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Factors Affecting Literacy Achievement of Eighth Grade Middle School Instrumental Music Students

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Middle School Instrumental Music Students

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Abstract

FACTORS AFFECTING LITERACY ACHIEVEMENT OF EIGHTH GRADE MIDDLE SCHOOL INSTRUMENTAL MUSIC STUDENTS

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The purpose of this pretest-posttest comparative efficacy study was to analyze factors affecting literacy achievement of eighth grade middle school instrumental music students (n = 38) including (a) socioeconomic status (SES), (b) gender, (c) grade point average (GPA), (d) music motivation, (e) music involvement, and (f) instrument section. The findings of this study indicate that, utilizing the Iowa Tests of Basic Skills (ITBS) reading comprehension, reading vocabulary, and science subtests and the Northwest Evaluation Association (NWEA) Reading Measure of Academic Progress (MAP) as the dependent variables for each of the six independent variables, significant growth over time was made in each of the measures among all the groupings.

Notable highlights from the study show that, in Post Hoc pairwise comparisons, large effect sizes were found for time and high SES students on the ITBS Science subtest, time and low SES students on the NWEA Reading MAP, time and male students on the ITBS Reading Comprehension subtest, time and high GPA students on the ITBS Reading Comprehension Subtest, time and high GPA students on the ITBS Reading Vocabulary Subtest, time and high GPA students on the ITBS Science Subtest, and time and low musically involved students on the ITBS Reading Vocabulary Subtest. While there were

other large and moderate effect sizes, these named pairwise comparisons were all well over one standard deviation in effect.

The results of the repeated measures analysis of variance statistical tests employed in this study indicate that there is an association between students' literacy achievement and participation in instrumental music. The findings from this research demonstrate that students who are actively engaged in music learning benefit from it and suggest that participating in music instruction also affects cognitive functions that influence other disciplines.

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Before I began this particular journey, I traversed another trail as a prelude to the one at hand. That began with my enrollment and subsequent completion of the graduate certificate in instruction in urban schools at the University. I would like to thank Dr. Carol Mitchell, with whom I took my very first class on that path that ultimately led me to the fork in the road known as the doctoral program. There, I met and became a benefactor of Dr. Karen Hayes’ and Dr. Sarah Edwards’ inspired instruction. It was Dr. Hayes who reignited my fervor for pursuing doctoral studies. Dr. Edwards’ gentle and open teaching style, along with her unbridled positivity further pushed me toward this goal. I am humbled and honored that they agreed to sit on my committee. Dr. Larry Dlugosh, who also served as my master’s advisor, was instrumental in my initial studies in the educational administration arena. It was he for whom I wrote my very first paper, where he exclaimed, “You are a great writer!” He embodies the exact energy I have been fortunate enough to enjoy from all my committee members on this excursion – that positive force that ignites inspiration in a student.

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CHAPTER ONE

Introduction

Over the past century, the arts have enjoyed prominence during times of progressive reforms, but have been regarded as an extra during the back-to-basics movements (Smithrim & Upitis, 2005). Between 1950 and 1980, arts education, under the mantle of aesthetic education, was justified by aesthetic or intrinsic ends, and not to enhance self-esteem or improve academic skills such as reading or science skills.

In the 1970s, Eisner (1974) called for the evaluation of arts programs. As a result, a growing body of evidence suggests that arts education positively affects aspects and learning beyond the intrinsic values of the arts themselves, including imagination, motivation to learn, creativity, school attendance, social skills, and higher academic achievement.

Later, in the 1990s, Eisner (1992) noted that public schools, in an effort to create an intellectual climate, have marginalized the significance of the arts in order to assist in fostering the desired intellectual paradigm of academic achievement. In a 1992 survey of principals by the U. S. Department of Education, only 12% of those who responded believed that the visual and performing arts were important enough to receive attention; the other 88% did not share the same opinion (Wright, 1994).

In an effort to promote and measure student performance and teacher and administrator accountability through the federal government's department of education, initiatives including No Child Left Behind (2001) and Race to the Top (2009) legislation, many educational policy makers have heralded a back-to-basics movement. These policy makers have apparently forgotten what Horace Mann, founder of the American school system, believed; that music is essential to the education of the young for the development of aesthetic appreciation, citizenship, and thinking.

There is a real concern associated with research on the arts and academic achievement. By suggesting that the arts might serve as handmaidens to other subjects, a danger exists that the arts will not be valued for their distinct contributions to education (Hetland & Winner, 2001).

Music instruction and academic achievement. Regarding the thinking component of Horace Mann's statement, there is an increasing yet still limited number of music educators, school administrators, and policy makers who in the past several decades have begun to look at empirical research that examines the relationship between instrumental music instruction and academic achievement (Babo, 2004). The intuitive speculation or anecdotal evidence that music and academic achievement have some type of relationship has been the subject of many inquiries (Phillips, 1976). If the existence of a positive relationship can be argued between music and other content area subjects, then a policy rationale that includes instrumental music instruction as a core academic subject can be supported.

Instrumental music and academic achievement. Some studies suggest that there is a positive correlation between instrumental music instruction and academic achievement (Dreyden, 1992; Hill, 1987; Robitaille & O'Neal, 1981; Trent, 1996), while others contradict these findings by stating that there is no significant relationship (Anello, 1972). Still, others suggest that it may be that students who achieve academically are naturally drawn to participate in instrumental music programs (Gordon, 1979; Hedden, 1982; Hill, 1987; Holmes, 1997; Phillips, 1976; Trent, 1996). The question as to whether there is a relationship between instrumental music and academic achievement remains generally unresolved. In a study by Fitzpatrick (2006), results show that instrumental students outperformed non-instrumental students in every subject and at every grade level. Instrumental students at both levels of socioeconomic status (SES) held higher scores than their non-instrumental classmates from the fourth grade, suggesting that instrumental music programs attract higher scorers from the outset of instruction. Results also show a pattern of increased achievement by lower SES instrumental students, who surpassed their higher SES non-instrumental classmates by the ninth grade in all subjects.

Socioeconomic status (SES) and academic achievement. The importance of students' family socioeconomic status (SES) has long been recognized as an influence on the academic achievement of children and current research in this area has demonstrated the effect of it while controlling a variety of factors (Caldas & Bankston, 2001). In fact, the relationship between student SES and achievement has been a topic of research for more than 30 years (O'Donnell & White, 2005). Okpala et al. (2001) found that the percentage of students in free/reduced-price lunch programs was statistically significant in explaining differences in mathematics achievement scores. However, few studies have linked these variables to long-term public school instrumental music student participation.

Throughout the literature, research that focused on school SES and student achievement has consistently related lower SES to lower student achievement (O'Donnell & White, 2005). Among adolescents, peer groups are strongly related to behavior and attitudes (Bankston, 1995; Hunter et al., Walter et al., 1993). In Coleman's 1966 findings, the order of importance of factors affecting achievement by students was facilities and curriculum least, teacher quality next, and backgrounds of fellow students most. Thus, it can be argued that students create their own social context, independent of any individual's own background, which has a strong influence on individual academic achievement (Caldas & Bankston, 2001).

The mean parental educational level of one's classmates was found to have an independent positive effect on student achievement (Rumberger & Willms, 1992). Given the recognized importance of peer groups for shaping adolescent behavior, knowledge of the class and economic background of peers can make a significant contribution to the ability to predict academic achievement that is independent of the class and economic backgrounds of the students (Caldas & Bankston, 2001).

Motivation and student achievement. While low SES is highly correlated with low achievement, some low SES students are academically successful. These differences in achievement may be associated with differences in learning styles and motivational factors (Caldwell & Ginther, 1996). Brophy (1988) defines motivation as the tendency to find academic activities meaningful and worthwhile and to try to derive the intended academic benefits from them, and the motivation to learn is governed by cognitive and affective components which guide and direct behavior (Ames, 1992). Low motivation is a critical factor in student achievement, especially for the low SES student. Enhancing motivation requires that students become active participants in their own learning with teachers assuming less a controlling role (Caldwell & Ginther, 1996).

The relevance of SES to cognitive neuroscience lies in its relationship to cognitive ability as measured by IQ and school achievement beginning in early childhood. In tests of prefrontal/executive function of the brain, the language system showed a highly significant relationship to SES. Middle school-aged children in the same set of tests exhibited similar patterns: SES disparities in language, memory, and working memory, with borderline significant disparities in cognitive control and spatial cognition. As such the basic science of human brain function and especially for the understanding of brain development and plasticity, socioeconomic variation is a key consideration in neurocognitive science (Hackman & Farah, 2009).

Neurological science, music, and academic success. The field of neurological science has begun to yield some interesting findings concerning this dichotomy that may infer a greater positive relationship between instrumental music instruction and academic success. Research into understanding higher brain functioning, using music as a window, conclusively finds that the area of the brain that is stimulated by music and music instruction is the same area that controls spatial reasoning and spatial reasoning is directly connected to both mathematics and science ability (Leng & Shaw, 1991).

Using a group of pre-school children as her subjects, psychologist Frances Rauscher noted that there is a direct connection between formal musical instruction and enhanced spatial reasoning ability (Viadero, 1998). From these findings, an assumption can be made to support the notion that instrumental music instruction indeed has a positive impact on academic achievement.

Brain processing function cannot be thought of simply as belonging to one half of the brain or the other. Instead, many functions may involve left hemispheric laterality, right hemispheric laterality, or complex interactions of bilateral brain processing preference (integrated function). More specific to language and to learning, the left hemisphere in most people is better at handling syntax and meaning, a more literal translation, and in reading and mathematical processing. The right hemisphere is more contextual, perceiving drawings and art, manipulating shapes, and recognizing faces, for example (Szirony, Burgin, & Pearson, 2008).

Language, reading readiness, and intellectual development. Norman Weinberger (1998) referred to the curricular level significance music plays when he discussed its ability to facilitate language, reading readiness, and general intellectual development. This concept is continually being buttressed by the proliferation of cognitive science discoveries, which demonstrates that active engagement in performance increases brain capacity by developing and strengthening connections among brain neurons. Learning and performing music exercises the brain in ways that are being discovered as current technological advances allows researchers to measure these effects.

Contrary to earlier research findings and considerations that suggested the brain is divided into right and left hemispheres, wherein each one is the center of control for any given human function or endeavor, these latest neurological research instruments have been able to show through visual depictions of brain scans the activations of the brain in various human activities. Evidence is overwhelmingly stacking to show that both hemispheres of the brain are activated as a result of these multi-modal musical experiences, involving visual, cognitive, affective, and motor systems simultaneously.

Arts for arts' sake. While most states have adopted educational standards that include visual and performing arts, the introduction of No Child Left Behind (2001) legislation at the beginning of the twenty-first century, the subsequent evolution of Race to the Top (2009) legislation, and other federally-generated, if not mandated, programs, have essentially relegated them to attenuate an element of aesthetics. While this is important in its own right, if the arts are to survive on this premise alone, educational policy makers may believe them to be unsubstantiated or unsustainable.

Arts educators should take care to not allow the arts to be justified wholly or primarily in terms of what the arts can do for reading or science, or any other subject. Rather, the arts are better justified in terms of what they can teach that no other subject can (Hetland & Winner, 2001).

Phillips (1993) reports that music programs are losing out based on the argument for aesthetic education. The music education profession needs a rationale to support and bolster its importance in the curriculum. Plainly put, Phillips pronounces educational policy makers need a philosophy that embraces both utilitarian and aesthetic objectives.

Educational policy and the arts. As the literature reiterates, because of the deplorable state of public educational policy on music due to financial concerns, it historically asks arts programs to prove their worth. However, Wilson (1985) suggests that music belongs in the curriculum as a valuable ingredient to verbal and computational skills.

In the current policy environment, the vast majority of time and energy are being devoted to research that addresses reading and math instruction. This work is essential and invaluable, but it would behoove parents and policymakers to encourage researchers and educators to ensure that their enthusiasm for basic skills is not marginalizing attention to questions of civic import. Whatever reforms one believes advisable in order to promote quality schools and schooling, we can agree that quality includes a broad, rich, and challenging liberal arts curriculum (Hess, 2008).

Economic and social reforms of globalization and neoliberalism have had significant ramifications for public education systems, and thus have fostered this new sense of approach to policymaking. To compete in the global market, schools must be efficient and produce maximum output while minimizing input. Educational basics in the form of reading, writing, science, and technology are stressed in this neoliberal model. Because the neoliberal agenda for education is not particularly arts friendly, there has been a movement among leaders in the field to demonstrate that adopting an attitude of arts integration in schools may be the way to achieve this goal (Horsley, 2009).

Kelstrom (1998) proposes that the future of music education and all the arts in this country depends upon administrators and their awareness of the benefits of providing a comprehensive music curriculum. This commitment may not be made unless the positive effects the arts have on students' academic achievement is demonstrated through research-based, quantifiable evidence.

Theoretical framework. While music, as an arts discipline, has been frequently seen as inessential in education, especially in times of economic strife, a considerable body of literature addresses its possible influences on academic achievement. Gardner (1993) and Gordon (1977) developed theories of learning that have been the basis for and contributed to a growing body of educational research. Gardner included musical intelligence as one of seven areas while Gordon's framework focused exclusively on music achievement. Both perspectives suggest the existence of an association between the study of music and reading development. Gardner (1993) theorized that learning occurs by means of multiple intelligences that individuals possess in varying degrees and levels. Linguistic and musical intelligences are related by the combined utilization of sight and sound for processing and understanding information. More than any of the other intelligences, verbal-linguistic and musical, depend on these two senses working in conjunction with one another for effective cognitive development.

Gordon (1977) based the music learning theory on the concept of musical aptitude. Defined as the measure of potential observed in an individual, musical aptitude is an indicator of future achievement in music. Gordon believed that similarities in learning processes establish a relationship between musical aptitude and academic achievement as well as the possibility of a transfer of learning between the two disciplines.

Empirical research has frequently cited the works of Gardner and Gordon as foundational bases in conducting studies in education. Both theorists agreed that effective cognitive abilities and skills are necessary for learning and understanding to take place.

Music performance and reading development rely on abilities and skills that include efficient visual and auditory mechanisms for the purpose of manipulating symbol systems that facilitate successful acquisition and understanding of information. Included in this association is the decoding of the symbol systems for purposes of discriminating between what a particular symbol represents and the sound or sounds related to each.

Purpose of the Study

The purpose of this study is to analyze factors affecting literacy achievement of eighth grade middle school instrumental music students.

Based on previous research into the relationship between instrumental music and academic achievement and the advent of neurological testing, this investigator will build upon that knowledge base to determine what factors affect literacy achievement of eighth grade middle school instrumental music students. This study proposes to look at a specific age group (eighth grade middle school students), take into account the number of years each student has been involved in formal public school instrumental music instruction, student socioeconomic status (SES) as determined by the eligibility for participation in the free and/or reduced lunch program, student gender, Iowa Tests of Basic Skills (ITBS) reading comprehension (RC) and reading vocabulary (RV), and science subtests scores, the Northwest Evaluation Association (NWEA) reading Measure of Academic Progress (MAP) Rasch Unit (RIT) score, academic achievement as measured by grade point average (GPA), music motivation (MM) as measured by competitive musical achievement, music involvement (MI) as measured by extracurricular musical ensemble participation, and instrument section (IS) as measured by section of participation in the school band.

Research Questions

Research questions will explore middle school instrumental music student achievement in literacy as measured by the Iowa Tests of Basic Skills (ITBS) reading subtests of reading comprehension (RC) and reading vocabulary (RV) normal curve equivalent (NCE) scores, Northwest Evaluation Association (NWEA) Measures of Academic Progress (MAP) Rasch Unit (RIT) scores, and ITBS science NCE scores.

Question #1. For students who participated in grades six through eight in the instrumental music program, will there be a significant difference from grades six to eight in high and low SES students as measured on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #2. For students who participated in grades six through eight in the instrumental music program, will there be a significant difference from grades six to eight between female and male students on

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #3. For students who participated in grades six through eight in the instrumental music program, will there be a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #4. For students who participated in grades six through eight in the instrumental music program, will there be a significant difference from grades six to eight between students who were not motivated or minimally motivated musically and students who were motivated or highly motivated musically on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #5. For students who participated in grades six through eight in the instrumental music program, will there be a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #6. For students who participated in grades six through eight in the instrumental music program, will there be a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Importance of the Study

This study contributes to research, practice, and policy. The study is of significant interest to administrators, teachers, parents, and most importantly, students and the communities in which they all live, if we espouse the notion that participating in music and activities outside the usual confines of academe is essential for the development of youths' aesthetic appreciation, citizenship, and thinking.

Assumptions of the Study

The study has several strong features. Among them is the nominal price band instrument rental program that allows students who are eligible for the free and/or reduced price lunch program to rent an instrument directly from the research district's school band program. This program has been built over several years of school- and instructor-purchased wind instruments. These instruments include tuba, baritone, trombone, French horn, trumpet, tenor sax, clarinet, and flute. The research district's school board has a current rate of $15 per trimester for rental of these instruments by eligible student musicians. Strengths also include that the students involved in the study received equally effective instruction in instrumental music, reading, mathematics, and science, based on the level of experience and education of the teachers delivering the curriculum. Additionally, the sample of students from the middle school is representative of the population of an average Midwest middle class community, and finally, the standardized test data collected measures what it purports to measure. Education in the arts is of tremendous importance in order to be able to compete and participate in the 21st Century economy. Participation in instrumental music is one way to experience an excellent arts education. The mental and spiritual benefits of continued instruction on a musical instrument are too compelling to ignore, and any educational institution worth its salt will invest in providing for its students the opportunities to be able to receive the highest quality instruction in music as possible.

Delimitations of the Study

This study will be delimited to the eighth grade students of one middle school in a suburban school district who were in attendance from the fall of 2007 to the spring of 2010. All eighth grade students in 2007-2008 were required to take the ITBS and NWEA tests during that academic year and all eighth grade students in 2009-2010 were required to take these tests again during that school year. Data on grade point average (GPA) and class grades were routinely collected. Socioeconomic status (SES) data were collected through official venues of permission request and granting. Study findings will be limited to the eighth grade students who were enrolled in the instrumental music program for all three of their middle school years in the research school.

Limitations of the Study

The data sample used in this study is confined to eighth grade students enrolled in the one middle school in the research school district during the 2009-2010 school year. Instrumental music students are defined as only those students who were enrolled in the formal instrumental music program, limited to band, during the 2009-2010 school year. Instrumental music students who received out-of-school instruction from a private instructor are not considered in this study as an added variable. The study focuses on reading and science achievement, only as measured by commercial and state standardized assessment tools and on student academic achievement of a specific age group (eighth grade middle school students). Additionally, the study takes into account the number of years each student has been involved in the formal public school instrumental music program (all three years of middle school in the research district). The Iowa Tests of Basic Skills (ITBS) reading comprehension (RC), reading vocabulary (RV), and science subtests scores, the Northwest Evaluation Association (NWEA) reading measure of academic progress (MAP) Rasch Unit (RIT) score are the dependent variables in the study. The independent variables in the study are student socioeconomic status (SES) as determined by the eligibility for participation in the free and/or reduced lunch program, student gender, academic achievement (AA) as measured by grade point average (GPA), music motivation (MM) as measured by competitive musical achievement, music involvement (MI) as measured by extracurricular musical ensemble participation, and instrument section (IS) as measured by section of participation in the school band.

Definitions of Terms

Academic achievement (AA). Academic achievement is defined in this study as a student's raw score and/or percentile performance in reading and/or language arts and science on a district-wide standardized assessment, i.e., Iowa Tests of Basic Skills (ITBS) and/or another standardized assessment tool, the Northwest Evaluation Association (NWEA) normal curve equivalent (NCE) scores and/or Rasch Unit (RIT) scores. Academic achievement is also defined as a student's grade point average (GPA), where below average/average (DF/C or 2.50 and below on a 4.0 scale) is one category and above average/superior (B/A or 2.51 and above) is another category.

Analysis of variance (ANOVA). Analysis of variance is a hypothesis-testing procedure that is used to evaluate mean differences between two or more treatments (or populations). As with all inferential procedures, ANOVA uses sample data as the basis for drawing general conclusions about populations (Gravetter and Wallnau, 2009).

Arts. Arts is defined as a category of school engagement that includes student groups involved in enrichment activities in the music performing arts category during the regular school day and outside of it, sponsored by faculty at the research school. For the purposes of this study, this category of engagement involves only the music performing groups.

Extracurricular musical ensemble participation. A student's involvement in one or more of the research school district's four major musical groups determines whether a student is least involved or most involved in the school's music program for the purposes of this study. Least involved would be characterized as participation in one to two of the four large groups, while most involved would be characterized as participation in three to four of the available large groups. The four large group ensembles available for student participation are: band, choir, jazz band, and show choir.

Formal instrumental music instruction. Formal instrumental music instruction is defined in this study as an individual lesson, a group lesson, a music performance ensemble rehearsal, or any combination of these.

Grade point average (GPA). For the purposes of this study, grade point average (GPA) is divided into two categories: below average/average (DF/C) and above average/superior (B/A).

Instrumental music student. An instrumental music student is a student who was enrolled in a formal public school winds and percussion band instrument instructional program that included a minimum of 45 minutes of instruction per week, which also included at least one large group rehearsal as part of that minimum instructional time.

Instrument section (IS). An instrument section, for this study, is broken down into two large classes: woodwinds (WW), including the following instruments of the band: piccolo/flute, oboe, clarinet/bass clarinet, alto/tenor/baritone saxophone, and bassoon, and brass and percussion (BP), including the following instruments of the band: trumpet, French horn, trombone, baritone/euphonium, tuba, keyboards/mallets, and batter/snare drum.

Iowa Tests of Basic Skills (ITBS). The Iowa Tests of Basic Skills was developed by the Iowa Testing Service at the University of Iowa and assesses student achievement in various content areas and reports reliable and valid norm-referenced data. Information about reading skills, language arts skills, mathematics skills, and science skills is provided in the resulting reports to evaluate students' and schools' strengths and weaknesses and to serve as a framework for assessing growth (Hoover, 2003).

Music achievement. Music achievement in this study is defined by a student's attainment of any awards that were earned through either performance before a qualified adjudicator, in a competitive audition, or both. For this study, these awards include: instrumental solo/ensemble awards, vocal solo/ensemble awards, district/region-level honor band membership selection, district/region-level honor choir membership selection, state-level honor band membership selection, and state-level honor choir membership selection.

Music involvement (MI). Music involvement in this study is measured by a student's participation in one of the four large group musical ensembles offered within the school day schedule by the research school district. Membership in just one of the groups (the eighth grade band) is considered least involved, while participation in two to four is considered most involved for this study. This is significant because each one of the four ensembles offered takes a time slot that would be otherwise open for another course selection by a student, thus attesting to a student's music involvement as well as music motivation.

Music motivation (MM). For the purposes of this study, music motivation is categorized in two areas: no/minimal and some/high motivation, which is determined by attainment of competitive musical achievements (MA), including selection through audition to the research school district's jazz band/show choir, instrumental solo/ensemble awards, vocal solo/ensemble awards, district/region-level honor band membership selection, district/region-level honor choir membership selection, state-level honor band membership selection, and state-level honor choir membership selection. In this study, attainment of zero to three of these musical achievements represents no/minimal music motivation and attainment of four to six of these musical achievements represents some/high music motivation.

National standard score (NSS). A national standard score is defined by Iowa Testing Services as a number that describes a student's location on an achievement continuum. It is a scaled score, interval-level measure, allowing for meaningful statistical analysis of student achievement and growth over time.

Non-instrumental music student. A non-instrumental music student is defined in this study as a student who was not currently enrolled (when data was collected) in the formal public school winds and percussion instrumental instructional program at the research district school.

Normal curve equivalent (NCE). Normal curve equivalents are standard scores with a mean equal to 100 and a standard deviation equal to 21.06 (Salvia and Ysseldyke, 2004).

Norm-referenced test (NRT). Norm-referenced tests measure and compare an individual's performance to the performance of a similar group of students who have taken the same test. The NRTs used in this study were the Iowa Tests of Basic Skills (ITBS) reading comprehension (RC) and reading vocabulary (RV) and science subtests and the Northwest Evaluation Association reading Rasch Unit (RIT) measure of academic progress (MAP).

Northwest Evaluation Association Measures of Academic Progress (NWEA MAP). Northwest Evaluation Association (NWEA) Measures of Academic Progress (MAP) is defined as state-aligned computerized adaptive tests that accurately reflect the instructional level of each student and measure growth over time (NWEA, 2010). The MAP assessments were given in reading and mathematics skills at the research school three times each year, fall, winter, and spring trimesters. Scores on the NWEA MAP assessments are reported and analyzed using the Rasch Unit (RIT) scale.

Rasch Scale (RIT). The RIT scale is an equal interval scale. Equal interval means that the difference between scores is the same regardless of whether a student is at the top, bottom, or middle of the RIT scale and it has the same meaning regardless of grade level. RIT scales, like scales underlying most educational tests, are built from data about the performance of individual examinees on individual items. The theory governing scale construction is called Item Response Theory (IRT). NWEA uses a specific IRT model conceived by Danish mathematician, Georg Rasch, (1901-1980). Rasch is best known for his contributions to psychometrics, and his model is used extensively in assessment in education, particularly for skill attainment and cognitive assessments.

Reading achievement. Reading achievement is defined as a student's percentile performance in reading on a district-wide standardized assessment (i.e., Iowa Tests of Basic Skills – ITBS) and/or another standardized assessment tool (i.e., Northwest Evaluation Association – NWEA) reading raw score performance.

Reading comprehension (RC). Reading comprehension is the ability to understand text that is read, or the skills to construct meaning from text. Basic comprehension generally refers to understanding a subset of individual ideas generally related to content of the text or the main idea of the text (Qian, 2002).

Science achievement. Science achievement is measured by a student's percentile performance in reading on a district-wide standardized assessment (i.e., Iowa Tests of Basic Skills – ITBS) science percentile performance.

Socioeconomic status (SES). Research school district free and/or reduced price lunch program eligibility information was used to identify which students were eligible or not for the lunch program. Socioeconomic status is defined by a student's enrollment in Iowa's free and/or reduced price lunch program. The research school district data shows that 1,219 students out of 3,159 students (39%) were participating in the free and/or reduced price lunch program in 2008-2009. Congruent with these figures, of the total students ($N = 38$) participating in this study, 15 students (39.5%) were eligible for participation in the free and/or reduced price lunch program and 23 students (60.5%) were not eligible for participation in the free and/or reduced price lunch program throughout their middle school years grades six through eight. For the purposes of this study, low SES is defined by a student's enrollment in the free and/or reduced price lunch program and high SES is defined by a student not being enrolled in the free and/or reduced price lunch program.

Significance of the Study

This study is designed to examine factors affecting the literacy achievement of eighth grade middle school instrumental music students. The study has significance on a curricular level and an educational policy plane. Results of this study will build upon previous research on the topic and provide implications for students, parents, teachers, administrators, the schools in which they learn, teach, and lead, the communities in which they live, and the future they will all build for themselves within those schools and communities.

Contribution to research. This study contributes to the body of limited, but growing, research on the effects of long-term public school instrumental music participation on students' academic achievement, specifically eighth grade middle school students' literacy development who have been involved in a formal public school winds and percussion band instrument instructional program that includes a minimum of 45 minutes of instruction per week, including at least one large group rehearsal as part of that minimum instructional time. Previous research has evidenced that instrumental music instruction does have a positive impact on students' academic achievement, but few such studies have been framed in terms specific to students' literacy development. This study will add to the body of knowledge and provide other researchers with additional resources for future study, in general, and in specific to the body of research regarding the instruction and learning of music and its contribution to student literacy.

Contribution to practice. The impact an instrumental music program can have on a student population will be demonstrated through this study. Before such a program is vanquished due to academic or financial concerns, this study and others like it can be cited to counter such propositions. Because there has been a resurgence of interest in the brain and music connection, especially with regard to its relationship to general intelligence, it is clear that those who study it, from neuroscientists to educators, can contribute to the expansion of the knowledge base by conducting research projects in the area. The practitioner – both classroom teacher and school administrator – should learn as much about the human brain as possible and how to translate this new knowledge into policies and practices that enhance learning for all (Lovett, 2001).

Contribution to policy. Although the need to study music and the creation of art is important in and of itself, the results from this research project will demonstrate to those who would make decisions regarding school finances and programs that instrumental music does, indeed, contribute to the academic achievement, among so much more, to the students involved in these programs. It will provide facts and figures for those who may have to make difficult decisions in times of strife to not only spare, but also fortify these programs because they are good for kids.

Organization of the Study

The literature review relevant to this study is presented in Chapter 2. This chapter reviews professional literature on music psychology and scientific inquiry, literacy, socioeconomic background, general academic achievement, gender and extracurricular school activities, behavioral development of reading skills, language and motivation, neuroscience and brain research, evolutionary aspects of music and language, and reading, science, and music. Chapter 3 describes the research design, methodology, independent and dependent variables, and procedures that will be used in this study to gather and analyze the data, including the number of participants, gender, age range, racial and ethnic origins, inclusion criteria, dependent variables, independent measures, and the data analysis that will be used for each research question. Chapter 4 presents an analysis of the data generated from this study. Finally, Chapter 5 presents interpretations of the findings, conclusions, and recommendations for further study.

CHAPTER TWO

Review of the Literature

Introduction. Frances Elliott Clark, the charter president of Music Educators National Conference said in a speech in 1918 that in education no element except reading is more vital in awakening the keen powers of attention, interest, concentration, selection, contrasting, judgment, and imagination (Allsup, 2007). As illuminated by Clark's comments in the early twentieth century, the issue of the interrelationship between the affective and cognitive-verbal domains was and still is of great concern. Not only are the arts and the humanities significant motivators for student participation in the total educational context – creating enabling conditions – but that education in the arts and humanities is much more (Engel, 1977):

> …That any division between cognition (reason) and affect (feeling) is artificial and ill-motivated; that certain of the arts bear strong analogies with certain of the sciences; that the capacity to read and produce symbols is central in both of the "two cultures"; and that any curriculum which focuses exclusively on the sciences or on "discursive language" is neglecting significant proportion of the mind, and equally, of the human brain. (Perkins & Gardner, 1977).

As music psychology has begun to move into the arena of scientific inquiry, to include cognition and brain research, this enormous growth has made it necessary for music researchers to widen their command of the literature and expertise within these fields. If music can be seen as a window to the human mind, then the science accompanying it has a coveted place in the inquiry of it.

In future perceptual research in music, according to Cornelia Yarbrough, the 1996 recipient of the Music Educators National Conference's Senior Researcher Award, researchers must understand what is known about the human brain. Further, she advises researchers who are also teachers to inquire philosophically into the functions of cognitive, psychomotor, and affective skills and characteristics. It is within all these parameters that this review of the literature surrounding brain research, the arts, music and reading and literacy development, and indeed, overall academic achievement, attempts to connect and make sense of the interplay among these subjects.

Many studies have documented the association of participation in school-based extracurricular activities with higher levels of academic commitment and better academic performance. Evidence is consistent with the model that it does indeed influence adolescent development in positive ways (Darling, 2005).

This review and the subsequent study is not an attempt to justify the existence of music as an ancillary to any academic subject, even in light of the increasing pressures to validate music in education which have long cycled through the decades. While there is much evidence that music does provide support to academic endeavors, it is not for this sole purpose that it should be integral in children's education. Rather, it is the notion that a successful society is one in which music takes center stage that permeates this work. As Plato said, music is a moral law – it gives soul to the universe, wings to the mind, and flight to the imagination. When one realizes that the human mind is partly musical and that musical intelligence has relationships with other intelligences, it is but a single step for educators to recognize that encouraging and nurturing musical development may be an important responsibility of schools, not simply just an option (Wilson, 1985).

Multiple intelligences. Howard Gardner first introduced the theory of multiple intelligences in 1983 in his book, *Frames of Mind: The Theory of Multiple Intelligences*, to define and explain the numerous ways learning occurs. Until the 1980s, there had been a general belief that intelligence was an inherited single entity as indicated by an intelligence quotient. Gardner challenged this concept by defining intelligence as the result of specific roles, potentials, and skills that allow individuals to process information in a manner that will solve problems or create products that are of particular value to a specific culture or community. Everyone possesses a measure of all the intelligences. However, no two people have all the intelligences to the same degree or the exact same combination of the intelligences.

Achievement in any intelligence, according to Gardner, is a reflection of inborn ability, cultural stimulation, and training. This training, or learning, results in specific alterations in the synaptic connections within the brain. The various combinations of these altered synapses led Gardner to develop specific criteria that described and explained the characteristics of several possible intelligences.

Gardner originally outlined seven intelligences. The first two, linguistic and logical-mathematical, have traditionally been the primary focus in educational settings (Dickinson, 1993). The next three intelligences, musical, bodily kinesthetic, and spatial, are related to the arts. Interpersonal and intrapersonal intelligences reflect the capacities to understand the intentions, desires, and motivations of self and others (Smith, 2002). In developing the multiple intelligences theory, Gardner classified several of the intelligences into broad categories. The spatial, logical-mathematical, and bodily-kinesthetic intelligences are object-related since objects an individual comes in contact and interacts with in a particular environment control them. Object-free intelligences consist of linguistic and musical, as they are dependent upon language and musical systems as opposed to being shaped by physical elements (Sherman, 2006). Gardner described linguistics as the ability to learn language, both spoken and written, and to use language to achieve specific goals. Musical intelligence involves skills necessary for performance, composition, and appreciation of musical patterns. Gardner thought that linguistic and musical expressions have common origins. One similarity is their reliance on auditory and oral systems for processing and understanding information.

Another common factor between linguistic and musical intelligences is dependence on similar systems of communication (Sherman, 2006). Both intelligences, as noted by Eady & Wilson (2004), incorporate symbol structures and decoding mechanisms to interpret and conceptualize meaningful sounds. Linguistic intelligence is characterized by the ability to aurally and visually process sounds as they relate to the letters representing the language. Musical intelligence is the ability to utilize the elements of pitch, melody, rhythm, harmony, and tone in creating an expressive means of communication when translated from music notation.

The characteristics that linguistic and musical intelligences have in common, as suggested by Gardner, have been confirmed by studies in research as linking reading development with music instruction (Butzlaff, 2000; Darby & Catterall, 1994; Dickinson, 1993; Fisher, 2001; Hansen & Bernstorf, 2002; Weinberger, 2004). Several researchers have even suggested that the similarities in the processes and symbol systems of one discipline may transfer and enhance the learning of another (Dickinson, 1997; Gromko, 2005; Rauscher & Hinton, 2006). However, others feel further research is necessary to substantiate the claim (Butzlaff, 2000; Eisner, 1999; Winner & Cooper, 2000).

Within all the intelligences Gardner suggested the existence of sub-intelligences that break down the general intelligence into various roles or activities in which an individual may participate. Linguistics can be broken down into reading, writing, speaking, creating, and analyzing. Musical intelligence includes playing, singing, writing scores, conducting, critiquing, and appreciating (Sherman, 2006). According to Reimer (1999), each sub-intelligence, or role, has its own set of cognitive processes that sets it apart from others within the one general intelligence. For instance, oral reading requires a process of converting a coded message (letters, words, sentences) into intelligible language. However, writing is more of an encoding process where the spoken word is converted into a coded form of letters, words, and sentences. Both of these disciplines are part of the linguistic intelligence, yet each relies on different learning processes. Similarly, the roles included in musical intelligence, such as conductor, listener, performer, and improviser, necessitate talents that are associated with each particular position. Sub-intelligence is dependent on a unique set of learning operations that characterizes it as distinct from another. Assuming that similarities in learning processes within a single intelligence have the capacity to exhibit equal measures of effectiveness on all sub-intelligences within that given domain is inappropriate. Consequently, the degree of similarities in multiple learning processes, when comparing two or more general intelligences, decreases significantly.

Advantages of multiple intelligences theory. With current research findings, support of a mindset related to a single intelligence has shifted to a belief in multiple intelligences, and the response by educators to Gardner's theory has been generally positive. Smith (2002) noted that one attraction to the theory is rooted in the ways students think and learn. Since learning styles vary in every classroom, the opportunity for developing multiple delivery styles is endless. The theory provides a conceptual framework for organization and reflection. It allows for the development of new instructional approaches and flexible curriculums capable of facilitating a transfer of knowledge from one educational setting to another.

Disadvantages of multiple intelligences theory. The theory of multiple intelligences, although widely accepted and embraced by the educational community, presents legitimate concerns to experts in psychology, psychometrics, and neuroscience. Empirical support is an area where the theory has significant problems (Smith, 2002; Waterhouse, 2006). There are no published empirical studies that validate the theory of multiple intelligences, a point that Gardner himself has conceded. The theory cannot be validated by means of testing since Gardner has not clearly defined the components within the intelligences that could be effectively evaluated. Neither can the theory be validated through application research since that process assumes the theory to be valid (Waterhouse, 2006). There is better empirical support for the theory of a single intelligence factor, particularly in the fields of cognitive psychology and neuroscience.

The multiple intelligence theory appears to be a viable way of thinking and practice. However, without adequate empirical support caution should be exercised with regard to its general application in education. In light of the literature reviewed, there is specific significance in the theory as it relates to the current research study. First, the theory is based on the value of achieving educational success through various abilities and learning styles. Whether there is a single general intelligence or many, the fact that individuals learn and process information at different rates, using various methodologies cannot be overlooked. Since the process of learning is equally as important as the final product, a goal of education should be to tailor instructional environments in such a way as to enhance and generate more effective academic achievement. Secondly, in developing the concept of multiple intelligences, Gardner suggested the existence of a possible relationship between linguistic and musical abilities. Since the purpose of this research study is to examine the extent and relevance of such a link, as it relates to music instruction and reading development, evaluating the claim for its merit in similar investigations is necessary.

Music learning theory. A leading researcher in the field of musical aptitude, Edwin Gordon, described and detailed the music learning theory in his book *Learning Sequences and Patterns in Music*. Gordon also developed and implemented several standardized tests designed to measure music aptitude at various ages. The oldest and most thorough music assessment tool is the Musical Aptitude Profile for children in grades 4 through 12 (Johnson, 2000).

Gordon based music learning on two concepts, aptitude, and audiation. Aptitude is readily definable and relates to most areas of learning. Audiation, a term coined by Gordon, is somewhat abstract by definition and limited to its relationship with music understanding. Relating the two as integral learning components is the foundation of the music learning theory.

According to Gordon, aptitude is the potential to achieve. Musical aptitude is a measure of potential to learn music. Children are born with a specific level of music aptitude, which is innate, as opposed to being inherited. Music aptitude can be developed; however, as with the multiple intelligences theory, it is dependent on environmental exposure and experience in music. Therefore, inborn potential and early environmental influences such as exposure to listening and experiences in performing are determining factors in developing music aptitude.

Musical aptitude is divided into two stages. The first is defined as the developmental music aptitude stage, which occurs in children from birth to nine or ten years of age. During this time period, music aptitude levels fluctuate considerably; a factor that Gordon claimed substantiates the need for early and continuous childhood music education. Somewhere after the age of 10, the developmental stage evolves into the stabilized stage. Gordon's research indicates that this is due to the diminishing effects of environmental factors at this stage of childhood development.

How effectively an individual learns music is dependent on the level of musical aptitude development. An individual learns music when what is heard is understood. That learning is based on audiation. Moore (1995) defined audiation as the act of hearing music or musical patterns internally when no sound is physically present. Gordon theorized that audiation is related to music in ways similar to those in which thought is related to language. Language is used to communicate speech, speech is how communication takes place, and thought is that which is communicated. Similarly, music is a tool used for communication purposes. Performance is how communication occurs, and audiation, or musical thought, is what has been communicated. Therefore, learning music is based on audiation, which is the precursor to musical understanding.

Gordon's approach to learning music is by means of a sound-to-symbol process where aural skills are taught before visual skills. Such a learning strategy emphasizes the process of sequencing using melodic and rhythmic skills, thus preceding descriptive words and definitions of musical symbols and structures. Children listen to and perform music before they learn to read and write musical notation (Johnson, 2000).

Although the music learning theory focuses on the development of musical aptitude, Gordon made comparisons of the similarities between reading text and reading music, using the sound-to-symbol process. Language and music utilize units of sound for aural processing, identified as phonemes and pitches, respectively. Both disciplines follow set rules for arranging sounds and pitches into well-formed sentences and melodic phrases. The objective of each is to facilitate meaningful comprehension as it relates to performing linguistically and musically (Johnson, 2000).

Once linguistic and musical vocabularies have been mastered through listening, speaking, reading, and writing, the symbols associated with each discipline can be learned. Reading language is recognizing words as unique groupings of letters that create mental images of the objects representing said words. What results is reading with a sense of comprehension. Similarly, reading music involves identifying patterns as groups of notes that develop a mental familiarity with how those patterns sound. As with the multiple intelligences theory, the music learning theory suggests that similarities in the symbol and communication systems may account for a relationship between music instruction and reading development. As a result of these common factors, Gordon suggested that a transfer of skills from one discipline to another is possible.

While the transfer of skills among music instruction and reading is acknowledged, critics of the music learning theory argue that although Gordon has developed a system designed to possibly replace previous ones, questions arise as to whether the theory serves the needs of music educators and students any better. Brink (1983) asserted that Gordon reinvented the wheel by creating new terms that describe the same learning concepts and processes found in research conducted prior to the music learning theory. Zimmerman (1986) took issue with Gordon's stages of musical aptitude development and the ages assigned to each. She strongly recommended further research into successive ages of children before definitive statements are made with regard to the developmental nature of musical aptitude and the age at which it stabilizes. While Gordon contended that the stabilized stage of musical aptitude occurs around the age of 10, he did not rule out the possibility that middle school students, as a whole, are in a borderline period of moving out of one stage and into another.

Music, literacy, and science. The content of science is important to language and literacy development in the middle school because science is an infinite source of meaningful content. It imbues language with a sense of importance and urgency and makes it integral to science learning (Thier, 2010).

Science education is in the process of shifting its pedagogical culture from an authoritarian sociointellectual discourse that emphasizes abstract knowledge separated from societal issues viewing language activity as marginal to a culture that places strategic language activity, critical thought, and social relevance at the core of its learning. Language is an essential technology, an integral part of science and literacy, particularly written language, and thus science is a process of inquiry conducted throughout the use of language (Yore, et al. 2004).

Scientific literacy cannot be attained without fundamental literacy – the ability to read and comprehend textual information and write competently about the subject under study (Norris & Phillips, 2003). One must be able to read and comprehend in order to examine information and must be able to compose (both in writing and orally) in order to communicate results, and several research studies have shown the positive effects of scientific inquiry on developing students reading skills and comprehension (Miller, 2006).

Inquiry-based science instruction can provide a rich context in which to build language skills, and inquiry and literacy intersect when students use reading, writing, and oral language to address questions (Hapgood & Palincsar, 2007). As in music, science offers many opportunities to expand students' vocabulary, an important benefit because one of the most robust findings regarding literacy is the relationship between vocabulary knowledge and reading achievement (National Reading Panel, 2000).

There is a small but significant body of research and scholarly work on the relationship between music, literacy, and science. Literacy strategies that can be learned and applied independently can have equal efficacy in the music and language arts classrooms (Begoray, 2008).

The extant literature is replete with studies researching the effects of music study on math and reading achievement, not to mention overall academic achievement including grade point average. Prior studies have considered elementary students and have not been, for the most part, of adequate length to prove consequential. Thus, studies by Costa-Giomi (1999), Kemmerer (2003), Perry (1993), and others, only show relatively equivalent measures between academic and intelligence scores as a result of music training. While some of the aforementioned studies have found that academic achievement did not improve – but only parallels – with music participation (Neuharth, 2000; Whitehead, 2001), others have found significant correlations (Andrews, 1997; Perry, 1993). These studies and others demonstrate a relationship between the arts – specifically music – and academic achievement, in terms of literacy. It is important to note that throughout the literature there are no studies that show participation in music negatively influences academic progress (Johnson & Memmott, 2006).

Music and socioeconomic background. Socioeconomic status (SES) is probably the most widely used contextual variable in education research. Increasingly, researchers examine educational processes including academic achievement in relation to socioeconomic background (Sirin, 2005). White (1982) carried out the first meta-analytic study that reviewed literature on this subject by focusing on studies published before 1980. The relation varies significantly with a number of factors such as the types of SES and academic achievement measures. While the empirical evidence of the latest studies are inconsistent, ranging from a strong relation to no significant correlation, Sirin's 2005 study demonstrated in that meta-analysis that family SES at the student level is one of the strongest correlates of academic performance, and that at the school level, the correlations were even stronger. Thus, that review's overall finding suggests that parents' location in the socioeconomic structure has a strong impact on students' academic achievement. Single subject achievement measures, such as verbal achievement, mathematics achievement, and science achievement, yielded significantly larger correlations than general achievement measures such as grade point average or composite achievement test scores. The results of the meta-analysis suggested future research in this area must assess student's family background, regardless of their main research focus.

In Woods' et al. (2005) study of SES and academic skills, the research team asked young adolescents about the musical and sports abilities of the rich and poor. Because of their saliency to children in that age group, they are aware of individual differences in all these areas. Citing the research of Croizet & Clair (1998), the team suggested an increase in teacher sensitivity training and in children's exposure to economic diversity could lead to greater awareness of the academic potential of all students.

Johnson and Memmott's (2006) other research findings parallel those of Catterall et al. (1999), who reported that, regardless of socioeconomic background, students involved in music had significantly higher standardized test scores than students not involved in music. This study also highlights confounding factors that plague the body of literature surrounding studies of this sort: data collection depth, which, while more could be collected, would at the same time decrease the number of subjects to be obtained. Further, the vast geographical representations, as chosen from widely diverse regions, serve as dependent measures. However, as with all research, the authors note the benefits of this broad sample outweigh these potential deficits.

Music and student academic achievement. As with most of the studies in the literature, acknowledgement of other possible explanations of the ostensible correlation between music and general academic achievement do exist. Some considerations include the possibility that schools that are diligent in hiring excellent music teachers might also be so in hiring excellent teachers across the board. Another explanation might be that excellent music programs attract academically gifted students, thereby bloating the averages and/or benefiting the more average students as a result of their association with the more gifted ones. Organizational skills and learning strategies that are generally and naturally present in music programs may transfer into the acquisition of knowledge in other subjects. This research agrees with previous research showing that music supports academic achievement (Butzlaff, 2000; Neuharth, 2000; Perry, 1993; Whitehead, 2001).

The notion of causation would seem to follow. However, while the relationship between music and academic performance appears to be strong, there is nothing in this and other studies that should necessarily imply causation. This brings to the table a discussion of the purpose of music and music education, which has long been and is more so becoming a serious topic of conversation among music educators as earlier alluded in this review. The purpose of music and music education is not to improve English test scores, and one should no more study music to improve English scores than one should study English to improve music scores (Johnson & Memmott, 2006). Numerous researchers in the area of music and academic achievement echo this philosophical viewpoint as referred to earlier in Wilson's (1985) comments.

To further illustrate these considerations, the arts and humanities have traditionally been taught in the schools as an enrichment of the basic curriculum, as ancillary to the core of knowledge and skills acquisition, and therefore as expendable frills (Engel, 1977). However, recent research suggests that the arts constitute the discipline or process as well as the body of knowledge of cognition, as will be evidenced throughout this review of the literature. In fact, in this particular early study, Engel points out that these disciplines could very well have profound impact on the more basic skills of reading comprehension and writing; that is, verbal expression, because, it is argued, learning and teaching in these areas include abilities which are truly fundamental to critical societal functioning. The capacity to receive and express verbal information within the cultural context, and to have competence in thinking, demands a more comprehensive understanding of modes of human symbolization. Thus, reading must be understood as human literacy among all modes of expression and communication essential to personal and social well being (Engel, 1977).

Gender and extracurricular activity participation. Research has found consistent gender difference in preferences for and participation in extracurricular activities. Studies have found that boys prefer sports and girls prefer music and art (Bucknavage & Worrell, 2005). This may well be related to differences in competence beliefs in those areas that students develop as early as first grade, and during the adolescent years, this translates into the need for peer acceptance and social affiliation often becomes the central concern of the adolescent's world. For both genders, physical appearance, academic performance, and participation in extracurricular activities determine a portion of the individual's acceptance. Beyond that, however, norms are gender specific. For males, athletics factors into the equation while for females it is aesthetics and popularity with the opposite gender. Such societal scripts influence young peoples' achievement (Quatman, Sokolik, & Smith, 2000).

The gender gap in academic achievement between boys and girls is widening. The NAEP (2003) writing tests show boys scoring an average 24 points lower than girls. It is difficult to identify where the problem begins in this complex subject. Societal expectations, long-held stereotypes, and myths about gender complicate conversations about the performance of boys and girls in the classroom. What we do know is that brain-based gender differences are at play (Connell & Gunzelmann, 2004). Research demonstrates that the way young boys and girls use their left and right hemispheres are markedly different, as a result of sex hormones. For example, many girls' left hemisphere strengths appear in the form of speaking, reading, and writing while their right hemisphere enables them to feel empathy and employ reflection. In boys, the left hemisphere advantage appears in the ability to recall facts, rules, and categorize, while the right brain encompasses visual-spatial and visual-motor skills, which enables them to excel in topics like geography, science, and math.

Yet national statistics show that boys are having more academic difficulties and are achieving at lower levels across most school subjects as a group than are girls, as shown by test scores, grades, and dropout rates (U.S. Department of Education, 2004). In addition to achievement data, there are attitudinal and motivational data that indicate boys, as a group, do not seem to think school is as important in their lives as do girls (NCES, 2005). Kessels' (2005) findings suggest that the development of students' motivation and interests at school reflects societal demands of fitting in, which during adolescence emphasize gender-role acquisition and peer-group popularity. Girls significantly outperform boys in reading literacy, a subject that is stereotyped as feminine.

Middle school appears to be a time when the gender achievement gap widens. Teachers and parents should encourage girls and boys in areas in which they doubt or under-develop their ability. Technology jobs will dominate the economy in the next century, and adeptness with computers will be necessary. Girls' doubt of themselves in these areas needs to be eliminated. As reading is the foundation for good performance in most other school subjects, it is crucial that this area of concern for boys is addressed (Freedman-Doan, Wigfield, Eccles, Blumenfeld, Arbreton, & Harold, 2000).

Music education and behavioral development of reading skills. The main goal of the imminent experiment is to investigate how aesthetic ability in arts education, specifically participation in music, correlates with behavioral development of academic achievement in middle school students, namely literacy. Recent research has indicated that the amount of musical training significantly correlates with the amount of improvement in reading fluency demonstrated in children over a three-year period of study (Wandell et al., 2008). This research team is careful to point out that this correlation does not necessarily imply that music training caused the reading improvement, but that the observed correlation should be followed up with a control study to analyze the possibility of a causal connection. Further, replication of the study is warranted to continue to build on the body of research knowledge that could answer this and other questions of causal relationships between music and reading development.

The interest in equipping children's reading ability has been around since the days of Horace Mann and the one-room schoolhouse. Likewise has been the interest in music and its performance. It was only a matter of time that the relationship between music and reading would become a topic of educational research, and – as a serious subject of inquiry – in the mid-twentieth century, so it did. One of the earliest studies found that the correlation between music reading and language reading was low but positive nonetheless (Wheeler & Wheeler, 1952).

Literacy learning and music learning. Literacy – as defined by Meltzer, Smith, & Clark (2001) – is the ability to read, write, speak, listen, and think effectively, enabling students to learn and to communicate clearly about what they know. Being literate gives people the ability to become informed, to inform others and to make informed decisions.

Literacy is synonymous with learning, requiring connection with the ever-increasing knowledge base for each content area. It is an active process and therefore, by its very nature social, wherein collaboration and engagement lead to increased motivation. This notion is supported by Smithrim & Upitis' (2005) analysis, which provided strong indications that involvement in the arts went hand-in-hand with engagement in learning at school. Their modest but statistically significant findings on the positive affects the arts have on student achievement were developed over a period of three years of programming, demonstrating gradual development of ability. It is hypothesized that this occurs as a result of these students' high levels of engagement.

Literacy learning, like music learning, is recursive. Students at every level in their development apply similar skills and concepts as they use more complex materials. Therefore, the essential skills and concepts for each level are very similar. An argument regarding emergent literacy as described by Heller (2002) poses that this is a developmental stage in which decoding occurs, which describes the learner's ability to see and manipulate sound/symbol relationships; fluency describes a level of word-reading proficiency. Thus, while there are some surface comparisons between learning to decode words and music-text symbols, based on oral language, there is minimal research to support that the latter is particularly essential or beneficial to reading acquisition. In a retort to this claim, however, Hansen & Bernstorf (2002), concede that while this is true, the challenge is posed to conduct studies proving the postulates of the ideas that decoding skills appear to be parallel in reading both text and music as reading skills and music skills advance through time.

Among some of the earliest studies in this domain, Freeburne & Fleisher's (1952) and Hall's (1952) findings showed that certain musical backgrounds tend to increase speed of reading for high school and college groups, yet the two studies disagreed on the role which IQ plays as an intervening variable. The limited research conducted to establish firm correlations or causal effects between music reading and text reading, such as a study by Lamb & Gregory (1993) has found a high correlation between children's ability to read and ability to discriminate pitches accurately.

In a meta-analysis study investigating reading achievement and music, a relationship between the two was found. One such analysis demonstrates that there is indeed a strong and reliable association between the study of music and performance on standardized reading/verbal tests. However, correlational studies such as this cannot explain what underlies this association. For example, it is possible that students who are already strong in reading choose to study music, and those who are interested in music are also interested in reading because they come from families which values both music and reading, or it is possible that a causal relationship exists, such that either music instruction transfers to reading achievement or the reverse (Butzlaff, 2000).

The test of the directional and causal hypothesis that instruction in music leads to heightened achievement in reading is in the examination of experimental studies, of which there are very few, and yield no reliable effect, thus suggesting that further research is needed. The fact that the few experimental studies conducted produced large effect sizes suggests that further exploration of this question is merited (Butzlaff, 2000).

The National Association for the Education of Young Children (1999) advises that learning to read and write is a complex and multifaceted process that requires a wide variety of instructional practices. Most basic skills used in text reading or decoding find parallels in music reading. Additionally, in choral music, one reads text or lyrics as they correspond to the musical symbols. According to findings by the National Reading Panel (2000), strong decoding skills have been found to be essential for reading text with comprehension.

In the immediate future, literacy researchers who want to reach beyond education to the arts need to do so within the limits of well-defined questions and tightly controlled research methods that examine the arts as a factor within literacy development across media and contexts (Heath, 2004). It has been suggested that future research in this arena focus on the comparison of the reading abilities of students who have been given music instruction emphasizing specific reading skills against students who have received literary-text-only instruction (Hansen & Bernstorf, 2002).

Duffy & Hoffman (1999) assert that improved reading is linked to teachers who use methods thoughtfully, not methods alone. Teachers need, however, to be knowledgeable about what methods are effective and for what children for the methods to take on a richer meaning (Juel & Minden-Cupp, 2000). The arts, and specifically music, are one such method that can contribute to this endeavor.

Gazzaniga (2008) explains that a vast area of valuable research lies between tight-correlation- and hard-evidence-based causal explanations, and that, while it does matter whether the scientific correlations found are loose or tight, this new research has done just that: lain the groundwork for unearthing true causal explanations through understanding biological and brain mechanisms that may underlie those relationships. He also goes on to say that theory-driven questions using cognitive neuroscience methods can go beyond efficacy-of-outcome measures by framing experiments that demonstrate how changes in the brain, as a result of arts training enrich a person's life, and how this experience is transferred to domains that enhance academic learning. Further, Gazzaniga (2008) declares that such mid-ground studies would significantly advance the knowledge base even though they are not at the level of cellular or molecular explanations.

Summarizing the group of participating scientists' research findings in the Report, Gazzaniga notes the findings of Wandell, et al. (2008), who found that correlations exist between music training and both reading acquisition and sequence learning. One of the central predictors of early literacy, phonological awareness, is correlated with both music training and the development of a specific brain pathway.

Language, music, and motivation. Music and human development research has multiple perspectives. The increasing amount of investigation into the broader context of music with regard to the cognitive, emotional, behavioral, and social aspects of children's lives – beyond a sort of supportive role – has considered it as an entry point into the topics of other learning, such as literacy.

Despite, and even perhaps in spite of, Swanwick's (2001) criticism of findings regarding music's causal effects on this learning, there has certainly been a number of clear, well-supported correlations that have been found between music instruction and cognitive/neurological development and academic improvement, as indicated by Altenmuller (1997), Catterall et al. (1998), and Costa-Giomi (1999) among the many others identified within this review.

Looking at several unpublished doctoral dissertations that support the need for extensive investigation of the connection between music and the development of language and/or reading skills, Cutietta (1995, 1996) indicated the findings showed significant growth in these areas. Since the studies he looked at included small numbers of subjects, he suggests that these studies be replicated.

The spontaneous disposition children have toward rhythm and melody make music an ideal tool for teaching the many facets of language: listening, speaking, reading, and writing (Kolb, 1996). This is further supported by new research garnered through the advances in technology in the field of neuroscience including functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET) brain scanning capabilities not available before. While still in a fledgling period, much of the results from studies thus far points to a connection between music and language, as will be highlighted throughout this review.

Guthrie, Wigfield et al. (2006) investigated whether classroom practices and education programs can influence reading motivation and thereby increase reading comprehension. Using Guthrie and Wigfield's (2000) theoretical framework of engagement perspective on reading comprehension, they focused on instructional practices that can increase reading motivation and reading comprehension, which shed light on the relationship of hands-on activities to reading engagement. This theoretical perspective on the relationship between situational interest and reading comprehension is that for stimulating tasks to have lasting effects on motivation and comprehension, they must be connected conceptually to further knowledge (Guthrie et al., 2006).

In a study by Sweet et al. (1998), teachers reported that the motivation of low-achieving students increased when books were connected to activities in which these students participated and enabled the students to read about a specialized extracurricular activity. The hands-on activity, such as playing an instrument, is one such stimulating task. However, that practice has not been studied experimentally for an examination of its effect on students' reading motivation or reading comprehension (Guthrie et al., 2006). Shiefele (1999) showed that students process information in text deeply if they possess a high level of situational interest for the topic of the text. Reading comprehension of text, then, is high when students are curious or excited about the topic. This stems from performing stimulating tasks of hands-on, kinesthetic tasks, such as playing an instrument.

Among motivation theories, attribution theory in particular has received considerable attention in music. The research indicates that music students have significantly greater tendencies toward internal attributions (ability and effort) over external attributions (luck, task difficulty) for success and failure, and these seem to be consistent across grade levels, school settings, and music populations (Schmidt, 2005).

Marsh, Craven, Hinkley, and Debus (2003) have hypothesized task/learning versus performance/ego orientation as two higher-order factors of academic achievement motivation. Marsh et al. defined task orientation as intrinsic motivation and learning goals, whereas they defined ego orientation as extrinsic motivation and performance goals. This study suggests that the motivation variables in instrumental music are not unlike those found for general academic achievement motivation.

Levels of students' internal characteristics, such as motivation and self-confidence, also strongly influence their achievements; however, little is known concerning the extent to which each of these factors affects academic performances and expectations. Expectations are the strongest predictors of students' performances in school, implying that if students have strong beliefs that they will accomplish a particular skill or goal, they are more likely to succeed in that attainment (Tavani & Losh, 2003).

Because reading is an effortful activity that often involves choice, motivation is crucial to reading engagement (Wigfield et al., 2004). The kinds of experiences that children have in classrooms strongly influence their motivation for reading and other subjects. Some experiences and educational practices can enhance children's motivation, and others may undermine it (Stipek, 1996, 2002; Turner, 1995).

Finally, Gazzaniga and the Dana Consortium Foundation (2008) have provided a mechanism for understanding the need for action in research. Current research of this kind offers validity for the future studies that build upon it, from the neuroscientist level to the educational practitioner level. Such further research suggested includes the question regarding to what degree the link between music training and reading is causative as well as correlational.

Neuroscience and brain research. Single studies may attract our attention because our desire for information has outpaced the ability of the field of neuroscience and educational research to provide information. We still need more related studies to provide multiple, converging findings (Weinberger, 1998). In a 1992 study, Sergent et al. found that activation of the human brain through the playing of, listening to, and reading of music caused an activation of the left cerebellum through the performance of scales, as measured with Positron Emission Tomography (PET). Overlapping with the premortial area that is activated in writing words and the left frontal region, Sergent et al. concluded that areas of the brain cortex become activated in listening to music and music-making that overlaps with identical areas which are involved in speech and speech perception (Pape, 2005).

Contrary to popularized thought of the 1970s findings in music and brain research, while certain areas of the brain do seem to exhibit a preference for music, the advent of medical technology in neuroscience has delivered more detailed information in the imaging of the human brain. Scans taken during musical performances show that virtually the entire cerebral cortex is active while musicians are playing (Weinberger, 1998), which refutes the earlier notion that the brain might be divided into two spheres where the right side exclusively controls musical function. Both sides actually control different aspects of musical behavior. Brain researchers have just begun to discover music as a whole-brain function.

Brain research pioneer Robert Ornstein (1997) makes this observation, and modern neurobiologists and neurochemists that study changes in the brain show this in their imaging studies. These same scientists who study this physiological piece also consider the cognitive characteristics. The notion of flow, as described by Csikszentmihalyi (1977, 1997), is the merging of action and awareness where consciousness narrows to focus attention is one such cognitive characteristic. In one study, professional pianists underwent brain scans while performing Bach on the piano. What resulted included a clear demonstration that motor control systems were highly activated during performance. At the same time, other brain regions were strongly deactivated – in effect, switched off – a hypothesized indicator of focused concentration (Hodges, 2000). It is this joining of positive emotions with academic challenge that may be an important virtue when considering the long-term value of music participation, viewing motivation as emphasizing learning as a process, highlighting the importance of concentration, enjoyment, and interest for building skills (Shernoff & Schmidt, 2008).

This idea coincides with what is described as the enjoyment of what one does – a desirable goal, though not always achieved – as preferable to being bored or frustrated. Where efficiency has been highly prized, pleasure takes time – the time for creative processes to unfold; time to experiment and fail and revise and try again; time to linger, to think, to talk, to share. When teachers and administrators – indeed, whole districts and states – are focused on raising test scores that time quickly starts to seem like a luxury (Weinstein, 2006). Hargreaves & Fink (2006) similarly espouse this view in their discussion of what they term in their writing as slow knowing.

In Peretz & Zatorre's 2005 study of brain organization for music processing, a vast network of regions located in both the left and right brain, with an overall right-sided asymmetry for pitch-based processing was observed for recruiting musical activities. This wide distribution, while not surprising due to the complexity of musical production, raises the issue of what brain areas are dedicated to music processing. It is thought that not only might language and music processing overlap, but may share such components. Based on Henschen's 1924 neurology studies, Peretz & Zatorre (2005) suggest that the part of the brain known as Broca's area – is a vast brain region that can easily accommodate more than one distinct processing network (Koelsch et al., 2002; Marcus et al., 2003) – is shared between music and language in syntactic processing (Levitin & Menon, 2003; Patel, 2003).

Thomas' (1969) model in which the eye and brain act together to build up a percept lends itself to the processes involved in perceiving graphic stimuli. However, with regard to reading, the periphery may play a more important role than responding primarily to movement during scanning and searching (Schiffman, 1972). Gibson (1969) concurs with this line of thought that a skilled reader takes in more at a single glance by the combined operation of peripheral vision and efficiency in grouping word chains into perceptible units.

Parsons et al. (1998) found that an area in the right half of the brain interprets written notes and passages of notes. This area corresponds in location to the area in the left half of the brain known to interpret written letters and words, lending further credence to the more current studies in this review showing similar results.

Children with reading deficits that accompany general oral language impairment frequently have small, symmetrical auditory cortical regions whereas children with specific reading (not oral language) deficits tend to have extra gyri in auditory cortex and exaggerated cerebral and cerebellar asymmetries (Leonard et al., 2001). Further, the view that comprehension and phonological ability are separate dimensions in reading ability is supported by the results of several studies which show that oral language skills and general intelligence contribute variance to reading scores that is separate from that contributed by phonological skill (Leonard, 2001).

Skilled musicians who started musical training early have larger auditory cortex and motor cortex (Schlaug et al., 1995). It is not clear if the larger cortical areas predisposed the children to seek training or resulted from the training. Leonard (2001) makes this analogy to reading that children with large cortical areas for processing auditory and visual word forms will have an advantage in processing language and text. If the environment is filled with language opportunities, reading is facilitated.

Wandell et al. (2008), using Diffusion Tensor Imaging (DTI) technology, discovered that strong and weak readers differ at a particular location within the posterior segment of the corpus callosum. Dougherty et al. (2007) and Wandell et al. (2008) also found that the diffusivity of water in the direction perpendicular to the callosal fibers is highly correlated with phonological awareness and reading skill. Further, they found that diffusion in the axon fiber bundles that connect the brain's temporal lobes is most strongly correlated with phonological awareness, which, as earlier mentioned, reliably correlated with reading ability. Children with better phonological awareness skills have fewer and perhaps larger axons passing through the part of the callosum that connect the temporal lobes. This is significant because the behavioral correlation between music training and reading fluency in their studies suggests that there could be a relationship between music training and development of the diffusion properties.

Evolutionary aspects of music and language. Music does not take place in a neural or psychological vacuum. While music may engage unique combinations of brain modules or systems these systems have not evolved just in case music developed in human culture. These systems, and their constituent brain cells, are not quiescent until utilized by music. In fact, unused neurons tend to lose their synaptic connections and wither (Weinberger, 2000).

Because we are primates – mammals that walk upright – our upper limbs are not used to supporting our body weight against gravity. With this mechanical change in posture, as humans, we have been given the opportunity to use hands and arms for a variety of specialized tasks. The brain's motor control system allows for the movement of limbs, control of the muscles of the face and oral cavity, and brain functions for controlling these muscles, all of which contribute to what makes us human and unique, as well as the capabilities and urge to communicate. As Wilson (1985) elaborates, making music involves the full exercise of these innate and special human capacities.

Creating art demands sustained visual focus, attentional memory, and role and stance self-assignment. All of these ways of learning have recently drawn considerable attention from neuroscientists. Such work across disciplines is being undertaken to consider the creation of art in the history of human evolution as well as through the span of individual development.

Since music and language are apparently universal human capabilities, it is possible that music is an evolutionary precursor to language. This speculation is comparable to the hypothesis that music confers an adaptive advantage by virtue of strengthening social bonds (Parsons, 1998).

A consensus of findings has emerged among researchers that phonological processing skills are fundamental to language development and to subsequent reading abilities (Brady, 1991; Fletcher, Foorman, Shaywitz, & Shaywitz, 1999; Wagner, Torgesen, & Rashotte, 1994). The question of domain-specificity is important from the evolutionary standpoint with regard to music and language (Hauser et al., 2002). The observations by Peretz & Zatorre (2005) that they share processing areas within the brain demonstrate that the part of the brain known as Broca's area, where this is thought to occur, can accommodate more than one distinct processing network (Marcus et al., 2003).

Students in arts environments play with and seek out multiple forms of literacies. Following language learning inevitably means following other forms of learning as well. Research attention to this area comes from the fact that the arts demand extended periods of time as well as special places for learning. Displays of progress show up through means other than simply the verbal (Heath, 2004). Rigorous practice schedules, association with professional artists, performances before audiences and hours of group practice are all factors of habits of strategic thinking that draw learners into language learning and reading comprehension. Work within the arts requires multiple types of verbal interactions repeated and reiterated in numerous ways.

Reading and music. Reading involves the detection and recognition of graphic symbols. The efficient performance of reading depends on many related sensory and perceptual characteristics of the physical input such as form, size, and patterning illumination and contrast, and the manifold features that determine visibility of printed text (Schiffman, 1972).

Literacy researchers, understandably, center on reading and writing through instruction and learning. Very few scholars centrally engaged in literacy research know studies on language acquisition, and fewer still have reached into the neuroscience or cognitive science aspects of it (Heath, 2004), as described above. To know what these fields might contribute to our understanding of literacy requires independent exploration into these fields and amalgamation of them.

Imaging techniques like PET and fMRI show areas of brain activity that underlie the various cognitive components of reading, but they cannot yet show how these areas interact during reading. Since so much happens in skilled reading, it is not possible in the one or two seconds for these tools to capture the dynamics of the brain processes.

Research suggests that when we read language, we read groups of words and similarly, when we read music we read groups of notes (Smith, 1997). Tonal and rhythm patterns are equivalent to words in language; they are the parts that make up the whole (the song). Just as children comprehend language through familiar words and phrases, they can understand the structure of tunes by becoming familiar with these varied patterns (Liperote, 2006).

There appear to be natural links between musical activity and literacy development. Within group musical activity, children learn as they read language within the highly active and engaging learning contexts music making provides (Fisher & McDonald, 2001). As identified by Frith (1985), the three stages of learning to read must be understood to grasp how music can benefit reading. Visually recognizing words (graphemes) and aurally recognizing their corresponding spoken sounds (phonemes) and achieving visual recognition of words without going through the earlier stages are how reading development transpires.

The phonemic stage is considered the most important in reading development and music can facilitate reading by improving on this sounding-out stage. Studies have shown a relationship between the visual arts and phonological awareness, an auditory skill that is reliably correlated with reading ability (Wandell et al., 2008). Lamb & Gregory (1993) determined the relationship between musical sound discrimination and reading ability. Their study suggested that the ability to discriminate between pitches in music enhances the phonemic stage of learning. Changing word pitch is a factor in conveying word information. The relationship between reading and music is thus clear because music training involves improving pitch discrimination (Weinberger, 1998).

The relationship of academic achievement to sight-reading in music investigation by Gromko (2004) found that high levels of music reading in high school wind players could be predicted by a combination of reading comprehension, auditory discrimination of rhythmic patterns, visual-field articulation, and spatial orientation.

A study showing an association between rhythmic ability and reading prompted the examination between music and literacy. A pilot study showed that training in musical skills is a valuable additional strategy for assisting children with reading difficulties (Rauscher et al., 1997). It has thus been suggested that a structured music program be utilized to assist children develop a multisensory awareness and response to sounds. This research demonstrates that the ability to respond physically to a musical beat is closely linked to children's skills in reading, writing, and concentration. Given the ability to develop an innate sense of timing as infants through lullabies and as children grow older using nursery rhymes and the like; they make connections between what they hear and what they do. This links action through language and supports speaking and reading in whole sentences as opposed to just one word at a time.

It is important to acknowledge the vast amount of research completed by Rauscher & Shaw in the music and brain field. Their contributions have been many. It should also be noted at this point, as Scripp (2002) intimates, that it would be a mistake to base school programs solely on recent research focused on the effects of music (e.g. the Mozart Effect), when far more studies tell us that making music and becoming literate in music – being able to read, interpret, and write music – make a greater and more sustainable difference in enhancing learning in other subjects. What Drs. Rauscher & Shaw have been able to emphasize is the causal relationships between early music training and development of the neural circuitry that governs spatial intelligence.

Among the earlier studies surrounding this question, Pelletier (1965) found that teaching students to play string instruments increased their reading achievement. Hurwitz and colleagues (1975) investigated whether music training improved reading performance in first graders. Upon listening, the experimental group exhibited significantly higher reading scores than did the control group. These results beckon the question: Was reading enhancement caused by music? They also ask: How could music training possibly improve reading and thus overall academic achievement? These are the questions this literature review attempts to address and the pursuant study considered.

In Switzerland, a major study in 1993 showed how playing music improved reading and verbal skills through improving concentration, memory, and self-expression. Further, it was found that these students made rapid developments in speech and learned to read with greater ease (Weber, Spychiger, & Patry, 1993). Dunbar (2008) found differences in activation levels between performing arts and non-performing arts groups in a study he and his colleagues conducted over a three-year period. The results showed that performing arts majors showed increased activation in two frontal areas of the brain: the left inferior frontal gyrus and in the left superior frontal gyrus. Prior work on word generation tasks has demonstrated that the left inferior frontal gyrus is involved in generating names in language processing tasks. The finding that performing arts students have increased activation in this area suggests that they are taking a more linguistic approach to the task, whereas the non-performing arts students are taking a more perceptual approach to the task.

Shown to be statistically significant, the hypothesis that performing arts students are more likely to be engaged in symbolic retrieval than non-performing arts students seems to hold. The last finding from this study indicates the generation of novel ideas is also a key strength of the performing arts students compared to the non-performing arts students. These results are important, as even more recent research on scientific thinking and expertise indicates that expertise can lead to increased activation in linguistic areas that are associated with conceptual thinking (Dunbar & Nelson, in press).

Among the latest studies to demonstrate a correlation between music involvement and reading achievement is Southgate & Roscigno's 2009 examination of children and adolescents using three measures of music participation: in school, outside of school, and parental involvement in the form of concert attendance. Their findings for reading achievement show that music involvement within school positively predicts achievement for both adolescent and small children. They acknowledge that there is generally a greater variation in reading ability among small children, and that the active involvement of children in music contributes in some way to the garnering of early reading skills. Furthermore, their findings regarding music participation outside of school is positively associated with reading achievement for adolescents. However, parental music involvement is not significantly associated with reading achievement.

The results from Southgate & Roscigno's 2009 research suggest some of the strongest evidence of a correlation between music and academic achievement, particularly reading. These effects are not strictly tied to very early cognitive development, as suggested by some, thereby lending some credence to an argument by Bruer to be presented later in this review, that there is no one, singular critical period in early childhood during which time brain plasticity is ripe for pruning and growth. In the final analysis of this most current research, the author's claim that for reading, music in school translates into higher overall reading achievement, as their findings statistically demonstrate.

The age-old question for this type of research remains: Are the differences between students in the performing arts and non-performing arts students due to the training in the performing arts, to underlying trait differences, or to inherent genetic differences? The nature-nurture hypothesis comes to mind, where an intersection between environmental and genetic mechanisms may be at the root of differences between performing arts and non-performing arts students. Dunbar & Petitto (in press) are currently developing a DNA-microarray technology to address this question.

More research of the twenty-first century by neurologists and cognitive scientists through fMRI experiments have found that anatomy does in fact matter: the areas of the brain that are defined on the basis of subtle differences in the shapes, sizes, and layering patterns of neurons demonstrates that boundaries define functionally distinct areas. Because species with large cortical surface areas have more cells and more maps than species with small cerebral cortices, the more maps, the more stimulus and response features can be processed and organized. These larger maps contain more detail, which enable more accurate information processing (Leonard, 2001). This illuminates how the size and distortion of cortical maps might promote or interfere with learning to read. In the 1995 Schlaug et al. study, musicians with perfect pitch have longer plana than non-musicians or musicians without perfect pitch. This reinforces the concept that size matters in the brain areas responsible for reading and music abilities.

As modern research investigating the links between the brain and music demonstrates, the concept of distributed processing, which suggests that reading and language ability depend on the integrated activity of many diverse systems, so too are the operations of music ability.

Before there are words, in the world of the newborn, there are sounds. In English, they are phonemes such as *ba*, *da*, *ee*, *ll*, and the sibilant *ss*. When a child hears a phoneme over and over, neurons from the ear stimulate the formation of dedicated connection in the brain's auditory cortex. This perceptual map reflects the distance and similarity between sounds.

Researchers find evidence of these tendencies across many languages. By six months of age, infants in English-speaking homes already have different auditory maps, as shown by electrical measurements that identify which neurons respond to different sounds from those in Swedish-speaking homes (Kuhl et al., 2003). This supports the contention that circuits are already wired at an early age, and the remaining undedicated neurons have lost their ability to form basic new connections for other languages. Once established, sounds become words, and the more words heard, in this line of thinking, the faster language is learned. Like a computer file filling with prose, the neural activity absorbs more words, enabling the creation of a vocabulary through the repeated exposure to words. The information derived from fMRI images in recent studies has suggested exposure to music rewires neural circuits. The somatosensory cortices of instrumental musicians' brains measured significantly larger than those of nonplayers, as demonstrated in a study by Schlaug et al. (1997).

The other side of the story. Spender (1978), in a discussion of the neuropsychology of music, presents the argument that while specific cortical centers have been identified for understanding or generating speech and for reading and writing, since speech is an essential part of human life, and music does not serve the information-exchange – the overriding priority for the survival of the species – that music in terms of brain function, cannot be divorced from language. While she expounds to acknowledge what is known through EEG, fMRI, PET, and other contemporary brain scanning technology of the era, the idea that right versus left in the 1970s was strong. Similar to the brain functioning in language processing and reading comprehension, in performing music, the interplay of perception, memory, and action is complex and must necessitate neuronal circuitry, which integrates primary sensory input. Motor areas of the cortex and other brain structures that selectively enhance this sensory input involve not either right or left hemispheric activation, as was once popularized in the early years of brain research but instead does, in fact, involve the whole brain.

The development of left hemisphere dominance in experienced musicians may be due to the early establishment of music memory when there is greater plasticity of brain systems, implying that activity rather than genetic influences determine the localization for music in the human brain. This subject has come under scrutiny by relatively recent researchers, such as Greenough, who has been making the distinction between experience-expectant and experience-dependent brain plasticity since 1986.

Additionally, Huttenlocher (2002) speculates that if interventions for the brain were to work, then these would have to happen immediately upon birth, and certainly prior to school age, by which time neural plasticity appears to be greatly diminished if not totally lost. Bruer (1997, 2002), also questions this hypothesis, even in light of current neuroscientific evidence to support it. The claim that children are capable of learning more at a very early age, when they have excess synapses and peak brain activity, says Bruer, is one of the more common ones made in neuroscience and education literature.

The neuroscientific evidence shows, according to some educators, in Bruer's view, that there is a critical period for learning in early childhood that is somehow related to the growth and pruning of synapses. Citing the variability of the critical age period – birth to three years, birth to six years, birth to ten years, three to ten years – the argument is that to use the science to support the educational embrace of it is only rhetorically appealing, but not based on sound science. Rather, in Bruer's opinion, it is more appropriate to connect educational practice with cognitive psychology and then connect cognitive psychology with brain science.

Bruer, who appears to be the most vocal and visible of the skeptics with regard to the connection between education and the brain, says educators should note two things: Increases in synaptic density are correlated with the initial emergence of skills and capacities, but continue to improve even into adulthood. Thus, the most that can be said about this process is that it may be necessary for the initial emergence of these abilities, but it cannot account for its continued refinement.

The second observation comes in the emergence or changes in sensory, motor, and working memory functions. There is not neuroscientific proof for how these capacities relate to later school learning, not to mention the acquisition of culturally transmitted knowledge and skills. It is based on these points that Bruer argues that it is premature, at best, to draw specific educational conclusions and recommendations from the neuroscience.

Bruer notes that the human language function also seems to have several critical periods, as Kuhl's (1994) study of language learning seems to support. Based on behavior, not neuroscientific evidence, the critical period for phonology begins in infancy, and probably ends around age 12, with another critical period for acquiring syntax ending at around age 16. This is contrasted to learning the lexicon of language, where the ability to acquire new vocabulary continues throughout the lifespan (Neville, 1995). Because of the plasticity of the brain over the lifetime of the human, it is inappropriate to speak of a single critical period for any sensory system in this argument. With the exception of vision, there is still relatively little known about critical periods for other sensory and motor systems.

As earlier alluded, it is still unclear if there are critical periods for culturally transmitted knowledge systems – reading, arithmetic – that children acquire through informal social interaction and formal schooling. It is upon this basis that Bruer claims a healthy skepticism should be maintained against attempts to generalize what we know from neuroscience to educational practice. Bruer does acknowledge that research on the effects of complex environments on the brain is important as it does, in fact, begin to link learning with synaptic change and brain plasticity, citing the animal's ability to learn from experience throughout its lifetime, which he claims – in contrast to critical periods – might eventually provide a neural basis for the informal and formal learning that goes on in the sociocultural environments, including school.

Neuroscientific evidence points to the existence of a general neural mechanism that contributes to life-long brain plasticity and, presumably, to learning, Bruer acknowledges, but contends that it provides little insight into how to teach anything, including reading. Drawing on concerns of cultural and class values, the idea of neuroscience and education correlation is not relevant. The abilities – or enhancement of them – of learning to read, learning math, and learning languages are not skills that can be directly attributed to any correlation between these activities and changes in brain structure at the synaptic level.

It is the connection between educational practice and cognitive psychology however that Bruer believes can be relevant. The study of mind and mental function, cognitive psychology attempts to discover the mental functions and processes that underlie observed behavior. This analytic method, then, also supports a connection between cognitive psychology and neuroscience – cognitive neuroscience. These researchers work at the mind-brain interface, at the interface between biological and behavioral science. This method of analysis allows those who study this relationship the ability to formulate informative, testable hypotheses about how brain structures implement the mental functions that underlie learning and intelligent behavior.

While the argument Bruer poses is convincing and is elucidated in a most compelling fashion the research at this juncture seems to continue to support and shed light through the advancement of technology to counter the stance. Bruer discusses the brain imaging technologies, including electroencephalography (EEG), event-related potentials (ERP) and magnetoencephalography (MEG), which measure the electric or magnetic fields that neural activity generates at the scalp surface, and Positron Emission Tomography (PET) and functional Magnetic Resonance Imaging (fMRI), methods which allow a visual of how cognitive tasks change brain activity in cortical maps of brain structures that contain millions of synapses. In the mid-1990s, the technology was relatively poor in recording temporal resolution, so it could inform relatively little about the timing and sequencing of component processes in cognitive tasks. However, the advancement of these and other technologies are surely all but extinguishing Bruer's skepticism.

Neuromusical studies have suggested that the human brain has the ability to respond to and participate in music. Like language, music is a species-specific trait of humans. The literature supporting this comes from anthropologists. The ubiquity of human musicality is undeniable based on the vast research on the topic. The musical brain operates at birth and persists through life. As research has demonstrated, babies respond not only at birth, but also in the womb, in the last trimester, which provides strong evidence of neural mechanisms' existence. Recent outcomes of research projects studying Alzheimer's disease and other forms of cognitive dementia suggest that the continual exercising of the mind can and does stave off such conditions.

Early and ongoing musical training affects the organization of the musical brain. As evidenced in the Schlaug et al. (1995) study, there are growing indications that those who study music, particularly early in life, show neurological differences from those who do not. Studies of musically trained and non-trained persons show those with the training had stronger and faster brain responses than those who did not. The neurophysiological data of brain imaging also show that the primary auditory cortex in the left hemispheres of musically trained persons is larger than that of untrained persons.

As in the discussion of Bruer's skeptical treatment of the research issue, it should be noted that probably anything done in early childhood has an effect on brain organization, and it is not clear whether there are transfer effects, which is why this study is of importance. Does music necessarily improve performance in other modes of cognition? Several studies suggest this may be the case. Flohr's 1981 study clearly demonstrates that near transfer occurs from music training to music perception skills, as does Morrongiello and Roes's 1990 study of musically trained children compared to non-trained children in their abilities to draw melodic contours.

Further evidence comes from the realm of instrumental music training to motor skills. Costa-Giomi (2005) showed that piano students improved significantly over non-piano students in a motor proficiency test. Parallels between music and language have been used to support the hypothesis that music training may strengthen verbal skills (Forgeard et al., 2008). Both music and written language involve formal notation read from left to right; music notation consists of symbols that represent information about sound and time, and listening to both music and speech requires attention to the temporal order of rapidly changing acoustic events (Patel, 1998).

A positive correlation between music lessons and IQ in six to eleven year-old students who took music lessons as a child predicted both academic performance and IQ in young adulthood, according to Schellenberg (2006), who argues that music lessons function as additional schooling – requiring focused attention, memorization and the progressive mastery of technical skill. The 2008 study by Forgeard et al. demonstrates that the association between music training and vocabulary is consistent with past research suggesting that (instrumental) music training enhances verbal memory, phonological awareness and reading skills (Butzlaff, 2000).

Conclusion. As is the case throughout the literature, limitations of studies always abound. From family dynamics to children's motivation, these possible non-causal explanations for these associations may be present. The point of interest from the motivational perspective is the possibility that children with superiority in this persistence not only may practice more but may also work harder at school and read more, thereby learning more and resulting in heightened performance on cognitive tasks.

The musical brain consists of extensive neural systems distributed throughout the brain with locally specialized regions. In the 1970s, the highly publicized left-brain/right-brain topic left the impression that musical knowledge is in the right side of the brain, a notion that is still believed to be true by some, contrary to the evidence of twenty-first century technology provided in the form of brain imaging. The review of research indicates that results can be highly varied depending on musical training, stimulus, and task variables, for example. However, these considerations do not preclude the possibility of differences in the ways the two hemispheres process music.

The literature in neuromusical research shows that music is not just in the right side of the brain, but is all over it. Consistent with what is known about language processing and development, music likewise appears to be handled by different neural mechanisms. The linkage between function and location is more clearly understood with regard to language and the brain, but neuroscientists are beginning to identify specific structures in the brain that carry out specific musical tasks. In cognitive studies, indications are that music processing involves functionally independent modules, wherein melody, harmony, and rhythm are individually processed. Music reading has been shown to activate an area on the brain's right side parallel to an area on the left side activated during language reading (Hodges, 2000).

Since only hundreds of research studies of the neuromusical exist in comparison to the thousands of language studies, it is inappropriate to make generalizations about music's effect on children's academic achievement in general and their development of reading and literacy in particular, but all indications point to the significant contributions that continued research in this area can make.

Because there has been a resurgence of interest in the brain and music connection, especially with regard to its relationship to general intelligence, it is clear that those who study it, from neuroscientists to educators, can contribute to the expansion of the knowledge base by conducting research projects in the area. The practitioner – both classroom teacher and school administrator – should learn as much about the human brain as possible and how to translate this new knowledge into policies and practices that enhance learning for all (Lovett, 2001). The fact that musical training is not uniformly and systematically imposed in current educational curricula makes this natural variety of musically acquired skills a formidable laboratory in which to study the effects of training on brain functioning (Peretz and Zatorre, 2005).

Musicians represent a unique model in which to study plastic changes in the human brain. Further, there is no doubt that a complex interplay exists between structural changes that may accompany prolonged behavioral performance and neural responses that underlie that performance, and we are far from understanding in detail the nature of the reorganization associated with musical training. Yet, the study of musical training effects is a unique paradigm to achieve this understanding (Peretz & Zatorre, 2005).

The preponderance of the latest evidence in terms of research studies at the neuroscientific level demonstrate that quantitative neural changes associated with musical training does indeed occur. Musicians appear to recruit more neural tissue or to use it more efficiently than do non-musicians. During the first half of the 20th century, the behavioral, cognitive, or humanistic views directed the outcomes of music and academic instruction to a psychological goal. In the late second half, and now, at the dawn of the twenty-first century, this new biological theory counters psychology as the primary value for the study of music, supplanting it with a more fundamental goal – actual changes in cerebral tissue growth that may result in enhanced mental function (Rideout, 2002).

While the biological model is nascent, the psychological models of behaviorism, cognitivism, and humanism should and do continue to influence our thinking profoundly. It follows that it would be fitting to continue cognitive study to accompany the scientific body of knowledge in the literature, which may complement one another. Evoking Plato's point of view wherein music is a moral law giving soul to the universe, wings to the mind, and flight to the imagination, it is but all of us our duty in education to contribute in the creation of citizens who are able to speak and write with eloquence and clarity, and thus be capable of participating in the civic life of their communities and to persuade others to virtuous and prudent actions. This underscores the sentiment that the existence of music ought not to be seen as a superfluous ancillary to any traditional academic subject.

Theoretical, empirical, and medical research has established associations between music and literacy that warrant consideration. While much of the literature contains examples of the benefits of music instruction for children, further investigation is needed to examine the affects of instrumental music on the literacy achievement of middle school students. This study considered different factors affecting literacy achievement of eighth grade middle school instrumental music students. In the following chapter, the methodology, including the research design by which this was achieved, is described.

CHAPTER THREE

Methodology

The purpose of this study was to analyze factors affecting literacy achievement of eighth grade middle school instrumental music students.

Participants

Study participants were students selected from the one middle school in the independent research school district located in a very small Midwestern city (population ca. 65,000). Most of the city is located within the city's school district, which operates 14 elementary schools, two middle schools, two high schools, a career center, and an alternative school. As of the 2008-2009 school year the city school district had a total enrollment of nearly 9,300 students. The independent research school district serves the southern portion of the city and enrolled just over 3,200 students with an expanding student population demographic. As a portion of a small (population ca. 1,000,000) metropolitan area, the city can be uniquely characterized as an urban/suburban/rural fusion, serving students from all three milieus that encircle it. The research school district's annual operating budget was forty-four million dollars.

Number of participants. The maximum accrual for this study was (N = 38) including multiple naturally formed groups of students who were enrolled in the eighth grade band and who had met those various conditions throughout their middle school years, grades six through eight as described in the research design.

Gender of participants. Of the 38 subjects in this research study, 26 (68%) were female and 12 (32%) were male. The gender of the study participants was congruent with the research school district gender demographics for eighth grade students.

Age range of participants. The age range for all study participants was from 13 years of age, 22 students (58%) to 14 years of age, 16 students (42%). The age range of the study participants was congruent with the research school district age range demographics for eighth grade students.

Racial and ethnic origin of participants. Of the total number of research subjects identified, 33 (87%) were White, four (11%) were Hispanic, and one (3%) was Black or African American. The racial and ethnic origin of the study participants was congruent with the research school district racial and ethnic origin demographics for eighth grade students.

Socioeconomic status (SES) of participants. Of the total number of selected research subjects who were enrolled in the eighth grade band and who had been eligible for participation in the free and/or reduced price lunch program throughout their middle school years, grades six through eight were six boys (15.5%) and nine girls (24%), for a total of 39.5% low SES as defined in this study. Of the selected research subjects who were enrolled in the eighth grade band and who were not eligible for participation in the free and/or reduced price lunch program throughout their middle school years, grades six through eight were six boys (15.5%) and seventeen girls (45%), for a total of 60.5% high SES as defined in this study. The socioeconomic status (SES) of the study participants was congruent with the research school district SES demographics for eighth grade students.

Inclusion criteria of participants. The sample of students for this study was selected from the research school's eighth grade class who were enrolled during the 2009-2010 academic year. All study participants who were members of both that class and the eighth grade band (*N* = 38) who had been enrolled in and participated in the instrumental music program throughout their middle school years; grades six through eight were included. Students who had met the conditions as outlined in the independent variables description throughout their middle school years, grades six through eight were the naturally formed groups of students that comprised each of them.

Method of participant identification. All data obtained for this study was collected with the permission of the district's superintendent, the cooperation of the school's principal, and the assistance of the school district's school improvement specialist. Student data was obtained using the district-wide student record database *PowerSchool*, and was collected to ensure anonymity, through de-identification, of the students' records. All student data was identified using district assigned student identification numbers, then de-identified from those numbers to specifically coded numbers for this research.

Description of Procedures

Research Design. This comparative efficacy study of literacy achievement used a two-group pretest-posttest study design of students participating in middle school instrumental music from 2008 to 2010. This type of research focuses on determining if a cause-effect relationship exists between one factor or set of factors – the independent variable(s) – and a second factor or set of factors – the dependent variable(s). Unlike an experiment, the researcher does not take control of and manipulate the independent variable in causal-comparative research but rather observes, measures, and compares the performance on the dependent variable or variables of subjects in naturally-occurring groupings based on the independent variable (Ellis & Levy, 2009).

Study Constant: Description of Eighth Grade Band

All students in the eighth grade band, regardless of status, followed the grade-level course scope and sequence appropriate for that performance level as defined by the research school district's instrumental music curriculum, at a minimum including, but not limited to: defining and executing basic parade marching band fundamentals with proper carriage, stance, and coordination; playing the full range of the chromatic scale from memory at metronome marking eighth note = 88 beats per minute; playing two octaves of the first six major concert scales (Bb, Eb, Ab, F, C, & G) from memory at metronome marking eighth note = 88 beats per minute; performing music notation/rhythmic and melodic lines found in up to grade level 2.5 music, including whole notes/rests through simple 16th-note/rest patterns in meters of 2/4, 3/4, and 4/4; developing criteria for evaluating quality of music performances and applying it to personal listening and performing; performing concert band literature from diverse genres and cultures written in music up to grade level 2.5; defining and executing musical terminology found in music up to grade level 2.5, using the Marzano model strategy for internalizing vocabulary; and singing and/or chanting various scales, triads, and other music.

Dependent Variables Descriptions

The Iowa Tests of Basic Skills (ITBS) reading comprehension (RC), reading vocabulary (RV), and science subtests are routinely administered by the research school district's guidance counselors in grades six, seven, and eight to all students each year during the third, or spring, trimester. The Northwest Evaluation Association (NWEA) reading Measure of Academic Progress (MAP) is also routinely administered by the research school district's guidance counselors in grades six, seven, and eight to all students in the first, second, and third trimesters of each year. For this study, only the second, or winter, trimester NWEA MAP for reading was employed. First trimester sixth grade cumulative grade point average (GPA) and third trimester eighth grade cumulative GPA was compared.

Independent Variables Descriptions

Students who participated in grades six through eight in the instrumental music program and were identified as or with: 1) High (n = 15) and low (n = 23) socioeconomic status (SES). 2) Female (n = 26) and male (n = 12). 3) Below average or average (n = 6) and above average or superior (n = 32) grade point average (GPA). 4) No or minimal (n = 21) and some or high (n = 17) music motivation (MM). 5) Most involved (n = 28) and least involved (n = 10) music involvement (MI). 6) Woodwind (WW) players (n = 19) and brass and percussion (BP) players (n = 19) instrument section (IS) of the band.

Research Questions and Analyses

Research questions explored middle school instrumental music student achievement in literacy as measured by the Iowa Tests of Basic Skills (ITBS) reading subtests of reading comprehension (RC) and reading vocabulary (RV) normal curve equivalent (NCE) scores, Northwest Evaluation Association (NWEA) Measures of Academic Progress (MAP) Rasch Unit (RIT) scores, and ITBS science NCE scores.

Question #1. For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight in high and low SES students as measured on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #2. For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between female and male students on

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #3. For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #4. For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were not motivated or minimally motivated musically and students who were motivated or highly motivated musically on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #5. For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Question #6. For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

Analyses. Research questions were analyzed using two-way repeated measures analysis of variance (ANOVA) in order to determine the significance over time for each grouping factor. ANOVA is a parametric test of significance used to determine whether a significant difference exists between two or more means at a selected probability level. This determines if the differences among the means represent true, significant differences or chance differences due to sampling error (Gay, Mills, & Airasian, 2006).

ANOVA was employed because it is efficient and keeps the error rate under control (Gay et al., 2006). Independent variables included the within-subjects variable of time from sixth grade pretest to eighth grade posttest. Between-subjects variables included SES, gender, GPA, music motivation, music involvement, and instrument played. When significance was found, follow up tests were conducted. Because of the small sample size, a two-tailed .05 alpha level was employed to help control for Type 1 errors. Means and standard deviations are displayed on tables.

A varied approach to statistical analysis was employed using the statistical software package *SPSS Statistics 17.0* for Windows and *PASW Statistics 18.0* for Mac. For the hypotheses, the specific statistical testing instrument utilized is described in Chapter 4.

Data Collection Procedures

The specific academic data gathered for this study included reading comprehension (RC), reading vocabulary (RV), and science national standard scores (NSS) and normal curve equivalent (NCE) scores from the third trimester 2008 and third trimester 2010 Iowa Tests of Basic Skills (ITBS) and Measures of Academic Progress (MAP), including Rasch Unit (RIT) for reading from the second trimester 2008 and second trimester 2010 Northwest Evaluation Association (NWEA) assessments in reading and student socioeconomic status (SES) as determined by the eligibility for participation in the free and/or reduced lunch program. This data was collected with the permission of the district's superintendent and with the assistance primarily from the school's principal and the school district's school improvement specialist.

Additional data was culled from *PowerSchool* routinely by the researcher and included: Student gender, academic achievement as measured by grade point average (GPA), music motivation (MM) as measured by competitive musical achievement, music involvement (MI) as measured by extracurricular musical ensemble participation, and instrument section (IS) as measured by section of participation in the school band.

Instrumentation. The instrumentation used to collect student academic data included the Iowa Tests of Basic Skills (ITBS) which is given each year to students in grades six through eight for the purposes of identifying students with basic skills needs and placement in advanced sections of a particular discipline. National standard scores (NSS) and normal curve equivalent (NCE) scores were collected for each student in the reading comprehension (RC), reading vocabulary (RV), and science sections of the instrument. This is a norm-referenced assessment in which student performance is measured against one another to determine the student's relative standing in relation to that particular population of students.

Academic data was also obtained from the Northwest Evaluation Assessment (NWEA), a computer-based adaptive assessment instrument. Its Measures of Academic Progress (MAP) tests present students with content that responds to the student, adjusting up or down in difficulty and is reported in Rasch Unit (RIT) scores. This test was administered three times each year in the district at grade levels six, seven, and eight. The data from the winter trimester, or second administration, of the test were collected for this study. Total scores were assembled for each student on the reading portion of the assessment.

Reliability and validity. The ITBS reading vocabulary test assesses students' breadth of vocabulary and is a useful indicator of overall verbal ability. At Levels 5 and 6, the focus is on listening vocabulary. Students hear a word, sometimes used in a sentence, and they choose one of three pictures. Levels 7 and 8 measure reading vocabulary. A picture or written word is followed by a set of written responses.

At all levels, words tested represent general vocabulary rather than the specialized vocabulary used in subject matter areas (Iowa Testing Services, 2010).

The ITBS reading comprehension test assesses students' capabilities at all stages of their development as readers. At Level 6 the Reading test measures students' ability to read words in isolation and to use context and picture cues for word identification. There are also sentence and story comprehension questions (Iowa Testing Services, 2010).

The tests at Levels 7 and 8 include a variety of reading tasks. Students answer questions about a picture that tells a story. They also demonstrate their comprehension of sentences and stories (Iowa Testing Services, 2010).

The ITBS science tests at all levels assess not only students' knowledge of scientific principles and information but also the methods and processes of scientific inquiry, in accordance with the recommendations of The American Association for the Advancement of Science (AAAS) and the National Science Teachers Association (NSTA). At Levels 7 and 8, all questions are presented orally and response choices are pictures (Riverside Publishing, 2010).

For all ITBS subtests, internal consistency and equivalent forms are used, of the 84 reliability coefficients (internal consistency) reported for the various subtests, only six are in the .70s; the others are in the .80s and .90s. The composite score reliabilities are all .98, and research studies are conducted to determine content validity (Creative-Wisdom, 2010).

The extensive item bank of questions used on the NWEA Measures of Academic Progress (MAP) tests have been developed over a substantial period of time. This has given staff charged with statistical analysis abundant opportunity to establish the reliability of the tests. The result has been the collection of a significant amount of reliability evidence over time (NWEA, 2010).

Test and re-test studies have consistently yielded statistically valid correlations between multiple test events for the same student. Most such studies rely on the methodology of having students re-test within several days. NWEA test and re-test studies have typically looked at scores from the same students after a lapse of several months. Despite this methodology (which would have the expected result of lowering the correlation figures) the reliability indices have consistently been above what is considered statistically significant (NWEA, 2010).

Performance sites. The research was conducted at the university and in the research school under normal educational practices. The study procedure did not interfere in any way with the normal educational practices at the university or in the public school setting and did not involve coercion or discomfort of any kind. Data was stored on spreadsheets and computer drives for statistical analysis. Data and computer drives were secured. No individual identifiers were attached to the data.

Confidentiality. Non-coded numbers were used to display individual achievement. Individual data was de-identified by the appropriate research personnel after all information was linked and the data sets were completed.

Human Subjects Approval Category

The exemption categories for this study were provided under 45 CFR 46:101b, category 4. The research was conducted using routinely collected archival data. A letter of support from the University for this study was obtained and sent to the University of

Nebraska Medical Center/University of Nebraska at Omaha Joint Institutional Review Board (IRB) for the Protection of Human Subjects for IRB review.

In the following chapter, results of the data that include descriptive statistics and correlations as they relate to the research questions are presented in table format. Any additional correlations that were detected and found to be significant are also presented. Data analysis demonstrates a relationship between the literacy achievement of eighth grade middle school instrumental music students and the factors presented in the study.

CHAPTER FOUR

Results

Purpose of the Study

The purpose of this study was to analyze factors affecting literacy achievement of eighth grade middle school instrumental music students.

The study dependent variables were the measurements of academic achievement utilized by the research school district, including the Iowa Tests of Basic Skills (ITBS) reading comprehension (RC), reading vocabulary (RV), and science subtests, which are routinely administered by the research school district's guidance counselors in sixth grade through eighth grade to all students each year during the third trimester. Normal curve equivalent (NCE) pretest scores from Spring 2008 and posttest scores from Spring 2010 from this instrument were analyzed. Additionally, the Northwest Evaluation Association (NWEA) Measure of Academic Progress (MAP) pretest scores for criterion referenced assessment in reading comprehension pretest scores from Winter 2008 and posttest scores from Winter 2010 were analyzed. The research school district's guidance counselors also routinely administer the NWEA MAP each year to all students in sixth grade through eighth grade in the winter trimester.

All study achievement data related to each of the dependent variables were retrospective, archival, and routinely collected school information. Permission from the appropriate school research personnel was obtained before data were collected and analyzed. The number of students who participated in the study was 38.

Analysis of variance (ANOVA) is a parametric test of significance used to determine significance over time for each grouping factor. This determines if the differences among the means represent true, significant differences or chance differences due to sampling error (Gay, Mills, & Airasian, 2006). The two-way ANOVA statistical test was employed for its efficiency and ability to keep the error rate under control (Gay et al., 2006). The significance level was set at .05 to help control for Type I errors. Cohen's (1977, 1988) original guidelines that d = .20 is a "small," d = .50 is a "medium," and d = .80 is a "large" effect size are still widely cited and used for interpreting magnitudes of effect (Dunst, Hamby, & Trivette, 2004). Cohen's d for showing the effect size, when the alpha level is significant, is calculated between subjects and in pairwise comparisons within subjects.

Research Questions and Analyses

Research questions explored middle school instrumental music student achievement in literacy as measured by the Iowa Tests of Basic Skills (ITBS) reading subtests of reading comprehension (RC) and reading vocabulary (RV) normal curve equivalent (NCE) scores, and ITBS science NCE scores, and the Northwest Evaluation Association (NWEA) Measures of Academic Progress (MAP) Rasch Unit (RIT) scores.

Question #1 – Reading Comprehension

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight in high and low SES students as measured on the ITBS Reading Comprehension Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 241.83$, $p < .005$, $d = .90$. There was no significant interaction between time (pretest/posttest) and SES, $F(1, 36) = 1.66$, $p = .206$. There was no significant main effect for SES, $F(1, 36) = 1.52$, $p = .225$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Comprehension Subtest from the pretest (M = 233.74, SD = 26.69) to the posttest (M = 261.84, SD = 35.33), regardless of their SES status. The means and standard deviations for SES on the ITBS Reading Comprehension Subtest are displayed in Table 1. The ANOVA for time and SES are displayed in Table 2.

Question #1 – Reading Vocabulary

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight in high and low SES students as measured on the ITBS Reading Vocabulary Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 626.95$, $p < .005$, d =1.10. There was no significant interaction between time (pretest/posttest) and SES, $F(1, 36) = 1.30$, $p = .263$. There was no significant main effect for SES, $F(1, 36) = 1.16$, $p = .288$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Vocabulary Subtest from the pretest (M = 228.84, SD = 27.11) to the posttest (M = 256.95, SD = 23.79), regardless of their SES status. The means and standard deviations for SES on the ITBS Reading Vocabulary Subtest are displayed in Table 3. The ANOVA for time and SES is displayed in Table 4.

Question #1 – Science

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight in high and low SES students as measured on the ITBS Science Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 50.88$, $p < .005$, $d = .95$. There was a significant interaction between time (pretest/posttest) and SES, $F(1, 36) = 4.30$, $p = .045$. There was no significant main effect for SES, $F(1, 36) = 1.81$, $p = .187$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Science Subtest from the pretest ($M = 220.95$, $SD = 16.82$) to the posttest ($M = 244.29$, $SD = 30.28$), regardless of their SES status.

In pairwise comparisons, there was a significant effect between time and high SES, $F(1, 36) = 53.69$, $p < .0005$, $d = 1.03$ and time and low SES, $F(1, 36) = 10.57$, $p = .002$, $d = .89$. The means and standard deviations for SES on the ITBS Science Subtest are displayed in Table 5. The ANOVA for time and SES is displayed in Table 6.

Question #1 – Reading

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight in high and low SES students as measured on the NWEA Reading MAP?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 413.65$, p < .005, $d = .82$. There was a significant interaction between time (pretest/posttest) and SES, $F(1, 36) = 15.01$, $p < .005$. There was no significant main effect for SES, $F(1, 36) = 1.09$, $p = .304$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the NWEA Reading MAP from the pretest (M = 215.63, SD = 11.38) to the posttest (M = 224.45, SD = 10.23), regardless of their SES status.

In pairwise comparisons, there was a significant effect between time and high SES, $F(1, 36) = 178.684$, $p < .0005$, $d = .65$ and time and low SES, $F(1, 36) = 242.138$, $p < .0005$, $d = 1.13$. The means and standard deviations for SES on the NWEA Reading MAP are displayed in Table 7. The ANOVA for time and SES is displayed in Table 8.

Question #2 – Reading Comprehension

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between female and male students as measured on the ITBS Reading Comprehension Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 591.40$, $p < .005$, $d = .90$. There was a significant interaction between time (pretest/posttest) and gender, $F(1, 36) =83.11$, $p < .005$. There was a significant main effect for gender, $F(1, 36) = 7.54$, $p = .009$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Comprehension Subtest from the pretest (M = 233.74, SD = 26.69) to the posttest (M = 261.84, SD = 35.33), regardless of their gender.

In pairwise comparisons, there was a significant effect between time and females, $F(1, 36) = 182.96$, $p < .0005$, $d = .76$ and time and males, $F(1, 36) = 408.47$, $p < .0005$, $d = 1.41$. The means and standard deviations for gender on the ITBS Reading

Comprehension Subtest are displayed in Table 9. The ANOVA for time and gender is displayed in Table 10.

Question #2 – Reading Vocabulary

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between female and male students as measured on the ITBS Reading Vocabulary Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 226.22$, $p < .005$, $d = 1.10$. There was no significant interaction between time (pretest/posttest) and gender, $F(1, 36) = 20.31$, $p = .550$. There was a significant main effect for gender, $F(1, 36) = 5.29$, $p = .027$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Vocabulary Subtest from the pretest ($M = 228.84$, $SD = 27.11$) to the posttest ($M = 256.95$, $SD = 23.79$), regardless of their gender. The means and standard deviations for gender on the ITBS Reading Vocabulary Subtest are displayed in Table 11. The ANOVA for time and gender is displayed in Table 12.

Question #2 – Science

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between female and male students as measured on the ITBS Science Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 513.49$, $p < .005$, $d = 1.17$. There was no significant interaction between time

(pretest/posttest) and gender, $F(1, 36) = 2.93$, $p = .095$. There was no significant main effect for gender, $F(1, 36) = 8.35$, $p = .006$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Science Subtest from the pretest ($M = 240.87$, $SD = 35.20$) to the posttest ($M = 278.58$, $SD = 29.16$), regardless of their gender. The means and standard deviations for gender on the ITBS Science Subtest are displayed in Table 13. The ANOVA for time and gender is displayed in Table 14.

Question #2 – Reading

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between female and male students as measured on the NWEA Reading MAP?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 259.95$, $p < .005$, $d = .82$. There was a significant interaction between time (pretest/posttest) and gender, $F(1, 36) = 5.98$, $p = .020$. There was a significant main effect for gender, $F(1, 36) = 4.80$, $p = .035$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the NWEA Reading MAP from the pretest ($M = 215.63$, $SD = 11.38$) to the posttest ($M = 224.45$, $SD = 10.23$), regardless of their gender.

In pairwise comparisons, there was a significant effect between time and females, $F(1, 36) = 272.931$, $p < .0005$, $d = .90$ and time and males, $F(1, 36) = 68.360$, $p < .0005$,

$d = .76$. The means and standard deviations for gender on the NWEA Reading MAP are displayed in Table 15. The ANOVA for time and gender is displayed in Table 16.

Question #3 – Reading Comprehension

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the ITBS Reading Comprehension Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 55.00$, $p < .005$, $d = .97$. There was a significant interaction between time (pretest/posttest) and GPA, $F(1, 36) =13.37$, $p = .001$. There was no significant main effect for GPA, $F(1, 36) = .143$, $p = .707$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Comprehension Subtest from the pretest ($M = 232.84$, $SD = 25.10$) to the posttest ($M = 221.74$, $SD = 35.75$), regardless of their GPA.

In pairwise comparisons, there was a significant effect between time and high GPA, $F(1, 36) = 194.06$, $p < .0005$, $d = 1.12$ and time and low GPA, $F(1, 36)$, $p < .0005$, $d = .30$. The means and standard deviations for GPA on the ITBS Reading Comprehension Subtest are displayed in Table 17. The ANOVA for time and GPA is displayed in Table 18.

Question #3 – Reading Vocabulary

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the ITBS Reading Vocabulary Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 258.94$, $p < .005$, $d = 1.14$. There was a significant interaction between time (pretest/posttest) and GPA, $F(1, 36) = 513.75$, $p < .005$. There was no significant main effect for GPA, $F(1, 36) = .053$, $p = .818$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Vocabulary Subtest from the pretest ($M = 228.47$, $SD = 26.44$) to the posttest ($M = 257.32$, $SD = 24.10$), regardless of their GPA.

In pairwise comparisons, there was a significant effect between time and high GPA, $F(1, 36) = 690.265$, $p < .0005$, $d = 1.13$ and time and low GPA $F(1, 36) = 37.932$, $p < .0005$, $d = .57$. The means and standard deviations for GPA on the ITBS Reading Vocabulary Subtest are displayed in Table 19. The ANOVA for time and GPA is displayed in Table 20.

Question #3 – Science

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the ITBS Science Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 177.35$, $p < .005$, $d = 1.18$. There was a significant interaction between time (pretest/posttest) and GPA, $F(1, 36) = 18.28$, $p < .005$. There was no significant main effect for GPA, $F(1, 36) = .002$, $p = .969$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Science Subtest from the pretest ($M = 240.71$, $SD = 35.22$) to the posttest ($M = 278.74$, $SD = 28.92$), regardless of their GPA.

In pairwise comparisons, there was a significant effect between time and high GPA, $F(1, 36) = 490.072$, $p < .0005$, $d = 1.33$ and time and low GPA, $F(1, 36) = 24.268$, $p < .0005$, $d = .52$. The means and standard deviations for GPA on the ITBS Science Subtest are displayed in Table 21. The ANOVA for time and GPA is displayed in Table 22.

Question #3 – Reading

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the NWEA Reading MAP?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 403.25$, $p < .005$, $d = .91$. There was no significant interaction between time (pretest/posttest) and GPA, $F(1, 36) = 3.07$, $p = .088$. There was no significant main effect for GPA, $F(1, 36) = .550$, $p = .463$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the NWEA Reading MAP from the pretest ($M = 215.21$, $SD = 10.67$) to the posttest

(*M* = 224.87, *SD* = 10.60), regardless of their GPA. The means and standard deviations for gender on the NWEA Reading MAP are displayed in Table 23. The ANOVA for time and GPA is displayed in Table 24.

Question #4 – Reading Comprehension

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were not motivated or who were minimally motivated musically and students who were motivated or were highly motivated musically on the ITBS Reading Comprehension Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 274.64$, $p < .005$, $d = .90$. There was no significant interaction between time (pretest/posttest) and music motivation, $F(1, 36) = 2.94$, $p = .095$. There was no significant main effect for music motivation, $F(1, 36) = 3.63$, $p = .065$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Comprehension Subtest from the pretest (*M* = 233.74, *SD* = 26.69) to the posttest (*M* = 261.84, *SD* = 35.33), regardless of their music motivation. The means and standard deviations for music motivation on the ITBS Reading Comprehension Subtest are displayed in Table 25. The ANOVA for time and music motivation is displayed in Table 26.

Question #4 – Reading Vocabulary

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were not motivated or who were minimally motivated musically and students who were motivated or were highly motivated musically on the ITBS Reading Vocabulary Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 558.60$, $p < .005$, $d = 1.10$. There was no significant interaction between time (pretest/posttest) and music motivation, $F(1, 36) = 1.24$, $p = .272$. There was a significant main effect for music motivation, $F(1, 36) = 4.53$, $p = .040$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Vocabulary Subtest from the pretest ($M = 228.84$, $SD = 27.11$) to the posttest ($M = 256.95$, $SD = 23.79$), regardless of their music motivation. The means and standard deviations for music motivation on the ITBS Reading Vocabulary Subtest are displayed in Table 27. The ANOVA for time and music motivation is displayed in Table 28.

Question #4 – Science

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were not motivated or who were minimally motivated musically and students who were motivated or were highly motivated musically on the ITBS Science Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 510.95$, $p < .005$, $d = 1.17$. There was no significant interaction between time

(pretest/posttest) and music motivation, $F(1, 36) = .334$, $p = .567$. There was no significant main effect for music motivation, $F(1, 36) = 2.25$, $p = .143$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Science Subtest from the pretest ($M = 240.87$, $SD = 35.20$) to the posttest ($M = 278.58$, $SD = 29.16$), regardless of their music motivation. The means and standard deviations for music motivation on the ITBS Science Subtest are displayed in Table 29. The ANOVA for time and music motivation is displayed in Table 30.

Question #4 – Reading

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were not motivated or who were minimally motivated musically and students who were motivated or were highly motivated musically on the NWEA Reading MAP?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 339.82$, $p < .005$, $d = .82$. There was no significant interaction between time (pretest/posttest) and music motivation, $F(1, 36) = 1.48$, $p = .231$. There was a significant main effect for music motivation, $F(1, 36) = 4.84$, $p = .034$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the NWEA Reading MAP from the pretest ($M = 215.63$, $SD = 11.38$) to the posttest ($M = 224.45$, $SD = 10.23$), regardless of their music motivation. The means and standard deviations for music motivation on the NWEA Reading MAP are displayed in Table 31. The ANOVA for time and music motivation is displayed in Table 32.

Question #5 – Reading Comprehension

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the ITBS Reading Comprehension Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 205.87$, $p < .005$, $d = .90$. There was no significant interaction between time (pretest/posttest) and music involvement, $F(1, 36) = .042$, $p = .839$. There was no significant main effect for music involvement, $F(1, 36) = .251$, $p = .620$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Comprehension Subtest from the pretest ($M = 233.74$, $SD = 26.69$) to the posttest ($M = 261.84$, $SD = 35.33$), regardless of their music involvement. The means and standard deviations for music involvement on the ITBS Reading Comprehension Subtest are displayed in Table 33. The ANOVA for time and music involvement is displayed in Table 34.

Question #5 – Reading Vocabulary

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the ITBS Reading Vocabulary Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 648.59$, $p < .005$, $d = 1.10$. There was a significant interaction between time (pretest/posttest) and music involvement, $F(1, 36) = 16.28$, $p < .005$. There was no significant main effect for music involvement, $F(1, 36) = .334$, $p = .567$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Vocabulary Subtest from the pretest ($M = 228.84$, $SD = 27.11$) to the posttest ($M = 256.95$, $SD = 23.79$), regardless of their music involvement.

In pairwise comparisons, there was a significant effect between time and high music involvement, $F(1, 36) = 436.377$, $p < .0005$, $d = .98$ and time and low music involvement, $F(1, 36) = 295.311$, $p < .0005$, $d = 1.47$. The means and standard deviations for music involvement on the ITBS Reading Vocabulary Subtest are displayed in Table 35. The ANOVA for time and music involvement is displayed in Table 36.

Question #5 – Science

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the ITBS Science Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 456.08$, $p < .005$, $d = 1.17$. There was no significant interaction between time (pretest/posttest) and music involvement, $F(1, 36) = .820$, $p = .371$. There was no significant main effect for music involvement, $F(1, 36) = .018$, $p = .894$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Science Subtest from the pretest (M = 240.87, SD = 35.20) to the posttest (M = 278.58, SD = 29.16), regardless of their music involvement. The means and standard deviations for music involvement on the ITBS Science Subtest are displayed in Table 37. The ANOVA for time and music involvement is displayed in Table 38.

Question #5 – Reading

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the NWEA Reading MAP?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 339.02$, $p < .005$, $d = .82$. There was a significant interaction between time (pretest/posttest) and music involvement, $F(1, 36) = 6.73$, $p = .014$. There was no significant main effect for music involvement, $F(1, 36) = .413$, $p = .524$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the NWEA Reading MAP from the pretest (M = 215.63, SD = 11.38) to the posttest (M = 224.45, SD = 10.23), regardless of their music involvement.

In pairwise comparisons, there was a significant effect between time and high music involvement, $F(1, 36) = 419.210$, $p < .0005$, $d = .85$ and time and low music involvement, $F(1, 36) = 84.898$, $p < .0005$, $d = .70$. The means and standard deviations for music involvement on the NWEA Reading MAP are displayed in Table 39. The ANOVA for time and music involvement is displayed in Table 40.

Question #6 – Reading Comprehension

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the ITBS Reading Comprehension Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 273.78$, $p < .005$, $d = .90$. There was a significant interaction between time (pretest/posttest) and instrument section , $F(1, 36) = 9.60$, $p = .004$. There was no significant main effect for instrument section, $F(1, 36) = .039$, $p = .844$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Comprehension Subtest from the pretest ($M = 233.74$, $SD = 26.69$) to the posttest ($M = 261.84$, $SD = 35.33$), regardless of their instrument section.

In pairwise comparisons, there was a significant effect between time and woodwind instrument section, $F(1, 36) = 90.421$, $p < .0005$, $d =.91$ and time and brass/percussion instrument section, $F(1, 36) = 192.959$, $p < .0005$, $d =.90$. The means and standard deviations for instrument section on the ITBS Reading Comprehension Subtest are displayed in Table 41. The ANOVA for time and instrument section is displayed in Table 42.

Question #6 – Reading Vocabulary

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the ITBS Reading Vocabulary Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 403.59$, $p < .005$, $d = 1.10$. There was no significant interaction between time (pretest/posttest) and instrument section, $F(1, 36) = .459$, $p = .503$. There was no significant main effect for instrument section, $F(1, 36) = .461$, $p = .502$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Reading Vocabulary Subtest from the pretest ($M = 228.84$, $SD = 27.11$) to the posttest ($M = 256.95$, $SD = 23.79$), regardless of their instrument section. The means and standard deviations for instrument section on the ITBS Reading Vocabulary Subtest are displayed in Table 43. The ANOVA for time and instrument section is displayed in Table 44.

Question #6 – Science

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the ITBS Science Subtest?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 516.50$, $p < .005$, $d = 1.17$. There was no significant interaction between time

(pretest/posttest) and instrument section, $F(1, 36) = 2.88$, $p = .098$. There was no significant main effect for instrument section, $F(1, 36) = .511$, $p = .479$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the ITBS Science Subtest from the pretest ($M = 240.87$, $SD = 35.20$) to the posttest ($M = 278.58$, $SD = 29.16$), regardless of their instrument section. The means and standard deviations for instrument section on the ITBS Science Subtest are displayed in Table 45. The ANOVA for time and instrument section is displayed in Table 46.

Question #6 – Reading

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the NWEA Reading MAP?

There was a statistically significant main effect for time (pretest/posttest), $F(1, 36) = 279.94$, $p < .005$, $d = .82$. There was no significant interaction between time (pretest/posttest) and instrument section, $F(1, 36) = .561$, $p = .459$. There was no significant main effect for instrument section, $F(1, 36) = .603$, $p = .443$.

The statistically significant main effect for time indicated that eighth graders who participated in the instrumental music program since sixth grade significantly improved on the NWEA Reading MAP from the pretest ($M = 215.63$, $SD = 11.38$) to the posttest ($M = 224.45$, $SD = 10.23$), regardless of their instrument section. The means and standard deviations for instrument section on the NWEA Reading MAP are displayed in Table 47. The ANOVA for time and instrument section is displayed in Table 48.

Summary

In summary, the results showed that there was significant improvement in time from the pretest to posttest results of the ITBS Reading Comprehension, Reading Vocabulary, and Science Subtests as well as the NWEA Reading MAP. The results indicate that regardless of a student's SES status, gender, GPA, music motivation, music involvement, or instrument section, his or her literacy achievement significantly improves over time while participating in an instrumental music program during all three years of middle school, as measured over time and within and between these variables.

Table 1

Descriptive Statistics for SES on the ITBS Reading Comprehension Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
High SES (*n* = 23)	237.78	28.79	267.70	38.78
Low SES (*n* = 15)	227.53	22.64	252.87	28.18
Total	233.74	26.69	261.84	35.33

Table 2

ANOVA for Time and SES for the ITBS Reading Comprehension Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
SES	1	2854.96	1.52	.225	ns
Error	36	938.16			
Within Subjects					
Time	1	13855.21	241.83	.001	.90
Time*SES	1	95.21	1.66	.206	ns
Error	36	57.29			

ns = not significant

Table 3

Descriptive Statistics for SES on the ITBS Reading Vocabulary Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
High SES (*n* = 23)	232.91	28.70	260.00	23.16
Low SES (*n* = 15)	222.60	27.11	252.27	24.79
Total	228.84	27.11	256.95	23.79

Table 4

ANOVA for Time and SES for the ITBS Reading Vocabulary Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
SES	1	739.19	1.16	.288	ns
Error	36	636.09			
Within Subjects					
Time	1	14621.53	626.95	.001	1.10
Time*SES	1	30.21	1.30	.263	ns
Error	36	23.32			

ns = not significant

Table 5

Descriptive Statistics for SES on the ITBS Science Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
High SES (*n* = 23)	222.35	16.78	250.74	35.10
Low SES (*n* = 15)	218.80	17.25	234.40	17.74
Total	220.95	16.82	244.29	30.28

Table 6

ANOVA for Time and SES for the ITBS Science Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
SES	1	897.66	1.81	.187	ns
Error	36	495.20			
Within Subjects					
Time	1	8784.95	50.88	.001	.95
Time*SES	1	742.74	4.30	.045	
Error	36	172.65			
Pairwise Comparisons					
SES*Pretest			.397	.533	ns
SES*Posttest			2.77	.105	ns
Time*High SES			53.69	.001	1.03
Time*Low SES			10.57	.002	.89

ns = not significant

Table 7

Descriptive Statistics for SES on the NWEA Reading MAP

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
High SES (*n* = 23)	217.78	11.79	225.21	11.05
Low SES (*n* = 15)	212.33	10.22	223.27	9.08
Total	215.63	11.38	224.45	10.23

Table 8

ANOVA for Time and SES for the NWEA Reading MAP

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
SES	1	124.29	1.09	.304	ns
Error	36	114.32			
Within Subjects					
Time	1	1531.56	413.65	.001	.82
Time*SES	1	55.56	15.01	.001	
Error	36	3.70			
Pairwise Comparisons					
SES*Pretest			2.15	.152	ns
SES*Posttest			0.32	.573	ns
Time*High SES			178.68	.001	.65
Time*Low SES			242.14	.001	1.13

ns = not significant

Table 9

Descriptive Statistics for Gender on the ITBS Reading Comprehension Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Female (*n* = 26)	229.08	24.60	249.46	28.91
Male (*n* = 12)	243.83	29.30	288.67	33.97
Total	233.74	26.69	261.84	35.33

Table 10

ANOVA for Time and Gender on the ITBS Reading Comprehension Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Gender	1	5976.95	7.54	.009	
Error	36	792.91			
Within Subjects					
Time	1	17461.25	591.40	.001	.90
Time*Gender	1	2453.88	83.11	.001	
Error	36	29.53			
Pairwise Comparisons					
Gender*Pretest			2.62	.114	ns
Gender*Posttest			13.53	.001	
Time*Females			182.96	.001	.76
Time*Males			408.47	.001	1.41

ns = not significant

Table 11

Descriptive Statistics for Gender on the ITBS Reading Vocabulary Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Female (*n* = 26)	222.50	23.50	251.31	24.53
Male (*n* = 12)	242.58	30.27	269.17	17.28
Total	228.84	27.11	256.95	23.79

Table 12

ANOVA for Time and Gender on the ITBS Reading Vocabulary Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Gender	1	2955.01	5.29	.027	
Error	36	558.50			
Within Subjects					
Time	1	12595.63	226.22	.001	1.10
Time*Gender	1	20.31	.365	.550	ns
Error	36	55.68			

ns = not significant

Table 13

Descriptive Statistics for Gender on the ITBS Science Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Female (*n* = 26)	230.69	29.58	270.15	27.36
Male (*n* = 12)	262.92	37.47	296.83	25.05
Total	240.87	35.20	278.58	29.16

Table 14

ANOVA for Time and Gender on the ITBS Science Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Gender	1	7121.94	8.35	.006	
Error	36	852.47			
Within Subjects					
Time	1	22104.22	513.49	.001	1.17
Time*Gender	1	126.22	2.93	.095	ns
Error	36	43.05			

ns = not significant

Table 15

Descriptive Statistics for Gender on the NWEA Reading MAP

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Female (*n* = 26)	212.77	11.17	222.38	10.23
Male (*n* = 12)	221.83	9.52	228.92	9.09
Total	215.63	11.38	224.45	10.23

Table 16

ANOVA for Time and Gender on the NWEA Reading MAP

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Gender	1	499.28	4.80	.035	
Error	36	103.96			
Within Subjects					
Time	1	1144.74	259.95	.001	.82
Time*Gender	1	26.32	5.98	.020	
Error	36	4.40			
Pairwise Comparisons					
Gender*Pretest			5.90	.020	
Gender*Posttest			3.58	.067	ns
Time*Female			272.93	.001	.90
Time*Male			68.36	.001	.76

ns = not significant

Table 17

Descriptive Statistics for GPA on the ITBS Reading Comprehension Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Above Average GPA (*n* = 32)	231.91	22.95	265.28	35.37
Below Average GPA (*n* = 6)	237.83	36.92	249.17	37.92
Total	232.84	25.10	262.74	35.75

Table 18

ANOVA for Time and GPA on the ITBS Reading Comprehension Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
GPA	1	131.01	.143	.707	ns
Error	36	913.80			
Within Subjects					
Time	1	5049.69	55.00	.001	.97
Time*GPA	1	1227.37	13.37	.001	
Error	36	91.82			
Pairwise Comparisons					
GPA*Pretest			.276	.602	ns
GPA*Posttest			1.028	.317	ns
Time*High GPA			194.06	.001	1.12
Time*Low GPA			4.20	.001	.30

ns = not significant

Table 19

Descriptive Statistics for GPA on the ITBS Reading Vocabulary Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Above Average GPA (*n* = 32)	226.94	25.77	258.03	23.71
Below Average GPA (*n* = 6)	236.67	30.98	253.50	28.14
Total	228.47	26.44	257.32	24.10

Table 20

ANOVA for Time and GPA on the ITBS Reading Vocabulary Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
GPA	1	34.13	.053	.818	ns
Error	36	638.35			
Within Subjects					
Time	1	5802.96	258.94	.001	1.14
Time*GPA	1	513.75	22.93	.001	
Error	36	22.41			
Pairwise Comparisons					
GPA*Pretest			.678	.416	ns
GPA*Posttest			.175	.679	ns
Time*High GPA			690.27	.001	1.13
Time*Low GPA			37.93	.001	.57

ns = not significant

Table 21

Descriptive Statistics for GPA on the ITBS Science Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Above Average GPA (*n* = 32)	239.22	32.71	280.41	29.09
Below Average GPA (*n* = 6)	248.67	49.56	269.83	28.83
Total	240.71	35.22	278.74	28.92

Table 22

ANOVA for Time and GPA on the ITBS Science Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
GPA	1	1.60	.002	.969	ns
Error	36	1025.47			
Within Subjects					
Time	1	9822.42	177.35	.001	1.18
Time*GPA	1	1012.63	18.28	.001	
Error	36	55.39			
Pairwise Comparisons					
GPA*Pretest			.357	.554	ns
GPA*Posttest			.669	.419	ns
Time*High GPA			490.07	.001	1.33
Time*Low GPA			24.27	.000	.52

ns = not significant

Table 23

Descriptive Statistics for GPA on the NWEA Reading MAP

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Above Average GPA (*n* = 32)	215.91	9.91	225.28	10.28
Below Average GPA (*n* = 6)	211.50	14.61	222.67	13.02
Total	215.21	10.67	224.87	10.60

Table 24

ANOVA for Time and GPA on the NWEA Reading MAP

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
GPA	1	62.26	.550	.463	ns
Error	36	113.12			
Within Subjects					
Time	1	1066.00	403.25	.001	.91
Time*GPA	1	8.11	3.07	.088	ns
Error	36	2.64			

ns = not significant

Table 25

Descriptive Statistics for Music Motivation on the ITBS Reading Comprehension Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Motivated (*n* = 17)	242.35	24.99	273.71	35.52
Not Motivated (*n* = 21)	226.76	26.54	252.24	32.93
Total	233.74	26.69	261.84	35.33

Table 26

ANOVA for Time and Music Motivation on the ITBS Reading Comprehension Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Motivation	1	3225.58	3.63	.065	ns
Error	36	888.31			
Within Subjects					
Time	1	15170.39	274.64	.001	.90
Time*Motivation	1	162.23	2.94	.095	ns
Error	36	55.24			

ns = not significant

Table 27

Descriptive Statistics for Music Motivation on the ITBS Reading Vocabulary Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Motivated (*n* = 17)	238.82	21.68	265.47	19.16
Not Motivated (*n* = 21)	220.76	28.83	250.05	25.34
Total	228.84	27.11	256.95	23.79

Table 28

ANOVA for Time and Music Motivation on the ITBS Reading Vocabulary Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Motivation	1	2633.39	4.53	.040	ns
Error	36	581.95			
Within Subjects					
Time	1	14695.60	558.60	.001	1.10
Time*Motivation	1	32.71	1.24	.272	ns
Error	36	26.31			

ns = not significant

Table 29

Descriptive Statistics for Music Motivation on the ITBS Science Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Motivated (*n* = 17)	249.88	33.96	286.53	26.38
Not Motivated (*n* = 21)	233.57	35.27	272.14	30.32
Total	240.87	35.20	278.58	29.16

Table 30

ANOVA for Time and Music Motivation on the ITBS Science Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Motivation	1	2213.25	2.25	.143	ns
Error	36	985.85			
Within Subjects					
Time	1	26576.87	510.95	.001	1.17
Time*Motivation	1	17.40	.334	.567	ns
Error	36	52.01			

ns = not significant

Table 31

Descriptive Statistics for Music Motivation on the NWEA Reading MAP

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Motivated (*n* = 17)	220.00	9.17	228.18	8.79
Not Motivated (*n* = 21)	212.10	11.96	221.43	10.51
Total	215.63	11.38	224.45	10.23

Table 32

ANOVA for Time and Music Motivation on the NWEA Reading MAP

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Motivation	1	504.26	4.84	.034	ns
Error	36	104.18			
Within Subjects					
Time	1	1440.18	339.82	.001	.82
Time*Motivation	1	6.29	1.48	.231	ns
Error	36	4.24			

ns = not significant

Table 33

Descriptive Statistics for Music Involvement on the ITBS Reading Comprehension Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Involved (*n* = 28)	235.36	28.12	263.25	37.52
Not Involved (*n* = 10)	229.20	22.94	257.90	29.76
Total	233.74	26.69	261.84	35.33

Table 34

ANOVA for Time and Music Involvement on the ITBS Reading Comprehension Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Involvement	1	243.92	0.25	.620	ns
Error	36	972.32			
Within Subjects					
Time	1	11799.61	205.87	.001	.90
Time*Involvement	1	2.40	0.04	.839	ns
Error	36	57.32			

ns = not significant

Table 35

Descriptive Statistics for Music Involvement on the ITBS Reading Vocabulary Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Involved (*n* = 28)	231.54	27.10	257.11	25.30
Not Involved (*n* = 10)	231.30	27.09	256.50	20.17
Total	228.84	27.11	256.95	23.79

Table 36

ANOVA for Time and Music Involvement (MI) on the ITBS Reading Vocabulary Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Involvement	1	216.57	.033	.567	ns
Error	36	647.46			
Within Subjects					
Time	1	13606.40	648.59	.001	1.10
Time*Involvement	1	341.56	16.28	.001	
Error	36	20.98			
Pairwise Comparisons					
MI*Pretest			1.05	.312	ns
MI*Posttest			.005	.946	ns
Time*High MI			436.378	.001	.98
Time*Low MI			295.31	.001	1.47

ns = not significant

Table 37

Descriptive Statistics for Music Involvement on the ITBS Science Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Involved (*n* = 28)	240.04	35.61	278.57	31.31
Not Involved (*n* = 10)	243.20	35.78	278.60	23.56
Total	240.87	35.20	278.58	29.16

Table 38

ANOVA for Time and Music Involvement on the ITBS Science Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Involvement	1	18.78	0.02	.894	ns
Error	36	647.46			
Within Subjects					
Time	1	20139.70	456.08	.001	1.17
Time*Involvement	1	36.23	.820	.371	ns
Error	36	44.16			

ns = not significant

Table 39

Descriptive Statistics for Music Involvement on the NWEA Reading MAP

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Involved (*n* = 28)	216.00	11.77	225.43	10.44
Not Involved (*n* = 10)	214.60	10.74	221.70	9.62
Total	215.63	11.38	224.45	10.23

Table 40

ANOVA for Time and Music Involvement (MI) on the NWEA Reading MAP

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Involvement	1	48.45	0.41	.524	ns
Error	36	117.29			
Within Subjects					
Time	1	1006.50	339.02	.001	.82
Time*Involvement	1	19.98	6.73	.014	
Error	36	2.97			
Pairwise Comparisons					
MI*Pretest			.109	.743	ns
MI*Posttest			.977	.329	ns
Time*High MI			419.21	.001	.85
Time*Low MI			84.90	.001	.70

ns = not significant

Table 41

Descriptive Statistics for Instrument Section on the ITBS Reading Comprehension Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Woodwind (*n* = 19)	235.37	22.03	258.21	28.10
Brass & Percussion (*n* = 19)	232.11	31.21	265.47	41.83
Total	233.74	26.69	261.84	35.33

Table 42

ANOVA for Time and Instrument Section (IS) on the ITBS Reading Comprehension Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Section	1	38.00	0.04	.844	ns
Error	36	972.01			
Within Subjects					
Time	1	15008.21	273.78	.001	.90
Time*Section	1	536.32	9.60	.004	
Error	36	58.82			
Pairwise Comparisons					
IS*Pretest			.139	.712	ns
IS*Posttest			.395	.534	ns
Time*WW IS			90.42	.001	.91
Time*B/P IS			192.96	.001	.90

ns = not significant

Table 43

Descriptive Statistics for Instrument Section on the ITBS Reading Vocabulary Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Woodwind (*n* = 19)	225.58	25.05	254.63	25.18
Brass & Percussion (*n* = 19)	232.11	29.34	259.26	22.77
Total	228.84	27.11	256.95	23.79

Table 44

ANOVA for Time and Instrument Section on the ITBS Reading Vocabulary Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Section	1	295.68	0.46	.502	ns
Error	36	641.66			
Within Subjects					
Time	1	15008.21	403.59	.001	1.10
Time*Section	1	17.05	.459	.503	ns
Error	36	37.19			

ns = not significant

Table 45

Descriptive Statistics for Instrument Section on the ITBS Science Subtest

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Woodwind (*n* = 19)	235.74	29.49	276.26	28.22
Brass & Percussion (*n* = 19)	246.00	40.26	280.89	29.16
Total	240.87	35.20	278.58	29.16

Table 46

ANOVA for Time and Instrument Section on the ITBS Science Subtest

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Section	1	526.90	0.51	.479	ns
Error	36	1030.69			
Within Subjects					
Time	1	27019.59	516.50	.001	1.17
Time*Section	1	160.65	2.88	.098	ns
Error	36	52.31			

ns = not significant

Table 47

Descriptive Statistics for Instrument Section on the NWEA Reading MAP

	Pretest		Posttest	
	M	*SD*	*M*	*SD*
Woodwind (n = 19)	214.47	11.16	222.89	9.98
Brass & Percussion (n = 19)	216.79	11.78	226.00	10.52
Total	215.63	11.38	224.45	10.23

Table 48

ANOVA for Time and Instrument Section on the NWEA Reading MAP

Source of Variation	*df*	*MS*	*F*	*p*	*d*
Between Subjects					
Section	1	69.80	0.60	.443	ns
Error	36	115.78			
Within Subjects					
Time	1	1476.65	279.94	.001	.82
Time*Section	1	2.96	0.56	.459	ns
Error	36	5.28			

ns = not significant

CHAPTER FIVE

Conclusions and Discussion

The purpose of this study was to analyze factors affecting literacy achievement of eighth grade middle school instrumental music students. The study dependent variables were the measurements of academic achievement utilized by the research school district, including the Iowa Tests of Basic Skills (ITBS) reading comprehension (RC), reading vocabulary (RV), and science subtests, which are routinely administered by the research school district's guidance counselors in sixth grade through eighth grade to all students each year during the third trimester. Normal curve equivalent (NCE) pretest scores from Spring 2008 and posttest scores from Spring 2010 from this instrument were analyzed. Additionally, the Northwest Evaluation Association (NWEA) Measure of Academic Progress (MAP) pretest scores for criterion referenced assessment in reading comprehension pretest scores from Winter 2008 and posttest scores from Winter 2010 were analyzed. The research school district's guidance counselors also routinely administer the NWEA MAP each year to all students in sixth grade through eighth grade in the winter trimester. This data was collected with the permission of the district's superintendent and with the assistance primarily from the school's principal and the school district's school improvement specialist.

Additional data was culled from *PowerSchool* routinely by the researcher and included: Student gender, academic achievement as measured by grade point average (GPA), music motivation (MM) as measured by competitive musical achievement, music involvement (MI) as measured by extracurricular musical ensemble participation, and instrument section (IS) as measured by section of participation in the school band.

Conclusions

The following conclusions may be drawn from the study for each of the six research questions.

Question #1

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight in high and low SES students as measured on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

A statistically significant gain in scores for both high and low SES students from sixth to eighth grade was observed. There was no significant interaction within and between time and SES level for the ITBS Reading Comprehension scores. Congruent with what the literature on socioeconomic status and academic progress, this study also demonstrated that high SES students, who started at a higher level, also ended at a higher level between pretest and posttest than did the low SES students.

ITBS Reading Vocabulary scores also showed a statistically significant gain for both high and low SES students from sixth to eighth grade. As in the comprehension subtest, there was no significant interaction within and between time and SES level for the vocabulary subtest. Again, the high SES students started at a higher level and ended at a higher level between pretest and posttest than did the low SES students.

The third subtest from ITBS considered for this study, Science, revealed statistically significant gain for both high and low SES students from sixth to eighth grade as well as within time and SES. Within time, the high SES students gained at a substantially higher pace than did their low SES counterparts, although both groups did improve from pretest to posttest. There was no significant interaction between time and SES level for the science subtest.

The NWEA Reading RIT instrument revealed statistically significant gain for both high and low SES students from sixth to eighth grade as well as within time and SES. The low SES group, which pretested at a considerably lower level than the high SES group did, nearly matched that group at posttest. There was no significant interaction between time and SES level for this measure.

Question #2

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between female and male students on

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

A statistically significant gain in scores for both male and female students from sixth to eighth grade was observed. There was significant interaction within and between time and gender for the ITBS Reading Comprehension scores.

ITBS Reading Vocabulary scores also showed a statistically significant gain for both male and female students from sixth to eighth grade. There was no significant interaction within time and gender. Between time and gender showed a significant interaction.

The third subtest from ITBS considered for this study, Science, revealed statistically significant gain for both male and female students from sixth to eighth grade as well as within time and gender. Within time, the male students gained at a substantially higher pace than did their female counterparts, although both groups did improve from pretest to posttest. There was also a significant interaction between time and gender for the science subtest.

The NWEA Reading RIT instrument revealed statistically significant gain for both male and female students from sixth to eighth grade as well as within time and gender. There was a significant interaction between time and gender for this measure.

Question #3

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students with below average/average GPAs and students with above average/superior GPAs on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

A statistically significant gain in scores for both high GPA students and low GPA students from sixth to eighth grade was observed. There was significant interaction within time and GPA for the ITBS Reading Comprehension scores. There was no significant interaction between time and GPA on this measure.

ITBS Reading Vocabulary scores also showed a statistically significant gain for both high and low GPA students from sixth to eighth grade. There was a significant interaction within time and GPA. Between time and GPA did not show a significant interaction on this measure.

The third subtest from ITBS considered for this study, Science, revealed statistically significant gain for both high and low GPA students from sixth to eighth grade as well as within time and GPA. Within time, the high GPA students started with a lower score than did the low GPA students but surpassed them at posttest. There was also no significant interaction between time and GPA for the science subtest.

The NWEA Reading RIT instrument revealed statistically significant gains for both high and low GPA students from sixth to eighth grade. There was no significant interaction within and between time and GPA.

Question #4

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were not motivated or minimally motivated musically and students who were motivated or highly motivated musically on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

A statistically significant gain in scores for both musically motivated students and not musically motivated students from sixth to eighth grade was observed. There was no significant interaction within time and musical motivation for the ITBS Reading Comprehension scores. There was no significant interaction between time and musical motivation on this measure.

ITBS Reading Vocabulary scores also showed a statistically significant gain for both musically motivated and not musically motivated students from sixth to eighth grade. There was no significant interaction within time and musical motivation. There was a significant interaction between time and musical motivation on this measure.

The third subtest from ITBS considered for this study, Science, revealed statistically significant gain for both musically motivated and not musically motivated students from sixth to eighth grade. There was no significant interaction within and between time and musical motivation.

The NWEA Reading RIT instrument revealed statistically significant gain for both musically motivated and not musically motivated students from sixth to eighth grade. There was no significant interaction within time and musical motivation. There was a significant interaction between time and musical motivation.

Question #5

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who were least involved and students who were most involved in music on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

A statistically significant gain in scores for both musically involved students and not musically involved students from sixth to eighth grade was observed. There was no significant interaction within and between time and musical involvement for the ITBS Reading Comprehension scores.

ITBS Reading Vocabulary scores also showed a statistically significant gain for both musically involved and not musically involved students from sixth to eighth grade. There was a significant interaction within time and musical involvement. There was no significant interaction between time and musical involvement on this measure.

The third subtest from ITBS considered for this study, Science, revealed statistically significant gain for both musically involved and not musically involved students from sixth to eighth grade. There was no significant interaction within and between time and musical involvement.

The NWEA Reading RIT instrument revealed statistically significant gain for both musically involved and not musically involved students from sixth to eighth grade. There was a significant interaction within time and musical involvement. There was no significant interaction between time and musical involvement.

Question #6

For students who participated in grades six through eight in the instrumental music program, was there a significant difference from grades six to eight between students who played in the woodwind section and those students who played in the brass and percussion section on the

a. ITBS Reading Comprehension and Reading Vocabulary NCE scores?

b. NWEA Reading RIT score?

c. ITBS Science NCE score?

A statistically significant gain in scores for both woodwind section students and brass/percussion section students from sixth to eighth grade was observed. There was a significant interaction within time and instrument section for the ITBS Reading

Comprehension scores. There was no significant interaction between time and instrument section on this measure.

ITBS Reading Vocabulary scores also showed a statistically significant gain for both woodwind section students and brass/percussion section students from sixth to eighth grade. There was no significant interaction within and between time and instrument section.

The third subtest from ITBS considered for this study, Science, revealed statistically significant gain for both woodwind instrument section students and brass/percussion students from sixth to eighth grade. There was no significant interaction within and between time and instrument sections.

The NWEA Reading RIT instrument revealed statistically significant gain for both woodwind instrument section students and brass/percussion section students from sixth to eighth grade. There was no significant interaction within and between time and instrument section.

Discussion

Socioeconomic Background (SES). Socioeconomic background is an important predictor of general school success. Verhoeven & Vermeer (2006) found that reading literacy correlated highly with educational experience, ethnic status, and SES. Children from higher socioeconomic backgrounds generally perform better on standardized tests. A strong and persistent connection between socioeconomic status and childhood cognitive ability and achievement has been documented by research (Noble, Tottenham, & Casey, 2005).

Because of the exceptional importance of reading skill for academic and life achievement, socioeconomic status plays a particularly important role in any research. How an individual child's experiences, many of which may vary according to racial, ethnic, or socioeconomic background, may affect the developing brain. Differences in experience influence the development of neurocognitive systems crucial for academic success. Thus, it is imperative to offer varied experiences and opportunities for all students, especially students with fewer resources, including instrumental music.
In the present study, high SES pretested higher than low SES and posttested higher than low SES overall, which is congruent with the literature.

•Reading Comprehension – both high and low SES students made significant growth over time.

•Reading Vocabulary – both high and low SES made significant growth over time.

•Science – both high and low SES made significant growth over time. High SES gained substantially more than low SES.

•Reading – both high and low SES made significant growth over time. Low SES started substantially lower than high SES students at pretest, but made significant progress to nearly equal that of the High SES students at posttest. This makes for a very strong case for instrumental music participation at the middle school level, supporting the notion that it has a positive effect on the achievement of both high and low SES students, and is thus good for all kids.

Gender. A substantial body of research has suggested gender differences are not present in the early grades and conversely, numerous studies have claimed that, on average, young girls possess more literacy skills than boys (Ready et al., 2005). When inquiring into the possible sources of gender differences in schooling, it is important to consider socioeconomic status (SES), and upon closer inspection, the gender gap in reading seems to be characteristic mainly of children from economically disadvantaged families (Entwisle, Alexander, & Olson, 2007).

For many boys, educational effort and achievement is viewed as an activity that is not consistent with their gender role or the masculine identity. In the lower SES levels, boys are more confronted with this culture than in the higher SES levels. While girls also do experience peer pressure, previous research has shown that is seems more acceptable for girls to work hard than for boys (Van de gaer et al., 2006).

Contrary to previous research which has suggested that certain types of masculinities and peer pressure to conform to a certain image are related to the underachievement of boys the current study demonstrates the opposite, though possibly due to the fact that the some of the males in the current study also are among those in the higher SES levels.

Males pretested higher than females overall, which is incongruent with much of the literature. The fact that the male population in the sample was considerably smaller than the female population, could explain this phenomenon. The boys who remained in band throughout the middle school years may have had a stronger desire and/or commitment to achieve at a higher level than their non-instrumental music male peers, and therefore excelled in these tested areas. Additionally, this particular sample included several male students whose scores may have skewed the boys' overall sample score, scoring in the very top percentile for the science instrument.

•Reading Comprehension – both females and males made significant growth over time, but especially the boys.

•Reading Vocabulary – both females and males made significant growth over time, but especially the boys.

•Science – both females and males made significant growth over time, but especially the boys. The girls, who started out significantly lower than the boys, and in fact significantly low for the instrument itself at the pretest grade level, improved substantially over time to posttest.

•Reading – both females and males made significant growth over time, but especially the boys.

Grade Point Average (GPA). In their study of tracking and its effects on language achievement of boys and girls, Van de gaer et al. (2006), found that students in the lower tracks achieve less in language in the highest track. The students in the higher tracks have a better relationship with teachers, have a more positive well being at school and have a more positive attitude towards homework than students from the lower tracks. These students have less positive school-related attitudes.

In all four measures, students with high GPAs, predictably, improved significantly more than their low GPA counterparts. However, in three of the four tests, the students with low GPAs started with higher scores than those with high GPAs, yet posttested lower. This inconsistency may be explained by a few theories that have been postulated in the literature, which intertwine with SES and gender.

Parents' expectations predict the specific actions that parents take to help children learn, and many of these actions vary by SES. Higher SES parents have higher expectations for their children's school performance than do lower-SES parents. They also read to their children more, see their children's school records more often, ensure that their children borrow books from the library in the summer, and take their children on more summer trips than do parents with lower expectations (Entwisle et al., 2007).

The students in this study who started out with low GPAs but had higher standardized test scores than their counterparts with high GPAs may have lacked the support as described above as they progressed through middle school. They may also have, for whatever reasons, experienced disengagement in classroom experiences as a result of boredom or being unchallenged.

•Reading Comprehension – both groups of students with high and low GPAs made significant growth over time, but especially the students with high GPAs.

•Reading Vocabulary – both groups of students with high and low GPAs made significant growth over time.

•Science – both groups of students with high and low GPAs made significant growth over time, but especially the students with high GPAs.

•Reading – both groups of students with high and low GPAs made significant growth over time.

Music Motivation. As the literature alludes to, students with higher motivation – musically or academically – do, in fact, attain higher standardized test scores than their peers who demonstrate lower motivation in these endeavors.

Guthrie et al. (2006) investigated whether classroom practices and education programs can influence reading motivation and thereby increase reading comprehension. Using Guthrie and Wigfield's (2000) theoretical framework of engagement perspective on reading comprehension, they focused on instructional practices that can increase reading motivation and reading comprehension, which shed light on the relationship of hands-on activities to reading engagement. This theoretical perspective on the relationship between situational interest and reading comprehension is that for stimulating tasks to have lasting effects on motivation and comprehension, they must be connected conceptually to further knowledge (Guthrie et al., 2006).

In a study by Sweet et al. (1998), teachers reported that the motivation of low-achieving students increased when books were connected to activities in which these students participated and enabled the students to read about a specialized extracurricular activity. The hands-on activity, such as playing an instrument, is one such stimulating task.

•Reading Comprehension – both groups of musically motivated and not musically motivated students made significant growth over time.

•Reading Vocabulary – both groups of musically motivated and not musically motivated students made significant growth over time, and the group of students with lower musical motivation improved dramatically.

•Science – both groups of musically motivated and not musically motivated students made significant growth over time.

•Reading – both groups of musically motivated and not musically motivated students made significant growth over time.

Music Involvement. A major theme of Vygotsky's theory (1978) is that the social interaction between adults and children laid the foundation for young children's development and learning.

Educational intervention programs should focus not just on book-reading types of interactions to positively affect students' literacy achievement, but also on other types of teaching situations (Britto, Brooks-Gunn, Griffin, 2006).

The students who were more musically involved pretested and posttested at higher levels than their counterparts who were less musically involved. The literature raises the question regarding reading achievement and music involvement, wherein a relationship between the two was found. One such analysis demonstrates that there is indeed a strong and reliable association between the study of music and performance on standardized reading/verbal tests. However, correlational studies such as this cannot explain what underlies this association. For example, it is possible that students are already strong in reading choose to study music, and those who are interested in music are also interested in reading because they come from families which value both music and reading, or it is possible that a causal relationship exists, such that either music instruction transfers to reading achievement or the reverse (Butzlaff, 2000).

In order to stimulate the literacy development of children, special attention should be given to strengthening the connections between home and school. Previous studies have clearly shown that the development of children's vocabulary and world knowledge is highly dependent on input from the home environment (Verhoeven & Vermeer, 2006).

Scientific literacy cannot be attained without fundamental literacy – the ability to read and comprehend textual information and write competently about the subject under study (Norris & Phillips, 2003). One must be able to read and comprehend in order to examine information and must be able to compose (both in writing and orally) in order to communicate results, and several research studies have shown the positive effects of scientific inquiry on developing students reading skills and comprehension (Miller, 2006).

The present findings, like those of Butzlaff's (2000), produced large effect sizes, thus suggesting further exploration of this question is of merit.

•Reading Comprehension – both groups of musically involved and not musically involved students made significant growth over time.

•Reading Vocabulary – both groups of musically involved and not musically involved students made significant growth over time. The students who were less involved, i.e., only in band, equaled that of the students who were most involved in music groups in school. Notably, they started from a significantly lower pretest score than did their more involved counterparts. This suggests that participation in instrumental music has a strong influence on students' vocabulary development.

•Science – both groups of musically involved and not musically involved students made significant growth over time. Interestingly, those students who were most involved performed lower than those less involved on the pretest but improved to match those students on the posttest, suggesting that the myriad of musical ensemble experiences that these students participated in contributed to their improvement realized in this field of study, presumably also as a result of the reading vocabulary gains enjoyed by these students. The content of science is important to language and literacy development in the middle school because science is an infinite source of meaningful content. It imbues language with a sense of importance and urgency and makes it integral to science learning (Thier, 2010).

•Reading – both groups of musically involved and not musically involved students made significant growth over time.

Instrument Section. The findings from this research question suggest that participation in instrumental music for students is equally valuable for students regardless of the instrument they chose to play. Anecdotally, the researcher has observed certain patterns over years of experience in the instruction of instrumental music that have seemed to emerge with regard to student academic performance and achievement and instrument choice. The results to the question posed herein alleviate concern or doubt with regard to that connection.

•Reading Comprehension – both the woodwind instrument section and the brass/percussion instrument section made significant growth over time. The students in the woodwind instrument section started with higher pretest scores overall but ended with lower posttest scores overall than the brass/percussion section.

•Reading Vocabulary – both the woodwind instrument section and the brass/percussion instrument section made significant growth over time. The students in the woodwind instrument section pretested lower and posttested lower than the students in the brass/percussion instrument section, but both sections scored substantially high for the instrument scale.

•Science – both the woodwind instrument section and the brass/percussion instrument section made significant growth over time. The students in the woodwind instrument section scored lower on the pretest but were nearly equal on the posttest.

•Reading – both the woodwind instrument section and the brass/percussion instrument section made significant growth over time. The students in the woodwind instrument section scored lower on the pretest but were nearly equal on the posttest.

Implications for practice. A single research study cannot provide a sound basis for establishing and explaining a relationship between instrumental music and literacy achievement in eighth grade middle school students. This investigation does, however, contribute to a growing body of research that supports participation in band for the enhancement it provides in the development of literacy skills. Factors affecting the relationship include SES status, gender, GPA, music motivation, music involvement and instrument section, with sustained involvement over the period of the three years of middle school, grades six through eight. Findings yield results that support research from brain studies by neuroscientists who have documented that brain activity occurs as a result of music performance, particularly in an instrumental venue (Altenmuller, 1997; Rauscher, 1997; Schellenberg, 2006; Schlaug et al., 1995; Wandell et al., 2008). The potential for growth and development in academic and creative endeavors for children, and as such warrants it inclusion in the middle school curriculum.

Early childhood education in music and the study of it is well documented in the literature. Continuous music instruction, particularly in the realm of instrumental music as this study suggests, throughout middle school strengthens the academic skills of literacy as defined by reading comprehension and vocabulary and in the content area of science.

Hearkening back to the sentiments of Eisner (1999), while music training and study does contribute in many ways to the intellectual development of children, music must still be arts for arts' sake. Arts educators are cautioned to remember that the arts are important in their own right, not simply for their contributions to the mastery of other subjects. Gardner (1999) also asserted that a danger lies in making music subservient to other subjects; that is, if the reason music is taught to make students smarter, and it doesn't, then why teach music? The inclusion of music education in the middle school curriculum should be based on what it offers in terms of developing the physical, emotional, intellectual, and social areas of cognition that other academic disciplines can or do not (Hetland & Winner, 2001).

Long-term instrumental music program instruction. Evidence implies a true association between students' literacy achievement and participation in music, particularly in the study and performance of instrumental music. The longer an individual participates in the study of music, the more possible it is to detect positive benefits formal training may have on cognitive development (Huber, 2009). Weekly music lessons for a minimum of seven to eight months is recommended (Schellenberg, 2004) and Costa-Giomi (1999) suggested instruction lasting longer than one year. Rauscher (2003) and others, however, have affirmed that significant observation of musical influences on literacy achievement, i.e. reading development, could not be adequately detected without active participation in music performance lasting at least two years. Results from the current investigation examined subjects who had been involved in such training for a period of three years.

Findings from research showed significant growth over time in literacy achievement as measured by reading comprehension, vocabulary, and science content batteries of assessment, which demonstrated that students actively engaged in music instruction do receive greater benefits from so doing. This suggests that the longer an individual participates in the study of music the greater impact such training may have on cognitive functions that influence other disciplines. Sustained involvement in music can influence success in reading (Babo, 2001; Catterall et al., 1999). These studies provide evidence that the association between musical training and performance and literacy achievement strengthens over a sustained period of time, thus supporting the theory that continuous involvement in the study of music is a factor affecting the literacy achievement of eighth grade middle school instrumental music students.

Some research conclusions question if an association between the study and performance of music and literacy development is the result of the arts' affect over reading. Kemmerer (2003) noted that it is possible that more intelligent students are naturally drawn to and engage themselves in music, which may explain why standardized assessment scores are consistently and significantly higher across the board than students who do not continue the study of music. Johnson (2006) and Winner & Cooper (2000) proposed that the quality of these programs may play an important role in relating the study of music to literacy development in the form of reading, both in terms of comprehension and vocabulary building, as well as content area reading. According to their findings, academically gifted students are attracted to superior programs where they may positively influence the environment for other students as well as themselves.

Students who are actively engaged in the study of music may be self motivated in practicing and learning musical concepts to the same extent they process information or other academic subjects. These students are self-disciplined and take significant interest in the quality of their work and performance. Parental influence may also play an important role when the same emphasis that is placed on completing homework is also stressed in practicing a music instrument (Winner & Cooper, 2000).

Implications for policy. Previous studies have yielded positive findings for the relationship between music participation and academic development in middle school students. Babo (2001) concluded that instrumental music programs have a significant impact on academic achievement, particularly reading development, based on standardized test scores favoring students actively involved in formal music training. The body of literature also provides evidence that years of instruction in the study of music can influence academic results in a positive way. Among various academic disciplines, Babo (2001) found that eighth grade students with years of formal music instruction had the largest positive impact on reading and language achievement. Neuharth (2000) observed significant differences in reading achievement that favored band students even after one year of participation in the study of music. Reading abilities tended to improve over time for those students who remained in band. Johnson (2006) conducted research using factor analysis that found middle school students in instrumental music programs scoring higher on English standardized tests than those with no music instruction.

The preponderance of empirical evidence suggests that schools should not only engage in musical instruction for their students but embrace and compel the continued and sustained study of it by all students.

Implications for further research. The growing body of literature conveys that the longer a student is actively engaged in the study of music, the more significant are the academic gains (Babo, 2010; Catterall et al., 1999; Schellenberg, 2004). Some extended studies produce the most conclusive results, examining a specific population from elementary to high school. Thus, this would be one recommendation for continued study. While long-term investigations are more time consuming, researchers in the field warn that formal training in the study of music less than one year is not sufficient to adequately evaluate its affect on literacy achievement (Rauscher, 1999; Schellenberg, 2004). Findings where the study of music lasts longer than two years may reveal significant differences in the robustness of the relationship while providing valuable information related to cognitive function (Rauscher, 2003).

The notion of transfer of knowledge from one discipline to another, suggesting benefits in the learning processes of both, has produced mixed results in research (Gromko, 2005; Johnson, 2000; Kemmerer, 2004; Rauscher & Hinton, 2006). Considering the similarities between the learning processes of reading text and reading music, future research in transferability as it relates to the parallels that facilitate cognition is recommended. Such investigation could supply specific skills that transfer.

Earlier research alludes to strong readers' predisposition to being able to learn how to play a musical instrument (Butzlaff, 2000; Johnson, 2006; Kemmerer, 2004). Future investigators should consider examining the association between reading skill-level and a child's degree of interest in learning how to play a musical instrument before formal training on it begins.

The current study did not take into account race or ethnicity in its scope. A suggestion for future research is an investigation of the relationship between music instruction and literacy achievement in middle school students differentiated by that variable.

There is evidence in the concluded study that demonstrates a relationship between sustained, active engagement in the study of instrumental music and literacy achievement of eighth grade middle school students. While a cause and effect relationship cannot be determined as a result of this study, neither can it be refuted. It is clear that the length of training in music for the group of students in this study also has a relationship to the literacy achievement attained as measured by the school district's standardized testing instruments.

Learning to play a wind or percussion instrument (woodwind, brass, and percussion) and participating in ensembles that feature this instrumentation have the most significant impact on reading development. This may be due to a combination of the technical requirements needed for effective performance, self-discipline, and/or parental influence. Whatever the factor(s), medical research confirms that playing music activates multiple areas of the brain, thus enhancing cognition and increasing brain efficiency (Huber, 2009).

The importance of music education in schooling should not be justified on the basis of its affects on other academic fields of study. Making music should be recognized for the cognitive and emotional affects it has on the individual. Thus, music and the arts play a valuable role in the development of the whole person, completing the educational process as Dewey envisioned it and communicating in ways that words alone cannot (Berube, 1999).

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APPENDIX A

Research School District Data Use Permission Letter

LEWIS CENTRAL COMMUNITY SCHOOL DISTRICT
1600 East South Omaha Bridge Road
Council Bluffs, Iowa 51503
(712) 366-8202

June 17, 2010

Johnny Kurt
14611 Saratoga Street
Omaha, NE 68116

Johnny,

I am hereby approving your request to use student data for your doctoral dissertation.

Sincerely,

Mark A. Schweer
Superintendent of Schools
Lewis Central Community School District
Council Bluffs, IA 51503

A Proud Past. . .
A Promising Future

APPENDIX B

Institutional Review Board Protocol Approval Letter

University of Nebraska Medical Center

NEBRASKA'S HEALTH SCIENCE CENTER

Office of Regulatory Affairs (ORA)
Institutional Review Board (IRB)

September 21, 2010

Johnny T. Kurt
College of Education
UNO – Via Courier

IRB#: 552-10-EX

TITLE OF PROTOCOL: Factors Affecting Literacy Achievement of Eighth Grade Middle School Instrumental Music Students

Dear Mr. Kurt:

The Office of Regulatory Affairs (ORA) has reviewed your application for *Social Science and Behavioral Research* on the above-titled research project. According to the information provided, this project is exempt under 45 CFR 46:101b, category 4. You are therefore authorized to begin the research.

It is understood this project will be conducted in full accordance with all applicable HRPP Policies. It is also understood that the ORA will be immediately notified of any proposed changes that may affect the exempt status of your research project.

Please be advised that this research has a maximum **approval period of 5 years** from the original date of approval and release. If this study continues beyond the five year approval period, the project must be resubmitted in order to maintain an active approval status.

Sincerely,

Gail D. Kotulak

Gail Kotulak, CIP
IRB Administrator
Office of Regulatory Affairs (ORA)

gdk

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