in the classroom helps students stay focused while completing specific learning tasks. Over stimulating music is more of a distraction and interferes with cognitive performance.

Classical music affects the brain's organizational abilities through melody and rhythm which increases the serotonin level which eases the tension level (Maglione, 2006). When a person listens to enjoyable music, the brain releases a certain amount of serotonin which arouses and increases pleasurable feelings. By creating a sequence of different emotions, certain types of music can give a different basis to thoughts, words, and actions. Music has the ability to intensify a person's happiness, alleviate sadness, encourage the spirit, and soothe the restless spirit. The effect of music on the listener will last for as long as you want it to last.

Music has the ability to improve spatial IQ, by increasing the short and long-term memory. Classical music has a positive effect on children, by increasing cognitive skills (Maglione, 2006). Listening to classical music can enhance the brain's ability resulting in more brain development. Music from the baroque period with a 60 beats per minute beat pattern affects the amplitude and frequency of brain waves (Maglione, 2006). Music also has the ability to affect breathing rate and electrical resistance of the skin as a result of the hormone system. Pupils begin to dilate, and there is an increase in blood pressure and heart rate. Thus, the brain begins to concentrate more easily and assimilate more information in less time. This happens because music stimulates the left and right hemisphere of the brain at the same time. Research has suggested the brain response differently in how it process melody and rhythm (Cronin, Gaab, Alsop, Winner, Schlaug, 2004). The right hemisphere of the brain is largely involved in melody processing, and the left hemisphere is largely involved in rhythm processing. As a result, this activates the two lobes boosting learning and information intake, resulting in amplifying cognitive skills.

Melody and rhythm are the two important components of music that work differently. Melody heightens creative reasoning, while rhythm orchestrates these emotions with the vital patterns. Our physical rhythm patterns include the heart-beat, walking, jumping, speaking, chewing, and breathing. Musical rhythm increases the serotonin level produced in the brain, resulting in embellishing critical thinking skills (Maglione, 2006).

Classical music affects the brain through rhythm and melody. These components work together along with the brain. First, rhythm works with the body's vital rhythms and produces the appropriate mood for increase cognitive and creative abilities. Secondly, melody, along with thought resolution, gives a person the ability to tackle new challenges,

and provide the ability to make the correct choice among possible solutions. Music from the baroque and classical periods allows the brain to release more serotonin allowing the body and mind to perform better when listening to these logical compositions (Maglione, 2006).

The influential effects of music are inherent and those who are beneficiaries of music continuously appear to perform better in life. Some of the greatest men in history were musicians or were influenced by music. Einstein was a violinist who used music to help him find solutions to complex equations and problems through the use of improvisation on the violin. As a child Einstein did extremely poor in school. It was suggested to his parents to withdraw him from school because it was a waste of resources for the school to invest time and energy in his education. Instead his parents purchased a violin and Albert Einstein became good at the violin. Einstein attributes music as the reason he was so smart (Dowd, 2008). Thomas Jefferson used music to help in finding the correct words to use in writing a passage in the Declaration of Independence. Many great men of history were in some way dedicated to music and music is what made the difference (Maglione, 2006).

### **The Importance of Music Integration**

There has been an interest in interdisciplinary or integrated curriculum by educators, scholars and administrators for the past two decades as part of the educational reform movement in the United States (Youm, 2007). The term interdisciplinary has been defined as a knowledge view and curriculum approach that purposely applies methodology and language from more than one discipline to study a central theme, issue, problem, topic, or experience. In this study the term interdisciplinary curriculum and curriculum integration will be used interchangeably.

There are three theoretical bases for interdisciplinary curriculum. The first is based on the progressive education philosophy. This philosophy is based on a child-centered approach that emphasizes creativity, activities, naturalistic learning, real world outcomes, and, experience. Progressive philosophers such as John Dewey and Jean-Jacques Rousseau believed to engage the child fully, learning in school should be connected to the real world and school activities appeal to the child's interest. The second is the constructivist theory which proposes each student to construct his or her own reality in the learning process and that students may learn best when they construct their own knowledge, and third is the relationship between integrating curriculum and cognition which is supported by recent brain research in neuropsychology (Youm, 2007). Interdisciplinary curriculum improves higher-level thinking skills, heightens the opportunity for transfer of learning, heightens a sense of initiative and autonomy and improves students' motivation to learn. For all of these reasons, integrated curriculum is considered to be an important learning strategy for music education (Sloan, 2009).

It has been suggested by educators that curriculum integration can be divided into two conceptual theories, student-centered and subject-centered (Brough, 2008). Thematic teaching allows for an in-depth understanding and is seldom confined to one particular learning area. Subject-centered approaches are more thematic. Student-centered approaches center on real-life problems, and where appropriate, allow for social interaction.

School reform initiatives have found the importance of curricular integration. This is especially true at the elementary school level. The mechanism for this increased popular and professional interest in the role of music and increased learning with other academic subjects is the Mozart Effect. This is a shift from emphasis being placed on cultural advantages of arts

education to emphasis on the cognitive and academic impact of learning. Researchers believe our brain is designed for music, and a music education has positive, measurable, and lasting academic and social benefits (Barry, 2006).

Arts integration has been define as a unit of study which focuses on the arts as a way of learning in other disciplines, involving creative, imaginative, experimental, and purposive and collaborative interaction while focusing on the integrity of the arts forms and life-centered issue, (Brown, 2007). Arts integration has been described to be like a weaving whereby the design may repeat a pattern or be a variable. Arts integration can be based on a theme or lessons to be designed through collaboration of classroom teacher and the specialist in the art. Researchers in the area of music integration believe music integration help foster learning in and through other disciplines by expanding awareness and comprehension.

Research has shown students who engage in music infused throughout the curriculum exhibits improved cognitive development (Appel, 2006). Music also enhances spatial and temporal reasoning which is used in mathematical reasoning. It increases positive self-concept, improves literacy and performance on Scholastic Aptitude Test (SAT) verbal and enhances English fluency for non-native speakers when combined with English as a Second Language curriculum.

School leaders in Europe and Asia have successfully infused the arts (especially music) into their educational institutions (Gullatt, 2008). Students in Japan receive instruction in choral and instrumental music starting with the elementary grades and continue through the secondary years. School leaders in the Netherlands have mandated both art and music be essential parts of the standard curriculum since 1968. These countries have been ranked at the top of an international list of seventeen countries for scientific achievement by secondary

schools. Educational leaders in these countries require arts programs be offered to all children. The supposition is that students can become proficient in the arts just as they can become proficient in other disciplines, consequently enhancing their life-long skills and creative ability.

There are various styles of integrating music with other core academic subjects. Integration is a two-way process where application and synthesis of ideas are promoted thus leading to a deeper understanding by fostering critical thinking skills and creativity. Research has shown a positive relationship between a music-integrated curriculum and improved school climate and academic achievement. Research has also shown a connection between an integrated curriculum and improved student attitudes, attendance, motivation, work habits and achievement test scores (Barry, 2008).

There are a variety of pedagogical approaches for arts integration at the elementary level. Bresler identified four integrative styles: subservient integration, co-equal integration, affective integration, and social integration.(Barry, 2008). The subservient style is used as an in service to other academic subjects. An example of subservient style is using a song about states to help students learn the names of the 50 states. The co-equal style integrates the arts as equal with other subjects. This integrative style requires one to have specific knowledge of the subject matter i.e. when studying composers you would include the study of the period in which the composer lived and his or her compositions to be included in a social studies lesson to place social events within an historical context. In the affective style of integration, the arts are used to change moods or as a creative outlet for children. An example of the affective style of integration is using music to help children to relax. The fourth integrative style is the social integration style. This is where the arts are used to support social functions

of the school. An example of integrative style is using the arts to increase attendance at Parent-Teacher Association (PTA) Meetings. Having children to perform at PTA Meetings will increase the number of parents coming to the school to see their children perform. Bresler supports the coequal-cognitive style of arts integration.

An example a coequal-cognitive style of integration focuses on the theme “Family”. The main focus of the unit is on social studies but language arts standards are also included. The classroom teacher also collaborates with the visual arts teacher to map out ideas for the unit. The classroom teacher begins with a general concept of a family and various different structures in various cultures. The visual arts teacher decides to spotlight two works of art. The first picture is by Carmen Lomas Garza, *Barbacoa para Cumpleanos* (1993). The artist is Mexican American. The second painting depicts a celebration of family life. The painting is by Romare Bearden called “*The Block II*” (1972). The painting depicts a New York City apartment building with various “families”, as viewed from windows. The classroom teacher has students to write journal entries about their families, and reading books about each artist. The visual arts teacher integrates a lesson on drawing people using correct proportions. The students also look at the two paintings and the students are asked to share what they see. Art history about the artist and paintings are also included in the lesson. As the unit continues students are engaged in visual arts activities linking them to social studies and language arts. Research discovered that students who participated in arts integration made significant gains in the areas of cooperative learning and adult and peer relationship development. Significant effects on personal learning showed gains in positive risk taking, as well as increased self-confidence, perseverance, and motivation.

Another researcher in the area of curriculum integration is Snyder (Barry, 2008). Snyder has three levels of integration. The first he calls connections. This form of integration is similar to Bresler's subservient style of integration. Materials or concepts are used to help teach or reinforce a concept in another curriculum area. The second form of curriculum integration is correlation. In correlation two or more fields are related through shared materials or topics. The last of Snyder's three levels' of integration is called integration. This style of integration is related to Breslers' coequal integration. In this form of integration, application and synthesis of ideas are strengthened. A profound understanding and critical thinking skills are stimulated by students. Snyder believes an authentic integration is when the integrity of each discipline is maintained (Barry, 2008).

Educators have also reported a cross disciplinary approach used to connecting music with other disciplines (Burrack and McKenzie, 2005). This approach attempts to motivate students to increase their understanding by working within each discipline to focus on concepts the disciplines share. One of the requirements of the National Standards for Music Education encourages cross-disciplinary instruction. This standard requires students to have an understanding of relationships between music, the other arts and disciplines outside the arts. By using cross-disciplinary instruction students are able to meet this standard. It is important when using cross disciplinary instruction to identify connections focused on common learning process so each discipline can maintain its own integrity.

For example, a cross-disciplinary unit (2006) was used in a band class to connect history, literature and instrumental music. The students studied ancient Greece through the composition "Epinicion" by John Paulsons. Epinicion was an ancient Greek tradition, a choral celebration of a victory. Students collected historical information and drawings which

was presented to the band. The information was used to support band members understanding behind the piece and the reasons for the aleatoric form of the piece. The band students were required to write an essay relating to the musical performance of “Epincion” to the historical background information. The essays were accepted as extra credit in language arts class. The performance of the aleatoric piece by the band assisted students to demonstrate informed judgment that was achieved through interdisciplinary connections. The use of the cross-disciplinary instruction supported intellectual curiosity regarding the structural, contextual, and expressive dimensions of the music composition. Connecting music and literature can be demonstrated through patterns of elements (pitch, duration, loudness and timbre), word sentences and paragraphs can be compared with musical motifs, phrases, and themes (Burrack & McKenzie, 2005).

Music can be used in an interdisciplinary way to teach music and math. They also believe integrating music and math can be used to assist children in achieving state and national standards (Edelson and Johnson, 2004). The use of music in the math curriculum can enhance a child’s understanding of complex math through the use of songs. When music is used in the curriculum it can help a child to be free of undue stress. The use of music in the math curriculum can, for example, assist children in understanding patterns. In music, patterns can be found in repeated melodies, refrains or rhythms in a song. Patterns in math can be found when children learn about alternating odd and even numbers. Music can also be used to support a child in learning cardinal and ordinal numbers through a song. Active, experimental learning experiences are needed for children to develop complex thinking skills and problem solving.

Continuation schools in the United States were developed to enable students to earn a high school diploma while they work fulltime in order to support themselves or to support a family (Stuht and Gates, 2007). These schools were traditionally to house poor teachers, narrowed curriculum and an unwelcoming culture. Through the years continuation schools became schools for those students who did not succeed in a traditional school setting. Students today who attend continuation schools are in need of innovative teachers, a broad curriculum that offers a expansive curriculum for different learning modalities and a welcoming culture. In other words, a continuation school curriculum should be arts-based. There is much evidence showing that a hand on arts-based curriculum should be designed after the works of Jerome Bruner (1994), Howard Gardner (2001) and Lev Vygotsky (2006) to increase academic achievement especially in the area of literacy and numeracy as reflected in standardized test scores. Jerome Bruner learning theory says children are able to construct new ideas based on their previous knowledge. He also says that different forms of representation of a single concept may be appropriate for children at various ages and/or stages of learning than others (Rains, Kelly & Durham, 2008). Howard Gardner learning theory says people learn in a multitude of ways. He is known for his Theory of Multiple Intelligences (Jackson, Gaud, McDaniel, Brammer, 2009). There is much strength in receiving an arts-based education and the arts provide channels by which all students can learn along with improving academic achievement and standardized test scores (Dickinson, 2006).

Researchers through various studies have found schools who use arts integration into core curriculum have the following results (a) students have a greater emotional investment in their classes; (b) students work more diligently and learn from each other; cooperative

learning groups turn classroom into learning communities; (c) parents become more involved; (d) teachers collaborate more; (e) art and music teachers become the center of multi-class projects; (f) learning in all subjects becomes more attainable through the arts; (g) curriculum becomes more authentic, (h) hands-on and project-based learning; (i) assessment is more thoughtful and varied; and (j) teacher' expectations for their students rise (Sousa, 2006). These are numerous reasons for using baroque and classical music in the elementary mathematics curriculum to increase student achievement. This will be very beneficial to students and stakeholders in the area of education.

### **Why Benchmark Assessments**

Annual state testing is required under the No Child Left Behind Act of 2001 (NCLB, 2002). Educators believe there is a need to quickly identify students who are falling behind on these test and as a result, many school districts in the country are requiring schools to administer quarterly benchmark assessments to measure student's academic progress and provide teachers with data on how to adjust instruction (Olson, 2005). Benchmark assessments are one component of a balanced assessment system designed to provide the continuous data needed by teachers and administrators to serve districts, schools and classroom improvement needs (Herman, Osmundon, & Dietel, 2010). Benchmark assessments many times serve four interrelated but diverse purposes: (a) communicate expectations, (b) plan curriculum and instruction, (c) monitor and evaluate instructional and/or program effectiveness, and (d) predict future performance (Herman & Baker, 2005). The assessments are administered in the areas of reading and mathematics and given three to four times a year (Henderson, Petrosino, Guckenburg, Hamilton, 2007). Test results are

reported by student categories, such as race, income, disability and English proficiency. Data is reported at the district, school, classroom and student levels (Olson, 2005). More and more school districts are using benchmark assessments in preparing for the end-of-year state tests (Olson, 2005). Benchmark test are aligned with state standards and fill a gap left by annual state tests and as a result, districts and schools can use the data to evaluate patterns and trends in school-by-school or teacher performance (Herman & Baker, 2005).

There is little empirical evidence to determine whether and to what extent aligned benchmark assessments affect student outcome. A study (2007) was performed using a quasi-experimental design to examine whether schools using quarterly benchmark test in middle-school mathematics increased student achievement (Henderson, Petrosino, Guckenburg, Hamilton). The study examined a Massachusetts pilot program using high-poverty middle schools in need of making Annual Yearly Progress. The goal of the study was to determine whether there was any immediate, discernable effect on eighth-grade mathematics achievement from using bench mark assessments in middle schools receiving the Comprehensive School Reform Grants. The study looked at 44 comparison schools and 22 program schools. At the end of one year, there was no immediate statistically significant difference between the program and comparison schools. The findings reflected limitations in the data rather than the ineffectiveness of benchmark quarterly assessments (Henderson, et al., 2007).

As a result of the first study receiving such high visibility among regional policymakers and the Massachusetts Department of Education, the research team was asked to include a second year of post-implementation data to determine whether benchmark assessments affected math achievement (Henderson et al, 2007). The research team used the same quasi-

experimental methodology, and the same comparison schools which were identified through a covariate matching procedure. The covariate matching procedure produced two groups of schools linked on prior math performance, and socio-demographic characteristics. The team also used the same descriptive and interrupted time-series methods used in the initial report to analyze the data. Each analysis included a second year of post-intervention data to identify any departure from the trend.

The findings showed a significant increase in the mean scaled grade 8 mathematics scores for program schools. Both scaled mean scores increased slightly for both groups. The program schools had slightly higher mean scaled scores. Despite the slight gain for scaled scores, researchers found it was not attributed to the benchmark assessment. The reason may be due to data limitations. With only two years of post-implementation data, it may still be too early to observe any effect from the intervention. A third year of post-implementation data may be needed to enable researchers to better assess the impact (Henderson et al, 2008).

### **Summary of the Literature Review**

For the last three decades research has shown there is an achievement gap in mathematics (Flores, 2007). This achievement gap is demonstrated on national as well as state test. Studies have revealed various reasons for the achievement gap in mathematics. One factor that affects student achievement in mathematics is the socioeconomic status of students (Lui & Lu, 2008). A child's' socioeconomic status can be affected by a lack of parent availability due to living in a single parent home, and the fact that some ethnic groups change schools often (Evans, 2005). Other factors that can influence student academic achievement are the lack of family income or the psychological-stress experienced by parents who may be

unemployed or on welfare (Kaushal & Nepomnyaschy, 2009). Another factor that can influence a student academic performance in mathematics is gender stereotyping (Forgasz et al, 2009). Mathematics has been viewed as a male dominant subject. Women were viewed as being incapable of the intellectual demands needed to be successful in mathematics. Not only have women been stereotyped as related to mathematics but other diverse groups to include ethnic minorities and low socioeconomic and social status groups (Gherasim & Popa, 2009).

The third factor that can affect the academic achievement in mathematics is the lack of highly qualified teachers working in high poverty schools (Ingersoll, 2004). These schools have difficulty in recruiting and keeping experience teachers. As a result, schools in high poverty neighborhoods experience difficulty in assisting these schools becoming high-performing schools.

Out of all the factors that can affect student academic achievement, Americans are more concerned with the Black/White achievement gap (Associated Press, 2009). This gap has been a major catalyst for the creation of federal education policies (Clotfelter et al, 2009). One of the most recent reports by the National Assessment of Educational Progress (2009) stated there are improvements in math and reading scores of fourth and eighth grade students, but African-American students are continuing to lag behind their white classmates. It is believed that this achievement gap is affected by several factors to include socioeconomic differences and the standard of quality education. According to the Center for Comprehensive School Reform and Improvement (2005), schools are in need of including more scientific-based research methods in order to improve student achievement. Music has been proven to be an effective tool in improving student achievement.

There is an increase amount of evidence that have proven the positive effect of the use on music in the classroom (Weiss, 2004). According to the Music Educators National Conference (MENC), music can provide effective learning opportunities to students by producing increased academic performance, lessening absenteeism and better skill-building. Music can also instill critical analysis skills, the ability to deal with difficulty, solve problems, persevere, and instill a sense of excellence (MENC, 2007). There are numerous statistical data which supports music education as increasing a child's intelligence (Schellenberg, 2004). It has been noted that music has the ability to improve spatial IQ, by increasing the short and long-term memory (Maglione, 2006).

As a result of all the research that has shown music as having a positive effect on student achievement, studies have indicated students who engage in music infused throughout the curriculum exhibits improved cognitive development (Appel, 2006). Schools in Europe, Japan, the Netherlands and Asia have successfully infused music into their educational institutions which aided these countries in ranking at the top of an international list of seventeen countries for scientific achievement (Gullatt, 2008). Many of these countries have included music instilled in the curriculum since 1968.

There are a variety of pedagogical approaches that can be used to integrate music with other core academic subjects where application and synthesis of ideas help to promote a deeper understanding of the subjects by fostering critical thinking skills and creativity (Barry, 2008). An interdisciplinary approach can be used to teach music and math (Edelson and Johnson, 2004). Music can be used in the math curriculum to enhance a child's understanding of complex math through the use of songs. Music can also be used to free a child of undue stress and assist in understanding patterns.

In using scientific-based research to increase school improvement methods, scientifically based methods should be used when assessing student achievement. School districts across the country are using quarterly benchmark assessments to measure a student's academic progress. Benchmark assessments are just one component of a balanced assessment system designed to provide continuous data needed by teachers and administrators to serve districts, schools and classroom improvements (Herman et al, 2010). There is little empirical evidence to determine whether and to what extent aligned benchmark affect student outcome. Yet there has been enough data available for school boards and policy makers to justify the increase use of quarterly benchmark assessments (Henderson et al, 2007). More research is needed to investigate the effect of baroque and classical music along with music integration into the third and fifth grade mathematics curriculum.

### **Chapter 3: Research Method**

The problem addressed in this study was the need to increase student achievement in mathematics. Traditional ways of teaching (i.e., working from textbook, designing quizzes, and assigning seatwork) are sedentary techniques that are ineffective in teaching students (Baine and Slutsky, 2009). The No Child Left Behind (NCLB) Act established guidelines for states to follow to measure how well students acquire skills and knowledge (NCLB, 2001).

Approximately 5 to 7% of school-aged children have difficulty in math achievement (Proctor, Floyd and Shaver, 2005). This may mean traditional ways of teaching mathematics are ineffective (Baine & Slutsky, 2009). This presents a challenge for society that demands at least minimal math proficiency (Proctor et al., 2005).

The achievement gap has been defined as the difference between the average score for Black students and the average score for White students (National Assessment of Educational Progress, 2007). The achievement level of mathematic students in the United States, fall far behind those of other developed nations. Students who are falling behind come predominantly from high-poverty and high-minority areas. Research has shown national and international comparisons of student achievement indicate that it is between fourth and eighth grade when students fall rapidly behind desired levels of achievement (Balfanz and Bynes, 2006).

The 2007 National Assessment of Educational Progress (NAEP) report in mathematics showed the average scale score for fourth-grade students in Georgia was 235. This score was lower than the national average score of 239. Black students had an average score that was lower than that of white students by 24 points. Students who were eligible for free/reduced school lunch , an indicator of poverty, had an average math score 23 points lower than that of

students who were not eligible for free/reduced school lunch. To address the achievement gap, there is a need to design a curriculum which allows all students to be successful in mathematics.

The purpose of this quantitative study was to examine the impact of baroque and classical music on student achievement in elementary mathematics. The sample group consisted of 51 third grade students and 51 fifth grade students. Students were divided into two groups: the experimental group and the control group. The experimental group consisted of 27 third grade students and 24 fifth grade students. The control group consisted of 24 third grade students and 27 fifth grade students. A quantitative pretest-posttest control group design was utilized.

The independent variables of baroque and classical music were played in the math class of the experimental group. Students in the experimental group received math integrated into the music curriculum. The dependent variable was the quarterly benchmark assessment. Descriptive statistics of this study will be based on the results of the quarterly benchmark assessments in mathematics for the school year of 2010-2011. There was a comparison of how participants performed based on gender, race, and students' socioeconomic status. The setting for this study was a large suburban school district in Southeast Georgia. A quantitative pretest-posttest design was utilized to determine if listening to baroque and classical music in the math class, along with math integration into the music curriculum, increase student achievement in math.

In Chapter 3, the research method and participants are described, along with the sources of data for the study. Operational definitions of variables are provided, as are the methods for data collection, processing, and analysis. Methodological assumptions, limitations, and

delimitations for the study are discussed, and ethical assurances are offered. The following research questions and hypotheses guided the study:

1. What effect, if any, does baroque and classical music have on student achievement in mathematics when integrated into the third and fifth grade math curriculum?

**H1o:** There will be no statistically significant difference in student achievement when baroque and classical music has been integrated into the third and fifth grade math curriculum.

**H1a:** There will be a statistically significant difference in student achievement when baroque and classical music has been integrated into the third and fifth grade math curriculum.

2. What will be the effect of baroque and classical music on student achievement based on race, when integrated into the third and fifth grade math curriculum?

**H2o:** There will be no statistically significant difference in student achievement, based on race, when baroque and classical music is integrated into the third and fifth grade math curriculum.

**H2a:** There will be statistically significant difference in student achievement based on race, when baroque and classical music is integrated into the third and fifth grade math curriculum.

3. What effect, if any, does baroque and classical music have on achievement of low-income students in a third and fifth grade math classroom?

**H3o:** There will be no statistically significant difference in student achievement of students who receive free/reduced lunch, when music is integrated into the third and fifth grade math curriculum.

**H3a:** There will be statistically significant difference in student achievement of students who receive free/reduced lunch, when music is integrated into the third and fifth grade math curriculum.

### **Research Method and Design**

A quantitative, experimental, pretest-posttest design method was used to investigate the impact of baroque and classical music on student achievement in elementary math. The dependent variable was the quarterly benchmark assessment in math. This assessment is used to measure student achievement. The independent variable of baroque and classical music was played during math instruction along with general music classes that incorporated math. There were two groups of participants for each grade level. The experimental group consisted of 51 students of which received the intervention of baroque and classical music during math instruction and in general music classes they received math integrated into music. The control group consisted of 51 students, and did not receive treatment. A two-tailed t-test was used to provide an accurate estimation of the statistical significance of the mean gain scores. To test a null hypothesis with no statistical significant difference of two mean scores of independent groups (two-tailed t-test), the alpha level probability was set at  $p = 0.05$ , the beta level probability is 0.50 with a power of .70. This will result in a medium effect size (Cohen, 1988). After the results from the ANCOVA were gathered, a post-hoc test was run to determine which groups differ significantly from another, and will determine the meaning of any association among the results.

### **Participants**

The sample group consists of 51 third grade students and 51 fifth grade students in a school located in Southeast Georgia. The students were randomly assigned and placed in an

experimental and control group. The experimental and control groups consisted of third and fifth grade students.

Recent demographics information from the participating school has 396 students in grades Pre-K through Fifth grade. The student ethnicity distribution is (38%) White, (55%) Black, (3%) Multiracial, (2%) Hispanic and (2%) Asian. 50% of the student population receives free/reduced lunch (an indicator of poverty). There are 60 third grade students and 62 fifth grade students. The student population is comprised of students from all across the school district. Students must have a grade point average of 80 or higher and good behavior to remain in the school. If students fail to meet the requirements, they are required to return to their neighborhood school. Students in the third and fifth grades must meet or exceed state standard to be promoted to the next grade level in mathematics and language arts (Georgia Department of Education, 2009). The quarterly benchmark assessment in math used by the school district was the pretest. It allows teachers to focus on weaknesses and strengths of students in the areas of math to prepare for the state mandated test that will be given in the spring of the year. The experimental group will receive music as an intervention for five days a week for fifty minutes a day. The researcher incorporated math into the music curriculum. The experimental group listened to baroque and classical music in the classroom as the classroom teachers instruct students in mathematics. This treatment was administered for 16 weeks before receiving the quarterly benchmark assessment in math as the posttest.

Students in the control group did not receive the treatment. Students in this study were randomly heterogeneously grouped by the administration. Participants were gifted students, inclusion students, and regular education students. The age ranges of the students are 8-12. To protect the privacy of each participant, pseudonyms will be used.

## Materials/Instruments

This study was conducted using a pretest-posttest control group design to investigate the use of music in the mathematics curriculum of third and fifth grade students to increase student achievement. The quarterly benchmark assessment in math was used to measure students' progress (Olson, 2005). The benchmark assessment was aligned with state standards which provide teachers with the necessary data on how to adjust instruction. The assessment is given three times during the school year. Data is usually reported by the following categories race, income, disability and English proficiency (Olson, 2005). Individual reports at the district, school, classroom and student levels are given. For this study, the researcher looked at data based on student performance, race, and those students who receive free/reduced lunch.

Students listened to a CD of baroque and classical music which was played as students were receiving instructions in mathematical concepts in the mathematics classroom. Baroque music was used to help the students relax during class instruction, and classical music was used to increase short and long-term memory (Maglione, 2006). The researcher included math in the music curriculum by teaching students to (a) add, subtract, and multiply musical notes, (b) find the missing addend using musical notes, (c)-combine music history and surveys to graph data, (d) combine the process of composition in music and the concept of probability, (e) understand musical notes and how they relate to fractions, (f) use time signatures to teach fractions, (g) reinforce math vocabulary, and (h) listening to baroque and classical music. At the end of 16 weeks the classroom teacher administered the posttest which was the quarterly benchmark assessment in math. A two-tailed independent t-test was used to determine whether a statistical significance exists between two means.

## **Operational Definition of Variables**

The main variables (dependent and independent) are:

**Baroque Music** is a style of European classical music extending from 1600-1750. Baroque music will be included on the CD that will be played in the classroom for students by the classroom teacher. The music will be used for relaxation as students are learning mathematical concepts.

**Classical Music** is a western musical style referring to music written between 1750-1820. The CD will also include classical music played when teachers are introducing new math concepts and when participants are working independently. The CD used in class will be the same music for each group. The classical music will be used to help in increasing short and long term memory as students are learning mathematical concepts.

**Benchmark quarterly assessment** will be used to measure student progress in math. The assessment is based on state standards that are required for each grade level to meet or exceed requirements on the state mandated test. The first assessment of the year will be used as the pretest. At the end of 18 weeks, students will receive a benchmark assessment in math as a posttest.

**National School Lunch Program Applications** information received from the lunchroom manager of those participants who receive free/reduced lunch. The information is based on the income of student's parent or guardian. The information was used to identify qualified students who are participating in the study.

## **Data Collection, Processing and Analysis**

Data collection began upon approval from Northcentral Institutional Review Board. Approval from the local school district was also required before data was collected. A letter of consent was sent to parents asking for their approval of their child's' participation in the study. Students in this study are randomly heterogeneously grouped by the administration. Participants were gifted students, inclusion students, and regular education students. The control and experimental group will receive the same amount of time in math and in the general music class.

The pretest was the quarterly benchmark assessment in math of all third and fifth grade students participating in the study for the school year 2010-2011. This pretest was used as a baseline for both groups. The experimental group received the treatment of listening to baroque and classical music. Third and fifth grade classroom teachers agreed to play the CD containing baroque and classical music during math instruction. The music was played for 50 minutes five days a week. The treatment was given for 16 weeks. The music teacher integrated math into the music curriculum by teaching students to (a) add, subtract and multiply musical notes, (b) find the missing addend using musical notes, (c) combine music history and surveys to graph data, (d) combine the process of composition in music and the concept of probability, (e) understand musical notes and how they relate to fractions, (f) use time signatures to teach fractions, (g) reinforce math vocabulary and listening to baroque and classical music. Students received individual as well as small group projects that integrate music and math. Individual and small group projects allow students to engage in making connections across the curriculum and provide classroom situations and activities to promote individual learning (Gullatt, 2008; Powell and Kalina, 2009). The data of all pre and post

tests was collected by the researcher. The posttest was the benchmark assessment in math which will be administered by classroom teachers.

In this study, the use of statistical data was used to represent academic achievement. The benchmark assessment measured student progress in math. A two-tailed independent t-test was used to determine whether a statistical significance exist between the two means. The researcher also determined if any observed differences between groups is statistically significant using Analysis of Covariance (ANCOVA). ANCOVA controls for pretest values and uses the posttest as the dependent variable. Descriptive data was used to identify race, gender and students who receive free/reduce lunch. Tables, figures and graphs are used in presenting data. Statistical significance was established at .05 level of probability to ensure all findings are statistically significant and relevant for use in the research findings.

### **Methodological Assumptions, Limitations, and Delimitations**

The following assumptions are made concerning the investigation: (a) the design chosen for this study is appropriate and will allow the researcher to calculate data such as the mean scores of the pretest and posttest along with testing for statistical significance of observed differences in the mean scores of the experimental and control groups; (b) before conducting the analysis, the researcher assumed that the analysis selected and the sizes of the sample were sufficient to detect significant differences if they existed in the population; and (c) the researcher's experience in correlating music with mathematics and the use of effective teaching strategies.

The research is limited by the study not being conducted for the entire school year. Next, increasing the length of the study can increase the validity and reliability of the research. Thirdly, the G\* Power post-hoc achieved power results for a two-tailed t-test and F-test

ANCOVA with a sample population of 51 result in a low statistical power. A low statistical power can decrease the reliability of the research. 85% of all third grade students and 82% of all fifth grade students comprised the sample population. The sample group is drawn from a stratified population. These students are chosen through a selection process to attend this school. Students are then randomly assigned by the administration. Lastly, it was not stressed to the teachers the importance of making sure baroque and classical music was play each day for the time required during the study.

The delimitation to the study is some teachers will not play music on a regular basis during instructional time for their students. A workshop was not provided for teachers on how to choose baroque and classical music used in the classroom to increase cognition and learning. All third and fifth grade students were not included in the study. The study was limited to one school in the school district.

### **Ethical Assurances**

The researcher must comply with the ethical principles found in The Belmont Report when research is performed involving human subjects (United States, 1979). The participants in this study are school-age children. Parent and students were informed of the study. The researcher answered all concerns about the study. Federal regulations consider children to be vulnerable subjects. Therefore, it is important to receive parental consent when using children in a research study (Hicks, 2008). Parents were given the opportunity to choose if they wanted their child to participate in the study. This study has ethical concerns even though it is considered to be low risk.

The researcher has designed a parent consent form for parents which states that they give consent or does not give consent for their child to participate in the study. The letter described the purpose of the research, steps that will be taken to obtain data, and how the researcher will keep all information confidential. Hence, all collected data were non-identifying in an effort to protect the identity of the participants.

Confidentiality and privacy are very important in this study. The participants test scores are protected by the Family Educational Rights and Privacy Act (FERPA) which is designed to protect the privacy of student's educational records. The school principal as well as district officials gave permission to the researcher to have access to student data. Students will be given pseudonyms, and no videos, pictures or discussions with other staff will be done during the study. All student information obtained for this study will be destroyed. Northcentral University Institutional Review Board (IRB) approval was obtained prior to any data collection.

### **Summary**

The purpose of the research study was to determine if listening to baroque and classical music during mathematics along with integration of math into the music curriculum increased student achievement. Chapter 3 elaborated on the research problem, purpose of the study, and hypotheses. The demographics of the participants, research materials/instruments, definitions of variables, data collection, processing and analysis methods, limitations, and ethical assurances were included. The findings from the study provided educators and researchers with information necessary for the implementation of effective scientifically-based mathematic curriculums in hopes of increasing student achievement in mathematics.

## CHAPTER 4: FINDINGS

The purpose of this quantitative study was to examine the impact of baroque and classical music on student achievement in elementary mathematics. Students were divided into two groups, the experimental group and control group. Data were collected using a quantitative pretest-posttest control group design. The sample group consisted of 51 third grade and 51 fifth grade students. All third and fifth grade students are required to meet or exceed standards on the state standardized test in mathematics. This study is intended to determine if listening to baroque and classical music in the math class, along with math integration into the music curriculum increases student achievement in math. This chapter presents the results of the analyses performed to address the research questions. The chapter ends with a summary of the key findings from this study. To conduct this investigation, the following research questions were examined, together with null ( $H_0$ ) and alternative ( $H_a$ ) hypotheses for each question.

1. What effect, if any, does baroque and classical music have on student achievement in mathematics when integrated into the third and fifth grade math curriculum?

**$H_{10}$ :** There will be no statistically significant difference in student achievement when baroque and classical music has been integrated into the third and fifth grade math curriculum.

**$H_{1a}$ :** There will be a statistically significant difference in student achievement when baroque and classical music has been integrated into the third and fifth grade math curriculum.

2. What will be the effect of baroque and classical music on student achievement based on race, when integrated into the third and fifth grade math curriculum?

**H2o:** There will be no statistically significant difference in student achievement, based on race when baroque and classical music is integrated into the third and fifth grade math curriculum.

**H2a:** There will be statistically significant difference in student achievement, based on race when baroque and classical music is integrated into the third and fifth grade math curriculum.

3. What effect, if any, does baroque and classical music have on student achievement of low-income students in a third and fifth grade math classroom?

**H3o:** There will be no statistically significant difference in student achievement of students who receive free/reduced lunch when music is integrated into the third and fifth grade math curriculum.

**H3a:** There will be statistically significant difference in student achievement of students who receive free/reduced lunch when music is integrated into the third and fifth grade math curriculum.

## Results

A two-tailed independent t-test was used to measure the means of the benchmark assessment scores. Table 1 is the basic information on the students that were involved in the study. Student information is listed in various categories to include gender, ethnicity, socioeconomic status based on lunch status of free/reduced and regular. The categories also include experimental and control group.

Table 1

*Descriptors of demographic variables*

	N	% of total population
Third Grade Students	51	50
Fifth Grade Students	51	50
Control Group	51	50
Experimental Group	51	50
Female	49	48
Male	53	52
Black	65	63.7
White	37	36.3
High Economic Status	49	48
Low Economic Status	53	52

The use of a two-tailed independent t-test was used to determine if there is a significant difference between the two mean scores. Table 2 is the pretest-posttest descriptive for the benchmark assessment scores for third and fifth grade students. Students were grouped by experimental and control group. The data was listed by group, N, pretest mean scores, posttest mean scores, mean tail sig, df, t-value and p-value. This information was used to verify the effectiveness of baroque and classical music on student achievement in third and fifth grade mathematics. Each group showed statistical significant difference.

Table 2

*Comparison of two-tailed independent t-test scores*

Group	N	Pretest Mean	Posttest Mean	Mean Sig	t-value	df	p-value
3-exp	27	42.56	65.89	23.33	6.01	26	.000
3-con	24	59.17	78.71	19.54	7.30	23	.001
5-exp	24	41.13	53.25	12.13	3.73	23	.001
5-con	27	56.11	70.44	14.33	6.11	26	.000

P = .000

F = 11.94

Table 3

*ANCOVA analysis by grade level*

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	8179.29	3	2726.43	11.94	.0000
Within Groups	22368.79	98	228.25		
Total	30548.08	101			

Following the analysis of the mean scores, the data were analyzed using Analysis of Covariance (ANCOVA). ANCOVA controls for pretest values and uses the posttest as the dependent variable. Pretest scores are used as a covariate. ANCOVA also reduces the error variance and eliminate systematic bias. The upper and lower bound 95% confidence interval data shows a statistical significance to be prevalent in each of the groups. When comparing experimental and control groups, the third and fifth grade control groups outperformed the experimental third and fifth grade groups. The lower bound 95% confidence interval mean

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for the third grade control group was 73.76. The lower bound 95% confidence interval mean for the third grade experimental group was 59.31. The upper bound 95% confidence interval mean was 83.65 for the third grade control group and the upper bound 95% confidence interval mean was 72.46 for the third grade control group. The lower bound 95% confidence interval mean of 64.34 for the fifth grade control group on the benchmark assessment, while the lower bound 95% confidence interval mean of 46.52 for the fifth grade experimental group on the benchmark assessment. The upper bound 95% confidence interval mean was 76.54, while the upper bound 95% confidence interval mean was 59.98 for the fifth grade experimental group (see Table 4).

Table 4

*ANCOVA analysis of the independent t-test*

Group	N	Mean	Std Dev	Std Error	Min	Max	95% Interval Lower Bound	Confidence for Mean Upper Bound
3-exp	27	65.89	16.62	3.20	18	91	59.31	72.46
3-con	24	78.71	11.71	2.39	55	95	73.76	83.65
5-exp	24	53.25	15.94	3.25	22	74	46.52	95.98\
5-con	27	70.44	15.42	2.97	35	91	64.34	76.54

Research question number two addressed the effect of baroque and classical music on student achievement based on race when integrated into the third and fifth grade math curriculum. The statistical technique of analysis of covariance was used to control for initial differences between groups before a comparison of within groups and between groups variance is made. ANCOVA was used to make all groups equal with respect to one or more

control variables. This type of analysis will indicate if there was a significant difference when baroque and classical music along with math integration has been incorporated into the third and fifth grade mathematics curriculum. The pretest data were used as a covariate to eliminate preexisting differences among classes such as innate ability or introduction to concepts prior to the study. Table 5 is the pretest and posttest descriptive by grade level and race. The specific data include group, N, and standard deviation for pretest scores and posttest scores. The experimental black group posttest mean score of 62.31 is lower than the control black group means score of 73.20. The experimental white posttest mean score of 54.75 is lower than that of the control white group of 75.95. The control groups outperformed the experimental groups. Both groups showed statistically significant difference.

Table 5

*Mean Score Analysis*

Group	N	Pretest		* Posttest	
		M	SD	M	SD
Exp-black	35	40.74	15.25	62.31	17.26
Exp-white	16	44.38	16.37	54.75	16.95
Con-black	30	54.53	11.13	73.20	15.01
Con-white	21	61.86	13.42	75.95	13.37

\*Note. Adjusted means and standard deviations represent scores after adjusting for the covariates.

Table 6 shows detailed information of descriptive of student's performance by race, grade level and group. Following the analysis of the mean scores, the data were analyzed using Analysis of Covariance (ANCOVA). ANCOVA controls for pretest values and uses the posttest as the dependent variable. Pretest scores are used as a covariate. The specific data

include group, N, standard deviation, standard error, minimum, maximum, lower bound and upper bound of the 95% confidence interval mean. The mean average is given by grade level, race and group. The upper bound of the 95% confidence interval mean for each race by grade level shows statistical significance.

In comparing the third grade experimental and control group data, the lower bound 95% confidence interval mean was 48.09 for the third grade experimental white group and the lower bound 95% confidence interval mean was 58.87 for the third grade black experimental group. The upper bound 95% confidence interval mean was 78.19 for the third grade experimental white group, and the upper bound 95% confidence interval mean was 74.83 for the black experimental group. The lower bound 95% confidence interval mean was 69.78 for the third grade white control group. The lower bound of 95% confidence interval mean was 72.09 for the third grade black control group. The upper bound 95% confidence interval mean was 86.62 for the third grade white control group, and the upper bound 95% confidence interval mean was 86.06 for the third grade black control group.

In looking at the fifth grade experimental and control groups data, the lower bound 95% confidence interval mean was 47.34 for the fifth grade experimental black group. The lower bound 95% confidence interval mean was 36.55 for the fifth grade experimental white group. The upper bound 95% confidence interval mean was 65.19 for the experimental black group, and the upper bound 95% confidence interval mean was 59.89 for the experimental white group. The last fifth grade group is the fifth grade control group. The lower bound 95% confidence interval was 59.66 for the fifth grade black control group and the lower bound 95% confidence interval mean was 63.87 for the white control group. The upper bound 95%

confidence interval mean was 76.46 for the fifth grade black control group, and the upper bound 95% confidence interval mean was 83.94 for the fifth grade white control group.

Table 6

*Two-tailed t-test of students by race and grade*

Group	N	Mean	Std Dev	Std Error	Min	Max	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
3-exp-bl	20	66.85	17.05	3.81	18	91	58.87	74.83
3-exp-wh	7	63.14	16.27	6.15	45	83	48.09	78.19
3-con-bl	14	79.07	12.10	3.23	59	95	72.09	86.06
3-con-wh	10	78.20	11.77	3.72	55	91	69.78	86.62
5-exp-bl	15	56.27	16.12	4.16	22	74	47.34	65.19
5-exp-wh	9	48.22	15.18	5.06	26	74	36.55	59.89
5-con-bl	16	68.06	15.77	3.94	35	87	59.66	76.46
5-con-wh	11	73.91	14.94	4.50	39	91	63.87	83.94

P = 0.000

F = 5.25

Table 7

*ANCOVA analysis by race*

	Sum of Squares	Df	Mean Square	F	Sig
Between Groups	7363.91	7	1051.99	5.25	.0000
Within Groups	18824.84	94	200.26		
Total	26188.75	101			

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Research question number three addressed the effect of baroque and classical music on student achievement based on lunch program status when integrated into the third and fifth grade math curriculum. The statistical technique of analysis of covariance was used to control for initial differences between groups before a comparison of within groups and between groups variance is made. ANCOVA was used to make all groups equal with respect to one or more control variables. A post-hoc test was run to determine which groups differ significantly from another, and will determine the meaning of any association among the results. The pretest data were used as a covariate to eliminate preexisting differences among classes such as innate ability or introduction to concepts prior to the study. Table 8 is the pretest and posttest descriptive by grade lunch program status. The specific data include group, N, and standard deviation for pretest scores and posttest scores of groups based on lunch status. All groups show a statistical significance in the mean scores. When comparing the experimental and control groups, the control high-ses group outperformed the experimental high-ses group. The posttest mean score of 77.04 for the control high-ses group is higher than the experimental high-ses posttest mean score of 59.00. The posttest means score of 71.73 for the control low-ses group was higher than the mean score of 60.78 for the experimental low-ses group.

Table 8

*Mean Score Analysis by Socioeconomic Status*

Group	N	Pretest		* Posttest	
		M	SD	M	SD
Exp-high-ses	24	41.17	14.94	59.00	19.34
Exp-low-ses	27	42.52	16.32	60.78	15.71
Con-high-ses	25	60.44	13.35	77.04	12.50
Con-low-ses	26	54.77	11.26	71.73	15.61

\*Note. Adjusted means and standard deviations represent scores after adjusting for the covariates.

Table 9 shows detailed information of descriptive of student's performance by grade level and socioeconomic status. Following the analysis of the means scores, the data were analyzed using Analysis of Covariance (ANCOVA). ANCOVA controls for pretest values and uses the posttest as the dependent variable. Pretest scores are used as a covariate. The specific data include group, N, standard deviation, standard error, minimum, maximum, lower bound and upper bound of the 95% confidence interval mean. The mean average is given by grade, group and socioeconomic status. The upper bound of the 95% confidence interval mean for each socioeconomic group by grade level shows statistical significance.

In comparing the third grade experimental socioeconomic status and the control socioeconomic status data, the lower bound 95% confidence interval mean was 55.21 for the third grade experimental high socioeconomic status group and the lower bound 95% confidence interval mean was 57.08 for the third grade low socioeconomic group. The upper bound 95% confidence interval mean was 75.72 for the third grade experimental high socioeconomic status group. The upper bound 95% confidence interval mean was 75.76 for the third grade experimental low socioeconomic status. The lower bound 95% confidence interval mean was ..

69.76 for the third grade control high socioeconomic status group, and the lower bound 95% confidence interval mean was 72.92 for the third grade low socioeconomic status group. The upper bound 95% confidence interval mean was 84.86 third grade control high socioeconomic status group, and the upper bound 95% confidence interval mean was 87.80 for the third grade control low socioeconomic status group.

In looking at the fifth grade groups, the lower bound 95% confidence interval mean was 35.68 for the fifth grade experimental high socioeconomic status group. The lower bound 95% confidence interval mean was 47.70 for the fifth grade experimental low socioeconomic group. The upper bound 95% confidence interval mean was 60.77 for the fifth grade experimental high socioeconomic group, and the upper bound 95% confidence interval mean was 64.83 for the fifth grade experimental low socioeconomic group. The lower bound 95% confidence interval mean was 68.45 for the fifth grade control high socioeconomic group, and the lower bound 95% confidence interval mean was 56.71 for the fifth grade control low socioeconomic status group. The upper bound 95% confidence interval mean was 85.05 for the fifth grade control high socioeconomic group, and the upper bound 95% confidence interval mean was 74.09 for the fifth grade control low socioeconomic group.

Table 9

*ANCOVA analysis of the independent t-test by socioeconomic status*

Group	N	Mean	Std Dev	Std Error	Min	Max	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
3-exp-hi	15	65.47	18.52	4.78	18	91	55.21	75.76
3-exp-low	12	66.42	14.70	4.24	32	86	57.08	75.76
3-con-hi	13	77.31	12.49	3.46	55	91	69.76	84.86
3-con-low	11	80.36	11.08	3.34	59	95	72.92	87.80
5-exp-hi	9	48.22	16.32	5.44	22	74	35.68	60.77
5-exp-low	15	56.27	15.47	3.99	26	74	47.70	64.83
5-con-hi	12	76.75	13.06	3.77	39	87	68.45	85.05
5-con-low	15	65.40	15.69	4.05	35	91	56.71	74.09

P = 0.000

F = 6.03

Table 10

*ANCOVA based on socioeconomic status*

	Sums of Squares	Df	Mean Square	F	Sig
Between Groups	9463.77	7	1351.97	6.03	0.000
Within Groups	21084.30	94	224.30		

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Total	30548.08	101
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### **Evaluations of Findings**

The first null hypothesis for this research was there will be no statistically significant difference in student achievement when baroque and classical music has been integrated into the third and fifth grade curriculum. Prior research has confirmed there is a link between music and student achievement (MENC, 2007; Maglione, 2006; Sousa, 2006, Teaching Music, 2006; Schellenberg, 2004), and have reported significant gains in student achievement with the implementation of listening to baroque and classical music along with correlating other subject areas. Each study differed in measurement and design. Neurological scientists have proven music contributes to brain development (Schellenberg, 2004).

Listening to certain types of music stimulates parts of the brain that is responsible for memory recall and visual memory (Sousa, 2006). Students who participate in music have a significant increase in IQ scores than students who do not receive music (Schellenberg, 2004). This hypothesis was tested using quantitative data that included the pre and posttest scores of the quarterly benchmark assessment in mathematics for third and fifth grade students. A two-tailed independent t-test was performed to measure the data (Table 2). The t-value 6.01 for the experimental third grade group was significant  $p = 0.000$ . The t-value 7.30 for the control third grade group was significant at  $P = 0.001$ . Table 2 shows the t-value for the experimental and control fifth grade groups along with the significant level. The data was also analyzed using Analysis of Covariance (ANCOVA). The upper and lower bound 95% confidence interval data in table 3 show a statistical significance to be prevalent in each of the groups. This indicates that the null hypothesis is rejected for third grade and fifth grade students.

The second null hypothesis for this research was there will be no statistically significant difference in student achievement based on race, when baroque and classical music is integrated into the third and fifth grade math curriculum. The racial achievement gap has been a concern of many Americans for decades (National Assessment of Educational Progress, 2007; Clotfelter, Ladd and Vigdor, 2009); Viadero, 2006; Phillips & Chin, 2004). The racial gap has been a major reason for the No Child Left Behind Act of 2001. The achievement gap is based on the difference between the average score for black students and the average score for white students (NAEP, 2007). The racial achievement gap is smaller in some states than others. In the state of Georgia, the average scale score for fourth-grade students was 235 and is lower than the national average of 239. Black students had an average score that was lower than that of white students by 24 points. In looking at the scores of black and white students who participated in the study, the hypothesis was tested using Analysis of Covariance test (Table 5). The F-ratio was 5.25 and was significant at  $p = 0.000$ . Both groups showed significant difference. White students in both the control and experimental group outperformed black students in the experimental and control groups. This indicates that the null hypothesis is rejected.

The third null hypothesis for this research was there will be no statistically significant difference in student achievement of students who receive free/reduced lunch when music is integrated into the third and fifth grade math curriculum. Prior research in the area of education economics are based on the effects of family socioeconomic status (SES) and student achievement (Lui & Lui, 2008; Evans, 2005; Kaushal & Nepomnyaschy, 2009; Orr, 2003). Parents of low-income families may find it difficult to meet nutritional, developmental and educational needs of their children (Kaushal & Nepomnyaschy, 2009). An early study in ..

the area of education economics found wealth had a significant effect on academic achievement (Orr, 2003). In a more recent study (2009) it was found that students from higher SES scores were significantly higher than those students from a low SES (Southgate & Roscigno). Both groups showed significant difference. When comparing the high socioeconomic group to the low socioeconomic group we find that many of the low socioeconomic groups scored higher than the high socioeconomic status groups. This hypothesis was tested using Analysis of Covariance test (Table 8). The F-ratio was 6.03 and was significant at  $p = 0.000$ . This indicates that the sample size ( $N = 51$ ) did not prove to be sufficient to establish the reliability.

## **Summary**

This chapter included a review of the research problem, the purpose of the research study, restatement of the research questions and hypotheses, descriptive statistics results and an evaluation of the findings. This research study proved listening to baroque and classical music along with math integration into the music curriculum has an effect on student achievement. The researcher was allowed to answer the research questions based on the analysis of data. The following demographics were used in the study: grade, race, socioeconomic status.

The research method of pretest posttest design along with ANCOVA allowed the researcher to determine if there were a change in scores of each group and allows the statistical power to be increased by using the pretest means as a covariate to statistically compare the groups. By analyzing the data using the various demographic groupings the researcher was able to identify vital similarities and disparities in the data as it applies to

prior research on the effects of classical and baroque music on student achievement. It was found that the mean scores for each of the demographics showed statistical significance. The findings in this chapter will be discussed in greater detail in the final chapter.

## **Chapter 5: Implications, Recommendations and Conclusions**

The problem addressed in this study was the need to increase student achievement in mathematics. Traditional ways of teaching (i.e., working from a textbook, designing quiz, and assigning seatwork) are sedentary techniques that are ineffective in teaching students (Baines and Slutsky, 2009). The No Child Left Behind (NCLB) Act established guidelines for states to follow to measure how well students acquire skills and knowledge (NCLB, 2001). Approximately 5 to 7% of school-aged children have difficulty in math achievement (Proctor, Floyd, and Shaver, 2005). This produces a challenge for society that demands at least minimal math proficiency (Proctor et al.,).

The achievement level of mathematic students in the United States, fall far behind those of other developed nations. Students who are falling behind come predominantly from high-poverty and high-minority areas. Research has shown national and international comparisons of student achievement indicate that it is between fourth and eighth grade when students fall rapidly behind desired levels of achievement (Balfanz and Bynes, 2006).

The 2007 National Assessment of Educational Progress (NAEP) report in mathematics showed the average scale score for fourth-grade students in Georgia was 235 of which was lower than the national average score of 239. The NAEP report showed black students had an average score that was lower than that of white students by 24 points. Students who were eligible for free/reduced school lunch had an average math score 23 points lower than that of students who were not eligible for free/ reduced school lunch. To address the achievement gap, there is a need to design a curriculum which allows all students to be successful in mathematics.

The intent of this quantitative study was to examine the impact of baroque and classical music on student achievement in elementary mathematics. A quantitative pretest-posttest control group design was utilized. The sample group consisted of 51 third grade students and 51 fifth grade students. Students were divided into two groups: the experimental group and the control group. The independent variables of baroque and classical music were played during math class of the experimental group. The dependent variable was the quarterly benchmark assessments in mathematics. Descriptive statistics of this study was based on the results of the quarterly benchmark assessment in mathematics for the school year of 2010-2011. There was a comparison of how participants performed based on gender, race, and socioeconomic status. The setting for this study was a large suburban school district in Southeast Georgia. A quantitative pretest-posttest design was utilized to determine if listening to baroque and classical music in the math class, along with math integration into the music curriculum, increases student achievement in math.

The pretest was the quarterly benchmark assessment in math of all third and fifth grade students participating in the study for the school year 2010-2011. This pretest was used as a baseline for both groups. The experimental group received the treatment of listening to baroque and classical music which was administered by the classroom teacher. Research points to various ways music has been used to develop cognitive and behavior skills necessary for success in math (Appel, 2006). Third and fifth grade classroom teachers agreed to play a CD containing baroque and classical music during math instruction. The music was played for 50 minutes five days a week. The treatment was given for 16 weeks. The music teacher integrated math into the music curriculum by teaching students to (a) add, subtract and multiply musical notes, (b) find the missing addend using musical notes, (c) combine

music history and surveys to graph data, (d) combine the process of composition in music and the concept of probability, (e) understand musical notes and how they relate to fractions, (f) use time signatures to teach fractions, (g) reinforce math vocabulary and playing baroque and classical music. Students received individual as well as small group projects that integrate music and math. The data of all pre and post tests was collected by the researcher. The posttest was the benchmark assessment in math which was administered by classroom teachers.

The benchmark assessment measured student progress in math. A independent t-test was used to estimate the statistical significance of the mean scores. Descriptive data was used to identify race, gender and students who receive free/reduce lunch.

The following are limitations to the study: (a) the study will not be conducted for the entire school year; (b) there is a need to conduct a power analysis to ensure sufficient sample size. The delimitation to the study is some teachers will not play music on a regular basis during instructional time for their students. The study was limited to one school in the school district.

Confidentiality and privacy are very important in this study. The design and implementation of this study were consistent with current ethical guidelines (Hicks, 2008; The Belmont Report 1979; Northcentral University, 2010). The proposal was approved by the Northcentral Review Board and the local school district to ensure participants were protected from undue risk. Confidentiality and privacy of the participants were used with the data collected for each participant. As, a result, the students were given pseudonyms. All information obtained for this study was destroyed. In addition, the researcher completed all required research and ethics training offered by Northcentral University.

This chapter includes an overview of the problem statement, purpose of the study, and method of the study including any ethical considerations. A summary of the findings as related to each research question will be provided and the limitation of the study. Lastly, recommendations for future research and conclusion are provided.

## **Implications**

The implication of the research come from several conclusions gathered from the research data. The research questions were:

1. What effect, if any does baroque and classical music have on student achievement in mathematics when integrated into the third and fifth grade math curriculum?
2. What will be the effect of baroque and classical music on student achievement based on race, when integrated into the third and fifth grade math curriculum?
3. What effect, if any, does baroque and classical music have on student achievement of low-income students in a third and fifth grade math classroom.

All null hypotheses were rejected based on the research findings.

According to researchers who study the effect of music on learning playing, listening, and practicing music aid in developing essential tools that are necessary in learning (Aziz,2009; Sousa, 2006). Studies have also shown how listening to music help students stay focus whole learning (Maglione, 2006; Sousa, 2006; Cronin, Gaub, Alsop, Winner, Schlaug, 2006). The findings of this study have shown how listening to baroque and classical music along with integrating math into the music curriculum for third and fifth grade students have a statistical significant effect on student achievement in the mathematics curriculum. Each of the experimental groups' posttest mean scores increased significantly.

## **Limitations**

Prior to discussing the implications generated by this research study it is important that the limitation of the study be considered. A limitation of the study was the research was not conducted for the entire school year. Second, the G\* Power post-hoc achieved power results for a two-tailed t-test and F-test ANCOVA with a sample population of 51 result in a low statistical power. A low statistical power can decrease the reliability of the research. 85% of all third grade students and 82% of all fifth grade students comprised the sample population. The sample group is drawn from a stratified population. These students are chosen through a selection process to attend this school. Students are then randomly assigned by the administration. Third the quarterly benchmark assessment in elementary mathematics is administered three times during the school year. Continuing to incorporate listening to baroque and classical music along with the integration of math into the music curriculum for an enhanced amount of time may have increased the mean scores for each of the participating grade level. This limitation was overcome by the fact that this study specifically focused on measuring the effects of listening to baroque and classical music along with math integration into the music curriculum. Another limitation is that teachers were not trained on the importance of playing the CD of baroque and classical music during mathematics instruction. Many of the teachers in the study play music during mathematics and/or during teaching of other subjects during the school day. Yet some teachers played music for their students but may not have played music on a consistent basis. By including all third and fifth grade students would have been very beneficial in assisting all students in meeting or exceeding state standard in mathematics to be promoted to the next grade.

Researchers in the field of education economics have found black students have lower levels of parent availability than white students (Evans, 2005). Wealth had a significant effect on student achievement, and having limited family resources may find it difficult to meet educational needs of children (Orr, 2003; Evans, 2005; Cooper & Schlesser, 2006; Kaushal & Neopomnyaschy, 2009). In a study of nontransient 6<sup>th</sup> & 8<sup>th</sup> grade students who participated in a performing ensemble (band, choir or none), the students results showed a small significant difference in those students who participated in an ensemble to those who did not participate. It was also found there was no significant main or interaction effects were evidence for home environment (Southgate & Roscigno, 2009). When considering the findings in the research the results shown (Table 8) there appears to be no significance or marginal significant difference in the students 95% confidence upper bound mean scores. Having a small sample size limits the ability to generalize the results because of a lack of power. Increasing the power will provide stronger evidence for determining the effect of baroque and classical music has on student achievement.

### **Recommendations for future research**

Based on the findings in this study, there are areas that merit more in-depth research. First, it is recommended that future studies incorporate a sufficient sample size to increase the reliability. In the current study, only third and fifth grade students from one elementary school were examined. Including more students in the study will not only help all students to meet or exceed state standards in mathematics, but including more students in the study would increase validity and reliability. The results from the current study have validated the

effect of baroque and classical music on third and fifth grade students on student achievement in mathematics.

The second recommendation is that teachers receive training on the importance of playing baroque and classical music during math instruction. It is important to remember that the independent variable (music) is very important to this study and that teachers must be dedicated to playing baroque and classical music on a daily basis for the required amount of time as stated in the study. Therefore, to determine the effectiveness of baroque and classical music on third and fifth grade student's achievement in math requires dedicated teachers who are willing to do more than teach mathematics.

## **Conclusion**

There is a need to increase student achievement in mathematics. Research has shown for the last three decades there are significant gaps in mathematics (Flores, 2007). This achievement gap is demonstrated on national as well as state test. According to the National Assessment of Educational Progress (NAEP), Georgia fourth-grade students in mathematics average scale score was lower than that of the national average (NAEP, 2007). Results from the current study provide information on the effect of baroque and classical music on student achievement of third and fifth grade students in mathematics.

Three research questions were focused on in this study, and this chapter has presented a discussion of the findings related to each research question. Research question 1 confirmed the effectiveness of baroque and classical music in improving student achievement in mathematics. All posttest mean scores increase from that of the pretest. Research question 2 demonstrated a significant difference when comparing the experimental and control groups

by race. In research question 3, a small sample size limited the ability to generalize the results because of a lack of power. Some of the low socioeconomic status students outperformed students in the high socioeconomic status group. This may be a result of students having to compete because of the school environment and school culture. Lastly, some students who receive free/reduced lunch are in the gifted program. This study indicates that the use of baroque and classical music plays an important role in increase student achievement.

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APPENDIX A:  
Informed Consent Form

Dear Parents,

I want to share with you the research study that I will be conducting in your child's classroom. Research has shown there is a correlation between music and mathematics. During the year, I will be conducting an experiment using music in the math curriculum to increase test scores using the Quarterly Benchmark Assessment in math. This would include listening to baroque and classical music while learning math, and music lessons that will include math. I will need your permission for your child's Quarterly Benchmark Assessment math scores to be included in my research. Please note that the scores will be anonymous. I would appreciate if you would please sign and return the attached permission form. I look forward to working with your child.

Sincerely,

Ruth Albright, Music Teacher

-----Return bottom portion-----

Child's Name \_\_\_\_\_  
(First and Last Name)

\_\_\_\_\_ I give permission for my child's scores to be included in the research.

\_\_\_\_\_ I do not give permission for my child's scores to be included in the research.

---

Parent/Guardian Signature



*Savannah-Chatham County Public School System  
208 Bull Street / Savannah, Georgia 31401 / 912 201 5600*

November 24, 2010

To Whom It May Concern:

Ms. Ruth Albright has requested and been granted permission to conduct research within the Savannah-Chatham County Public School System on the following topic:  
*The Impact of Music on Student Achievement in the Third and Fifth Grade Math Curriculum.*

This permission has been granted by the office appointed by the Superintendent of schools to review all requests for research to be conducted within the school system. Ms. Albright has fulfilled all local requirements and provided the documentation necessary to ensure that we understand the scope of her research and the methods which will be used to collect and present her data.

Should you have any questions regarding Ms. Albright's research approval status, please feel free to contact me at (912) 395-5735.

Thank you,

Kristy Collins Rylander  
Coordinator of Research and Statistics  
Office of Accountability, Research, Evaluation, and Assessment  
Savannah-Chatham County Public School System  
208 Bull Street Savannah, GA 31401  
(912) 395-5735  
[kristy.collins-rylander@sccpss.com](mailto:kristy.collins-rylander@sccpss.com)

*Mission - To ignite a passion for learning and teaching at high levels*

*Vision - From school to the world ALL students prepared for productive futures*

AN EQUAL OPPORTUNITY EMPLOYER

December 14, 2010

Reference: Ruth Albright

IRB: 2010-12-13-198

Dear Dr. Calvin Lathan, Dissertation Chair:

On December 13, 2010, Northcentral University approved Ruth's research project entitled, The Impact of Music on Student Achievement in the Third and Fifth Grade Math Curriculum.

IRB approval extends for a period of one year and will expire on December 14, 2011.

Please inform the Northcentral University IRB when the project is completed.

Should the project require an extension, an application for an extension must be submitted within three months of the IRB expiration date.

In-the interim, if there are any changes in the research protocol described in the proposal, a written change request describing the proposed changes must be submitted for approval.

Sincerely,

Dr. Chris Cozby

IRB Committee Chair

Northcentral University

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## Appendix D

### Experimental Group Benchmark Data

<b>Group</b>	<b>Name</b>	<b>Gender</b>	<b>Race</b>	<b>Economic Status</b>	<b>Pretest</b>	<b>Posttest</b>
Experiment 3	Tom Cain	M	B	Reduced	20%	68%
Experiment 3	Millard Valdez	M	B	Free	45%	77%
Experiment 3	Susanne Newman	F	B	Paid	50%	77%
Experiment 3	Karin Gay	F	B	Free	70%	82%
Experiment 3	Harriett McIntyre	F	B	Free	30%	73%
Experiment 3	Jeremiah Mack	M	B	Free	35%	73%
Experiment 3	Burton Randolph	M	B	Paid	75%	91%
Experiment 3	Marissa Russo	F	W	Paid	44%	83%
Experiment 3	Damien Baxter	M	B	Paid	45%	59%
Experiment 3	Lucien Frost	M	W	Paid	45%	73%
Experiment 3	Marcel Fuentes	M	W	Paid	25%	82%
Experiment 3	Scottie Nguyen	M	B	Paid	55%	68%
Experiment 3	Nicholas Wells	M	B	Free	40%	73%
Experiment 3	Landon Thornton	M	B	Free	40%	55%
Experiment 3	Millie Owens	F	B	Paid	65%	77%
Experiment 3	Marci Rodriguez	F	B	Reduced	30%	64%
Experiment 3	Delmar Glover	M	W	Paid	45%	59%
Experiment 3	Teri Bailey	F	B	Paid	45%	64%
Experiment 3	Ellis Marks	M	W	Reduced	80%	55%
Experiment 3	Carol Sosa	F	B	Paid	50%	18%
Experiment 3	Ernesto Johnston	M	B	Free	50%	86%
Experiment 3	Lillian Sosa	F	B	Reduced	40%	59%

Experiment	Alyson Ballard 3	F	B	Paid	15%	73%
Experiment	Jessie Murphy 3	M	B	Paid	45%	68%
Experiment	Sherry Thompson 3	F	W	Paid	35%	45%
Experiment	Alfreda Becker 3	F	W	Paid	25%	45%
Experiment	Gavin Becker 3	M	B	Free	5%	32%
Experiment	Claudine Chang 3	F	W	Free	75%	64%
Experiment	Dillon Nunez 5	M	W	Paid	32%	52%
Experiment	Mable Sweet 5	F	W	Paid	40%	48%
Experiment	Eli Pate 5	M	B	Free	24%	43%
Experiment	Bennet Burt 5	M	B	Free	52%	70%
Experiment	Robert Rosa- 5	M	B	Free	48%	57%
Experiment	Mohammed Waller 5	M	B	Reduced	56%	57%
Experiment	Millard Wise 5	M	B	Free	36%	43%
Experiment	Brandi Gordon 5	F	B	Free	36%	35%
Experiment	Juliana Whitney 5	F	W	Reduced	36%	26%
Experiment	Lanny Bentley 5	M	B	Paid	32%	65%
Experiment	Lazaro Hendrix 5	M	W	Free	48%	74%
Experiment	David Jackson 5	M	B	Free	40%	74%
Experiment	Marissa Jackson 5	F	B	Free	40%	70%
Experiment	Cherry Rocha 5	F	B	Free	28%	70%
Experiment	Jonah Benton 5	M	B	Paid	32%	60%
Experiment	Leonard Nash 5	M	B	Paid	56%	74%
Experiment	Gabriel Holcomb 5	F	W	Paid	28%	39%
Experiment	Keven Jennings 5	M	W	Free	36%	39%
Experiment	Milo Coffey	M	B	Reduced	52%	65%

	5					
Experiment	Hannah Beach 5	F	W	Paid	60%	35%
Experiment	Alphonse Holloway 5	M	B	Paid	24%	39%
Experiment	Dzena Velaquez 5	F	B	Paid	20%	22%
Experiment	Gary Memahon 5	M	W	Reduced	56%	57%

**APPENDIX E:**  
**Control Group Benchmark Data**

<b>Group</b>	<b>Name</b>	<b>Gender</b>	<b>Race</b>	<b>Economic Status</b>	<b>Pretest</b>	<b>Posttest</b>
Control	Ty Henson 5	M	B	Reduced	44%	48%
Control	Loren Neal 5	F	B	Free	52%	57%
Control	Renee Cunningham 5	F	B	Paid	50%	77%
Control	Bret Jacobs 5	M	B	Reduced	60%	70%
Control	Elvia Herring 5	F	W	Free	45%	61%
Control	Emile Bowen 5	F	B	Free	24%	35%
Control	Bridget Justice 5	F	W	Paid	24%	39%
Control	Carlos Beach 5	M	W	Paid	60%	74%
Control	Augustine Ramos 5	M	W	Paid	64%	87%
Control	Josephine Franks 5	F	W	Free	68%	83%
Control	Gina McConnell 5	F	W	Free	56%	91%
Control	Sang Tate 5	M	B	Free	44%	52%
Control	Daryl Wise 5	M	B	Paid	64%	83%
Control	Barbara Dickerson 5	F	B	Free	44%	83%
Control	Patrick McKenzie 5	M	W	Paid	72%	87%
Control	Leanna Kane 5	F	B	Free	64%	83%
Control	Hans Farley 5	M	B	Free	36%	52%
Control	Bonita Kinney 5	F	W	Free	64%	65%
Control	Gracie Brown 5	F	B	Free	60%	70%
Control	Jacob Baxter 5	M	B	Paid	68%	83%
Control	Coy Cabrera 5	M	B	Free	60%	57%
Control	Lou Riddle 5	M	B	Paid	44%	87%

Control	Leta Heath 5	F	B	Reduced	68%	74%
Control	Danielle Serrano 5	F	W	Paid	76%	70%
Control	Colleen Maddox 5	F	B	Paid	64%	78%
Control	Wilmer Cummings 5	M	W	Paid	84%	78%
Control	Robin Blair 5	F	W	Paid	56%	78%
Control	Alex Knight 3	M	B	Paid	50%	91%
Control	Lesa Pena 3	F	B	Paid	55%	59%
Control	Jeanette Wood 3	F	W	Paid	55%	55%
Control	Stacie Greer 3	F	B	Reduced	60%	77%
Control	Jerri Gibson 3	M	B	Free	55%	59%
Control	Myrtle Jackson 3	F	B	Free	45%	82%
Control	Valeria Gaines 3	F	B	Paid	45%	59%
Control	Jennifer Carver 3	F	W	Paid	55%	73%
Control	Faith Hurst 3	F	B	Paid	75%	86%
Control	Dean Hickman 3	M	B	Free	60%	86%
Control	Cheryl Ellison 3	F	W	Paid	60%	91%
Control	Natalie Hodge 3	F	B	Paid	65%	86%
Control	Cornelia Jimenez 3	F	W	Paid	85%	82%
Control	Hugh Yates 3	M	B	Free	65%	86%
Control	Jamie O'Neill 3	F	B	Free	55%	95%
Control	Tyson Fulton 3	M	W	Reduced	70%	64%
Control	Rosalinda Bryant 3	F	W	Paid	55%	82%
Control	Hugo Day 3	M	B	Free	45%	73%
Control	Pat Cleveland 3	M	B	Paid	65%	82%
Control	Lyman Valdez 3	M	B	Free	50%	86%

Control	Jeff Compton 3	M	W	Reduced	65%	86%
Control	Beau Fischer 3	M	W	Paid	70%	86%
Control	Madelyn Keith 3	F	W	Paid	50%	73%
Control	Val Leonard 3	M	W	Reduced	65%	90%