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Impact of a Music Program on Students' Standardized Test Scores

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COLLEGE OF EDUCATION

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Abstract

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MA, Missouri State University, 2010

ME, University of Oklahoma, 2003

BM, Northwestern University, 1983

Dissertation Submitted in Partial Fulfillment

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Abstract

Administrators at the focus school had not determined if participation in a music program has influenced students' academic achievement, thereby ushering doubt about the utility of this program. The purpose of this causal-comparative study was to determine the impact of the music program on students' English language arts (ELA) and math Measure of Academic Progress (MAP) scores. The theoretical foundation for this study was Miendlarzweska and Trost's model of musical training, which indicates the impact of musical training on academic, social, and cognitive outcomes and identifies factors that mediate that impact. Archival data were retrieved on 74 Grade 5-8 students who participated in the program during the 2012-2013 school year and who also participated during the 2011-2012 school year as Grade 4-7 students. Analysis of covariance indicated no significant effect on ELA or math MAP scores for music program participation. Implications for positive social change include providing initial research findings to the local site on the potential academic impact of this music program. Further research with recent data and larger sample sizes were recommended. Additional research at the local level may yield results that can help administrators better support higher levels of student success.

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Dedication

This paper is dedicated to my mother, Joanne Murray, and the U.S. Army, both of whom encouraged me to “be all that I can be.”

Acknowledgments

I am grateful for the expertise of my project study chairperson, Dr. David A. Hernandez, who helped me finish this study, and taught me a great deal in the process. Thank you to Laura Richardson who continually supported and encouraged me in this endeavor. I am also indebted to Kathy K.-M., whose sharing of experience, strength, and hope has changed my life. I need to thank two great superintendents, Sherry Heavin and John Fluhrer, and all the support personnel at the focus school for their assistance. Thank you to Susan Hueck for her encouragement, patience, and attention to detail throughout this challenging process.

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Chapter 1: Introduction to the Study

Perspectives on the value of music education to improve students' academic outcomes are mixed. Theorists such as Miendlarzweska and Trost (2014) and researchers such as Baker (2012); Bugaj and Brenner (2011); and Hille, Gust, Bitz, and Krammer (2011) have argued that skills gained during music education transfer to learning in other cognitive and social domains. Also, preservice music teachers (Kim & Kemple, 2011), both working music and nonmusic teachers, and students support music education in schools because they perceive music to be beneficial for students (Vitale, 2011). In addition, parents perceive a benefit of music education (Royal Conservatory of Music, 2015). On the other hand, some researchers have argued that the evidence showing a connection between music education and student achievement is apparent not because participation in music education helps students perform better but because students with specific characteristics (e.g., higher achieving, more motivated, good study habits) choose to participate in music education (Corrigall, Schellenberg, & Misura, 2013; Elpus, 2013; Hash, 2011; Schellenberg, 2011). Thus, it is likely that these students would demonstrate high levels of achievement regardless of their participation in music education (Corrigall et al., 2013; Elpus, 2013; Hash, 2011; Schellenberg, 2011).

These varying perspectives give rise to the question of whether or not music education programs implemented in schools are contributing to improved student outcomes. An exploration of this topic is important for two reasons. First, if a school music program is not associated with improved student outcomes, valuable, and often scarce, resources may be wasted on funding a music program. Second, if a school music

program in not associated with improved student outcomes, other more beneficial programs could be sought to help improve student outcomes.

There are 12 sections in this chapter. The first section includes background information on the status of music education programs in the United States in the 15 years prior to this study that provides perspective on the introduction of a music program at the focus school. The next sections are related to the key aspects of the study: problem statement, purpose of the study, research questions and hypotheses, theoretical foundation, and nature of the study. A section of key definitions also is included. Additional concepts related to the study follow: assumptions, scope and delimitations, limitations, and the significance of the study. A summary section concludes the chapter.

Background

While music was identified as a core subject in No Child Left Behind (2002), it was not identified as a subject for mandated testing. This expectation for music education was carried over in the Every Child Achieves Act (2015), the successor of No Child Left Behind. Because music is not a tested subject, it often is considered to be of lesser value when compared to other core subjects (Nash, 2013; West, 2012). Beveridge (2010) claimed that the view of music education as a subject of lesser value has contributed to its decreased presence in the public school system. In addition, budget cuts have prompted schools to cut programs; often music and art programs are the first to go (Baker, 2012). On the other hand, other research has demonstrated there is no decline in music programs. For example, the National Center of Education Statistics (NCES; 2012) showed that the number of music education programs has remained consistent for

elementary schools between the 1999-2000 and 2009-2010 school years; music education at the secondary school level actually increased by 1% between those years (NCES, 2012).

At the focus school in this study, a music program was introduced for the 2012-2013 school year. Based on the understanding that participation in music programs has many positive outcomes above and beyond improved academic performance, during the 2012-2013 school year, I designed and supervised the implementation of a music program for students in Grades 4-8 at a rural K-8 school in Missouri. The program was held after regular school hours. When I implemented the music program, I anticipated the learning students achieved through music education would transfer to academic areas of learning such as English language arts (ELA) and math and ultimately help students perform better academically in these areas.

Problem Statement

While a music program was implemented at the focus school during the 2012-2013 school year, at the time of this study, no research had been conducted to determine if the implementation of the program has had an impact on the academic achievement of the students at the focus school who have participated in the program. The lack of follow-up regarding the impact of the music program in the focus school is problematic because it is possible that the music program is not achieving one of its originally intended purposes, to support positive student outcomes, including improved academic outcomes.

The use of school resources to effectively support student achievement is especially critical at the focus school because the majority of students in the school are

economically challenged, as indicated by their participation in the free and reduced-price lunch program. Poverty has been found to be associated with poor academic achievement (e.g., Ratcliffe & McKernan, 2012; Young, Cordes, & Winner, 2013) and low enrollment in postsecondary education (Catterall, Dumais, & Hampden-Thompson, 2012).

The use of school resources to effectively support student achievement also is especially critical at the focus school because, historically, students in the focus school have not consistently performed well academically. For example, the focus school did not meet its adequate yearly progress goal for ELA in 2006, 2007, 2010, and 2011 and for math in 2008 and 2010 (Missouri Department of Elementary & Secondary Education [MDESE], 2016). In addition, Missouri Assessment Program (MAP) data from 2 years prior to the implementation of the music program during the 2012-2013 school year showed that students at the focus school were, with few exceptions, achieving proficient and advanced levels of performance at rates lower than the state average (see Table 1).

Purpose of the Study

The purpose of this quantitative, causal-comparative study was to determine the impact a music program had on student achievement, using differences in MAP test scores between students who participated in the music program and those who did not. Because the literature has shown that participation in music education can improve students' academic skills (Moreno, Bialystok, et al., 2011; Rauscher & Hinton, 2011) and achievement, particularly in reading (Bugaj & Brenner, 2011), spelling (Hille, Gust, Bitz, & Krammer, 2011), and math (Baker, 2012), I anticipated finding a connection between participation in the music program and achievement, particularly in ELA and math.

Table 1

School and State MAP scores for Grades 4-8: 2010-2011 and 2011-2012 School Years

Grade	English Language Arts		Math	
	School	State	School	State
	2010-2011			
4	42.9	52.7	32.1	51.2
5	44.4	52.0	27.8	53.4
6	61.1	51.1	72.2	57.5
7	60.0	54.4	73.3	56.4
8	23.8	53.1	42.9	51.5
	2011-2012			
4	65.2	52.9	73.9	51.1
5	37.5	52.6	37.5	55.0
6	58.8	50.9	58.8	56.3
7	56.3	55.8	50.0	60.2
8	53.3	53.9	73.3	52.7

Note. Data retrieved from the Missouri Department of Elementary & Secondary Education, 2016, State assessment, http://mcds.dese.mo.gov/guidedinquiry/Pages/State-Assessment.aspx

Research Questions and Hypotheses

There were two research questions for this study:

RQ1: Does participation in a music program impact students' performance in ELA as measured by differences in ELA MAP scores between students who participated in a music program and those who did not?

H_o1: Participation in a music program does not significantly impact students' performance in ELA as measured by differences in ELA MAP scores between students who participated in a music program and those who did not.

H_a1: Participation in a music program does significantly impact students' performance in ELA as measured by differences in ELA MAP scores between students who participated in a music program and those who did not.

RQ2: Does participation in a music program impact students' performance in math as measured by differences in math MAP scores between students who participated in a music program and those who did not?

H_o1: Participation in a music program does not significantly impact students' performance in math as measured by differences in math MAP scores between students who participated in a music program and those who did not.

H_a1: Participation in a music program does significantly impact students' performance in math as measured by differences in math MAP scores between students who participated in a music program and those who did not.

Theoretical Foundation

Miendlarzweska and Trost's (2014) model of musical training was the theoretical framework for this research study. This model was developed to depict the impact of musical training on academic, social, and cognitive outcomes as well as to show the factors that mediate both learning in music education and the transfer of skills learned during music education to other cognitive domains (Miendlarzweska & Trost, 2014). According to Miendlarzweska and Trost, musical training can impact outcomes in other

cognitive domains through the development of skills that transfer between domains, possibly because the skills are developed in domains that are responsible for more than one type of cognitive function. These skills are grouped into two categories: near and far transfer skills (Miendlarzweska & Trost, 2014). A more detailed description of this model is presented in Chapter 2.

Miendlarzweska and Trost's (2014) theory is aligned with this study's approach and research questions. The model depicts relationships between specific measurable variables and, in this study, I will measure relationships between specific variables. In particular, the model of musical training provides a foundation for understanding how participation in the instrumental portion of a music program could contribute to improved academic outcomes in reading for students, the essential relationship depicted in the research questions developed for this study. This connection is apparent because the skills acquired through learning music, as depicted in this model, are applicable to learning in other domains as demonstrated in the literature (e.g., Moreno, Bialystok, et al., 2011; Moreno, Friesen, & Bialystok, 2011; Rauscher & Hinton, 2011). A more detailed description of the applicability of the model of musical training in this study is presented in Chapter 2.

While Miendlarzweska and Trost's (2014) model of musical training was helpful for understanding how student participation in the band portion of the music program could contribute to improved reading outcomes for students at the focus school, the model does not address exposure to vocal training. However, study results have shown that vocal training contributes to improved academic outcomes for students when

compared to students who do not participate in vocal training (e.g., Helmrich, 2010; Rauscher & Hinton, 2011). Details of these studies are discussed as part of the literature review in Chapter 2.

Nature of the Study

This study was a quantitative causal-comparative study. Quantitative research is valuable when researchers want to measure variables associated with specific populations (Kraska, 2010). A quantitative study was appropriate for my study because I measured achievement differences between students who participated in the music program and those who did not. Causal-comparative research is valuable when researchers want to examine pre-existing data to look for relationships between variables (Brewer & Kuhn, 2010). Causal-comparative research is appropriate for my study because I used archival data to make comparisons between variables: student participation in the music program and ELA and math MAP scores.

An administrator at the focus school provided both the demographic and archival MAP score data I used in this study. For the demographic data, I calculated frequencies and means. For the student performance data, I conducted analysis of covariance (ANCOVA). When I conducted the ANCOVA, the independent variable was student participation in the music program, the dependent variables were the 2012-2013 ELA and math MAP scores, and the covariates were the 2011-2012 ELA and math MAP scores.

Definitions

Adequate yearly progress: Adequate yearly progress refers to the No Child Left Behind mandate requiring students to make annual progress in core subjects, including reading and math (Farmer et al., 2006).

After-school program: The term after-school program can represent a broad range of activities. According to Russell and Smith (2011), "the term afterschool program can mean anything from a YMCA basketball league to an extended-day program that includes both before-school and afterschool care" (p. 3). In their network analysis of regional afterschool programs in Dallas, Texas, Russell and Smith found a variety of program types, including arts-, sports-, and academic-based programs. In this study, after-school program referred to the music program, band and choir, that was offered to students at the focus school following their regular school day.

Missouri Assessment Program (MAP): The MAP is an assessment tool used to measure student performance in ELA (Grades 2-12), math (Grades 2-12), and science (Grades 3-9; Northwest Evaluation Association [NWEA] 2014).

Assumptions

Three assumptions were made in this study. Two of the assumptions were related to the use of archival data for analyses. First, I assumed that the MAP assessments were administered according to the directed protocols. It was necessary to make this assumption because I did not administer the MAP assessments and, therefore, could not verify that the assessments were administered properly. It was important to assume that the assessments were administered properly because if they were not administered

properly, they would not be a representative measure of student achievement in ELA and math. However, because the teachers receive extensive instruction on the testing procedures, it is most likely that the tests were administered according to directed protocols. Second, I assumed that the state accurately recorded students' test results that were shared with the school and subsequently with me. It was necessary to assume that the state accurately recorded students' test results because I was not involved with this process and, therefore, could not verify that the assessment results were properly recorded. It was important that the scores the state reported were accurate so that the analyses I conducted using the data would accurately reflect any differences identified between the students who participated in the music program and those who did not. However, because the MDSES is a state level agency tasked with implementing state-wide testing, it is feasible to assume that the agency reported the scores accurately. The third and final assumptions were that students tried their best on the MAP tests and, therefore, the MAP scores are a true reflection of their abilities.

Scope and Delimitations

The scope of the study was limited to student participation in a music program and students' ELA and math MAP scores. These variables were chosen as the focus of this study, because, as mentioned previously, it was important to determine whether implemented music programs are impacting students in the way the programs were intended. Music programs that are not achieving the outcomes for which they were intended may be misdirecting school resources away from other opportunities that might be more beneficial to students. While the school accommodates students in Grades K-8,

this study was delimited to students in Grades 4-8. It was necessary to delimit students to these grades because the music program is not offered to students in younger grades.

The use of theories in this study was delimited to Miendlarzweska and Trost's (2014) model of musical training, which was appropriate for this study for reasons discussed previously in the Theoretical Framework section of this chapter. Another theory that connects the concept of music with education is Gardner's (1987) theory of multiple intelligences. Gardner (1987) defined intelligence "as the ability to solve problems, or to fashion products, that are valued in one or more cultural settings" (p. 189) and proposed that people learn in a variety of ways, or through a variety of intelligences. Originally, Gardner (1987) proposed that there were seven intelligences: linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal. Gardner (1999, 2003) later proposed that there was strong evidence to support a naturalistic intelligence in addition to evidence that suggested an existential intelligence. While the concept of a musical intelligence appears well connected to the topic of study in this study, the theory of multiple intelligences is focused on the impact of learning styles on how students learn, and the focus of this study was on the impact of learning in music education on other areas of learning. For this reason, I did not consider this theory in the development of this study.

The results of this study were delimited to students in Grades 4-8 at the focus school; the results from this study will not be generalizable to larger populations. The most consequential reason that the study results will not be generalizable to the larger population is because I used a convenience sample in my study. The use of convenience

sampling can impact the external validity of a study through selection-treatment interaction (Lodico, Spaulding, & Voegtle, 2010). Participants in this study were not randomly selected or randomly assigned to participate or not participate in the music as they would be, according to Trochim (2006), in experimental research in which results lend themselves to generalization to larger similar populations.

Limitations

A noted limitation in this study was the lack of generalizability of results. One reason I determined that the results of this study would not be generalizable was because of the small population of students from which data could be drawn (N =200). I anticipated that data would not be available for all of the students for both the 2011-2012 and 2012-2013 school years and would yield a sample size smaller than 200. Another reason I determined that the results of this study would not be generalizable was because students self-selected to participate in the music program at the focus school. Such lack of random assignment in causal comparative research limits the generalizability of a study (Lodico et al., 2010) because of possible differences between participants who chose to be in a program and those who do not (Leos-Urbel, 2015). In this study then, it was possible that students who chose to participate in the music program were characteristically similar in some way when compared to those students who chose not to participate. A final reason I determined that the results of this study would not be generalizable was that as the music teacher in the focus school, I was in charge of implementing the music program and may have, through my regular contact with the students in the music program, influenced them in a way that could have impacted the

results (i.e., experimenter effects may have impacted student outcomes). The concepts of self-selection and experimenter effects are discussed as threats to validity and in more detail in Chapter 3. While a lack of generalizability of results is limiting, the results of this study can still inform decisions at the focus school. Administrators in other schools may make their own determinations about the applicability of the study results to their own unique settings.

Another limitation in this study was that I was only provided with 2 years of data. The lack of data beyond the first year of student participation in the music program was limiting because it was possible that the impact of participation in a music program may not be fully observable after only 1 year. However, results of analysis after 1 year of participation in the music program can be useful as a starting point of discussion about the value of student participation in the music program at the focus school.

Significance

Researchers have mixed perspectives about the value of music education for improving students' learning in other cognitive domains. Some researchers have argued that skills learned through music education transfer to other cognitive domains (e.g., Baker, 2012; Bugaj & Brenner, 2011; Hille et al., 2011; Miendlarzweska & Trost, 2014). Other researchers claim additional variables are responsible for the apparent association between music education and skills in other domains (e.g., Corrigall et al., 2013; Elpus, 2013; Hash, 2011; Schellenberg, 2011). The music program examined in this study was relatively new, and the impact of the program had not been examined. If the music program was not bringing about the intended change for which it was implemented,

school resources may have been wasted and other opportunities to support student achievement may have been overlooked. For these reasons, it was important to determine the impact of the music program in this unique setting.

Despite the noted limitations, this study is important because it generated data to fill the gap in knowledge regarding the impact of the music program on student performance at the focus school. Administrators at the focus school can use what was learned in this study to make informed decisions about the music program. While narrow in scope, this study may serve as a starting point for additional research into the impact of the music program.

Summary

At the focus school in this study, no research had been conducted to determine if the music program that was implemented during the 2012-2013 school year had had an impact on students' academic achievement. This problem was important to study to ensure that valuable school resources were not being wasted and that students were being provided with support that was impactful with regard to their academic success. To determine if the music program had had an impact on student outcomes, I conducted causal-comparative research in which I compared student performance in ELA and math on the MAP assessment between students who participated in the music program and those who did not. Miendlarzweska and Trost's (2014) model of musical training served as the theoretical framework for this study and provided a means of understanding potential connections I might have discovered between music education and student performance at the focus school. A more detailed discussion of the study methodology is

presented in Chapter 3. The following chapter includes a presentation of the literature related to the main topics of this study.

Chapter 2: Literature Review

Although a music program was implemented at the focus school during the 2012-2013 school year, at the time of this study, no research had been conducted to determine if the implementation of the program had had an impact on the academic achievement of the students at the focus school who had participated in the program. The lack of follow-up regarding the impact of the music program in the focus school was problematic because it was possible that the music program was not achieving one of its originally intended purposes, to support positive student outcomes, including improved academic outcomes. Therefore, the purpose of this causal-comparative study was to determine the impact a music program had on student achievement, as evidenced by differences in MAP test scores in ELA and math between music program participants and nonparticipants.

The main focus of this study, the potential for a music program to impact student achievement is reflected in the literature reviewed in this section. Research has shown that various types of learning occur during music education (Alluri et al., 2012; Herholz & Zatorre, 2012; Merrett & Wilson, 2012; Pearce et al., 2013) and that numerous factors contribute to learning during music education (Merrett, Peretz, & Wilson, 2013; Penhune, 2011; Skoe & Kraus, 2013; Strait, Chan, Ashely, & Kraus, 2012; Wilson, Lusher, Martin, Rayner, & McLachlan, 2012). In addition, participation in music programs is related to student achievement. This connection is apparent because skills acquired through learning music are applicable to learning in other domains as demonstrated in the literature (e.g., Moreno, Bialystok, et al., 2011; Moreno, Friesen, et al. 2011; Rauscher &

Hinton, 2011). Research also has shown that vocal training contributes to improved academic outcomes for students when compared to students who do not participate in vocal training (e.g., Helmrich, 2010; Rauscher & Hinton, 2011).

There are eight key sections in this chapter related, either directly or indirectly, to the variables in this study. They are (a) learning in music education, (b) factors impacting learning in music education, (c) connections between learning in music and other brain functions, (d) factors impacting the connections between learning in music and other brain functions, (e) positive outcomes associated with music education, (f) student characteristics associated with music education, (g) music education, and (h) after-school programs. The chapter begins with a discussion of the literature search strategy and the theoretical foundation and ends with a summary.

Literature Search Strategy

To conduct the literature review for this study, I searched multiple databases including Academic Search Complete, Education Source, Education Resource Information Center, ProQuest Central, Education Research Complete, JSTOR database, Web of Science, Science Direct, and Wiley Online Library. I used numerous and varied search terms, but they were based on these key concepts: *music education, fine arts education, learning processes in music/fine arts education, brain function and music/fine arts education, after-school programs, after-school music/fine arts programs, and academic achievement* and *music/fine arts education.* The majority of articles included in this review were taken from scholarly, peer-reviewed journals. In some cases, I used study results gathered from organizational reports because the data were not published

elsewhere. The majority of the articles included in this review are dated between 2011 and 2016. When I included older articles, I did so either because they demonstrated a pattern over time, were the most recent studies available on the particular topic, or because they were particularly relevant to my study.

Theoretical Foundation

In this section, I used Miendlarzweska and Trost's (2014) model of musical training introduced in Chapter 1 as the framework for my study. The underlying concept of the model is that musical training can impact outcomes in other cognitive domains through the development of skills that either transfer between domains or are developed in domains that are responsible for more than one type of cognitive function (Miendlarzweska & Trost, 2014). This concept differs from general transfer of learning in which, as described by Salomon and Perkins (1989), one learned skill transfers between two or more contexts in which that one skill is applied.

The concept of near and far transfer skills had been established in the literature (Moreno & Bidelman, 2014) prior to Miendlarzweska and Trost's (2014) development of their musical training model. However, other researchers have specifically acknowledged the concept of near and far transfer skills in reference to Miendlarzweska and Trost's work (e.g., Banerjee et al., 2016; Hallam, 2014; Wang, Ossher, & Reuter-Lorenz, 2015). In addition, many studies have been conducted in which researchers explore the concepts that support the specific relationships depicted in Miendlarzweska and Trost's model of musical training. For this reason, in this section, I discuss these concepts in addition to the actual theoretical model.

Model of Musical Training

Miendlarzweska and Trost's (2014) model of musical training was developed to depict the impact of musical training on academic, social, and cognitive outcomes as well as to show the factors that mediate both learning in music education and the transfer of skills learned during music education to other cognitive domains (see Figure 1). The academic, social, and cognitive outcomes impacted through musical training can be grouped into two main categories: near and far transfer skills (Miendlarzweska & Trost, 2014).

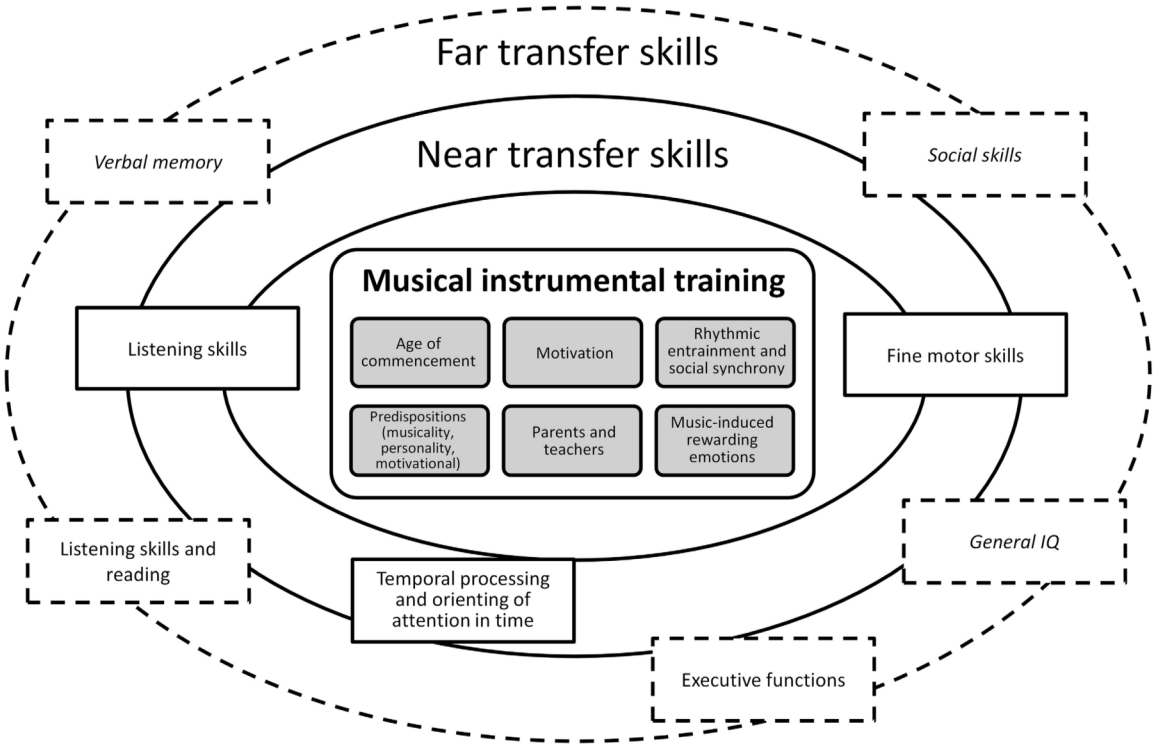

Figure 1. Miendlarzweska and Trost's model of musical instrument training. Adapted from "How Musical Training Affects Cognitive Development: Rhythm, Reward, and Other Modulating Variables," by E. A. Miendlarzweska and W. J. Trost, 2014, *Frontiers in Neuroscience, 7*(279), p. 5. Reprinted with permission.

As the name implies, near transfer skills are skills understood to be closely associated with the act of playing a musical instrument: “listening skills, temporal processing and orientation of attention in time, and fine motor skills” (Miendlarzweska & Trost, 2014, p. 5). Near transfer effects occur among tasks within the same musically associated domain. Far transfer skills are skills not typically understood to be closely associated with the act of playing music but which nonetheless are developed as the result of training with a musical instrument: “social skills, general IQ, executive functions, listening and reading skills, and verbal memory” (Miendlarzweska & Trost, 2014, p. 5). Far transfer effects occur among tasks within nonmusically associated task domains.

Miendlarzweska and Trost (2014) include six additional variables in their model. Those variables are “age of commencement; motivation; rhythmic entrainment and social synchrony; predisposition (musicality, personality, motivational); parents and teachers; and music-induced rewarding emotions” (Miendlarzweska & Trost, 2014, p. 5). In various capacities, these variables play a role in the degree of learning students achieve during music education and impact the extent to which skills transfer from one cognitive domain to another (Miendlarzweska & Trost, 2014).

As indicated previously, Miendlarzweska and Trost’s (2014) model of musical training was chosen as the theoretical framework for this research study because it is aligned with this study’s focus. The model depicts a relationship between musical training and skills associated with academic functions, such as general IQ, executive functions listening skills, verbal memory, and reading skills (Miendlarzweska & Trost, 2014), and in this study, I explored the relationship between musical training and

academic performance in ELA and math. Although this model was appropriate for this study because it is well-aligned with the study focus regarding participation in the band portion of the music program, it does not incorporate participation in vocal programs, a topic also addressed in this study. In addition, the theory does not address how learning in music theory classes may impact learning in other cognitive domains. However, research has shown that vocal training (e.g., Moreno, Bialystok, et al., 2011; Moreno, Friesen, et al., 2011; Rauscher & Hinton, 2011) is connected to learning in other cognitive domains. Miendlarzweska and Trost's model of musical training may serve as an appropriate framework for understanding and discussing how learning in vocal training also may transfer to other cognitive domains.

Other researchers have studied the impact of music training on similar outcome variables (near and far transfer skills) identified in Miendlarzweska and Trost's (2014) model of musical training. For example, Tierney and Kraus (2013) researched processes related to reading and learning music and found that both activities share processes related to both listening and listening specific to orientation in time. Rautenberg (2015) found an alignment between skills associated with both the identification of rhythmic stress and with word decoding. Word decoding could be interpreted as a skill needed for reading, a far transfer skill identified in Miendlarzweska and Trost's model of musical training. Summarizing decades of research, Rauscher and Hinton (2011) stated that skills used to understand rhythm are similar to skills needed to understand part-whole problems in mathematics. These skills could be represented in the executive function or general IQ aspects of Miendlarzweska and Trost's model of musical training.

Learning in Music Education

Learning occurs when neurons in the brain change or grow as a reaction to stimuli (Spingath, Kang, Plummer, & Blake, 2011). This growth may occur in pre-existing neural pathways or may manifest in the production of new neurons or the development of new neural pathways (Spingath et al., 2011). The ability for neurons to grow and change is referred to as neuroplasticity (Spingath et al., 2011). Neural change may be more pronounced when learning activities are perceived to be positive (Spingath et al., 2011).

In two reviews of neuroimaging studies, researchers found convincing evidence that music can significantly impact neuroplasticity (see Herholz & Zatorre, 2012; Merrett & Wilson, 2012). In other words, music can significantly impact the structure of the brain and how it functions. However, little significant changes in neuroplasticity occur until after a person has been participating in music education for at least 6 months (Chobert, François, Velay, & Besson, 2012).

Distinguished neuroscientists have postulated that when people learn about music or how to create music, the learning occurs in specific areas of the brain responsible for specific types of learning (Pearce et al., 2013). In particular, "producing and perceiving music engage a wide range of sensorimotor, cognitive, and emotional processes" (Vuilleumier & Trost, 2015, p. 212). The rhythm structure of music may be an essential component that helps connect engagement in music with such a diverse range of neural processes (Vuilleumier & Trost, 2015).

Factors Impacting Learning in Music Education

Various factors have been found to impact how people learn when they study music (Merritt et al., 2013). In a review of literature, Merrett, Peretz, and Wilson (2013) found that "age at commencement of training, sex, absolute pitch (AP), type of training, and instrument of training" (p. 1) all have been identified as factors that may moderate how music education and training can impact the brain's structure and how it functions. In an earlier review of the literature, Strait, Chan, Ashely, and Kraus (2012) found evidence that the impact of the instrument of training on neuroplasticity in particular was likely due to differences in morphology of musicians' motor and sensorimotor cortexes. Both the extent of music training a person receives (Penhune, 2011) and the type of music training a person receives (Lowe & Belcher, 2012) also may act as mediating factors. With regard to the type of music training a person receives, Lowe and Belcher (2012) found that direct instruction was an effective method for improving music literacy levels among seventh grade students when compared to music students who participated in music education using more typical teaching strategies.

While much of the research on learning in music education is focused on the impact of external factors on neurological processes associated with learning, Fitzpatrick (2011) suggested that the importance of attention to the teaching context should not be ignored. Fitzpatrick explored student learning in music education in an urban setting and found that teachers of successful music students first concentrated on their teaching approaches in the unique setting of the urban school. Only after the teachers made adjustments to their pedagogical approaches and overcame both administrative and

financial barriers associated with teaching music did they observe changes in student learning in the music classroom (Fitzpatrick, 2011). Similarly, Elpus (2014) suggested that underrepresented students who traditionally struggle in other academic areas also struggle to achieve in music education. These students typically include students who receive special education services, are of Hispanic descent, and/or are nonnative English speakers (Elpus, 2014).

Of these identified factors, age at commencement of training and extent of music training may be the most impactful (Penhune, 2011). The extent of training a person has becomes more impactful on learning during music education when the person comes from a family of musically talented people and when the person starts studying music at a very young age (Wilson et al., 2012). The age when a person learns music may be so impactful because experience-dependent learning is most notable during the ages of 5 and 14 (Skoe & Kraus, 2013). Learning that occurs in this way during this time frame of human development has been found to last at least 2 years after the music training has ended (Rauscher & Hinton, 2011) and possibly into adulthood if the training is ongoing during earlier years (Skoe & Kraus, 2012). Among adult musicians, Rauscher and Hinton (2011) found that the benefits of music on pitch perception were most evident when the musician began training before the age of 7.

As indicated here, various factors may impact how people learn when they study music. It should also be noted, however, that not all students may be afforded the same opportunities to engage in music education. For example, when compared to English speaking students, nonnative English speaking students have been found to participate in

music education less often (23% vs. 13%, respectively; Lorah, Sanders, & Morrison, 2014). According to Lorah, Sanders, and Morrison (2014), this difference in participation rates between native and nonnative English speakers can be attributed to lack of opportunity.

Connection Between Learning in Music and Other Brain Functions

Researchers have yet to definitively explain how learning in music transfers to other brain functions. However, some insight into this process can be gained by understanding two predominant concepts in the literature associated with neurological processes in the brain. One concept is that the brain is capable of being multifunctional (Yuskaitis et al., 2015). The other concept is that the neural pathways in the brain that make learning possible can be strengthened (Alluri et al., 2012).

Although some parts of the brain are in charge of only one cognitive function, some parts of the brain are in charge of multiple cognitive functions (Herholz & Zatorre, 2012). In some instances, multifunctional parts of the brain are responsible for tasks associated with learning music as well as other cognitive functions (Alluri et al., 2012; Bishop-Leibler, Welch, Huss, Thomson, & Goswami, 2014; George & Coch, 2011; Halwani et al., 2011; Herdener et al., 2011; Krizman, Marian, Shook, Skoe, & Kraus, 2012; Schulze, Zysset, Mueller, Friederici, & Koelsch, 2011; Strait & Kraus, 2011; Strait, Parbery-Clark, Hittner, & Kraus, 2012; Tsang & Conrad, 2011; Yuskaitis et al., 2015). When people are engaged in learning music, the neural pathways that allow learning to occur become stronger in these parts of the brain (Alluri et al., 2012). These newly strengthened neural pathways in that multifunctional part of the brain may then be more

capable of supporting the learning of other cognitive functions in other cognitive domains (Alluri et al., 2012). It is in this way that learning in music may support learning in other cognitive domains. The extent to which learning in music can transfer to other cognitive domains is dependent on the degree to which the neural pathways are strengthened during the music learning experiences (Moreno & Bidelman, 2014).

Factors Impacting the Connection Between Learning in Music and Other Brain Functions

One reason that researchers have yet to definitively explain how learning in music transfers to other brain functions is that various factors can mediate this process. For example, as is the case with learning in music education, the type and extent of music training a person receives may mediate the transfer of learning gained through music education to other cognitive domains (Hallam, 2010). With regard to type of music training, Hash (2011) suggested that whether or not students are removed from the academic setting to participate in music education, as opposed to participating in a music education program during an elective period, this approach may impact the relationship between music education and academic performance. With regard to the extent of music training, Corrigall and Trainor (2011) found that the length in which students engaged in music education over time was a predictor of reading comprehension; Strait, Parbery-Clark, Hittner, and Kraus (2012) found the extent of musical training was related to stronger neural processes associated with encoding of speech; and Degé, Kubicek, and Schwarzer (2011) found that months of musical training mediated the relationship between musical training and general IQ.

In addition to type and extent of music training a person receives, transference of skills gained through music to other cognitive domains has been linked to early commencement of music education (Hanna-Pladdy & Gajewski, 2012) and brain multifunctionality (Patel, 2014). According to Patel (2014), transference of skills between domains may occur when a single processing center in the brain is responsible for multiple functions including both musically related functions and other cognitive functions. However, this transference only will occur if the musically related function is the more dominant function of those in question (Patel, 2014).

Music Education and Positive Student Characteristics

Researchers have found direct connections between music education and numerous positive student characteristics. For example, in the most recent national study of student participation in chorus programs, Chorus America (2009) found that students who participate in choral programs are more likely to be emotionally stable and have better behavior when compared to students who do not participate in chorus programs. This higher level of emotional stability and better behavior could be a contributing factor to the civicmindedness Catterall, Dumais, and Hampden-Thompson (2012) found among students with higher levels of musical engagement. In particular, Catterall et al. found that students with higher levels of musical engagement are more likely to have volunteered in their communities, participated in student government and philanthropic-focused school clubs, and/or read a newspaper in the last week (Catterall et al., 2012).

Students who participate in music education are more likely than students who do not participate in music education to have high levels of individual and social self-

concepts that can contribute to academic achievement (Degé, Wehrum, Stark, & Schwarzer, 2014). Degé, Wehrum, Stark, and Schwarzer (2014) found that this relationship remained apparent after controlling for students' level of intelligence, income, and gender. Low-income middle school students in particular who participate in music education also are more likely to have higher levels of self-esteem as well as higher school- and math-related self-concepts when compared to students who do not participate in music education (Shin, 2011). Parents of students who participate in choral programs also have reported that their children display high levels of self-worth, self-esteem, and self-discipline when compared to parents of students who do not participate in choral programs (86% vs. 63%, respectively) (Chorus America, 2009).

Students who participate in arts education also are more likely to undertake more advanced academic and professional endeavors than their counterparts who do not receive arts education. Specifically, within the population of low-income students, high school students who receive arts education are more likely than students who do not receive arts education to take challenging math courses in high school (Catterall et al., 2012). After high school, these students are more likely to enroll in college, enroll in a 4-year college, choose a college major in a professional field, graduate from college, and choose a career in a professional field (Catterall et al., 2012). Young, Cordes, and Winner (2013) have argued that student characteristics of this nature are evidence that students who choose to engage in music education are more successful because they inherently have a stronger desire to succeed than students who do not choose to participate in music education.

Music Education and Nonacademic-Related Variables

Actively engaging in musical activities in general may bring about affective outcomes and implicit rewards (Nakahara, Furuya, Masuko, Francis, & Kinoshita, 2011). For example, when people engage in music-related activities, including listening to music, they often report feeling more imaginative and creative (Royal Conservatory of Music, 2015). Music also may impact a person's mood (Koelsch, 2014) and evoke diverse emotional reactions (Loui, Bachorik, Li, & Schlaug, 2013). Because music may have these affective outcomes, music may impact a person's general sense of well-being (Miendlarzweska & Trost, 2014).

Engagement in musical activities also may slow cognitive aging with respect to cognitive flexibility and speeds at which the brain completes cognitive functions (Hanna-Pladdy & MacKay, 2011). In particular, engagement in music has been found to be associated with improved nonverbal memory, image recall, and executive processes in older age participants who have engaged in musical activities for at least 10 years (Hanna-Pladdy & MacKay, 2011). These results may be indicative of the enduring impact of music on cognitive functions (Hanna-Pladdy & MacKay, 2011).

Participation in music education specifically can help improve students' social skills. After participating in a year-long music program designed to promote musical group interaction, a group of 8-11-year-old children demonstrated improved empathy scores when compared to a control group (Rabinowitch, Cross, & Burnard, 2012). The program was designed to encourage positive aspects of working together musically (e.g., flexibility) and discourage negative aspects (e.g., conflict; Rabinowitch et al., 2012).

While Schellenberg and Mankarious (2012) found that music education also was related to students' emotional understanding, the researchers attributed the connection to higher IQs found for students engaged in music education. Students who participate in chorus programs also have been described as having higher levels of social skills when compared to students who do not participate in chorus programs (Chorus America, 2009).

Music Education and Academic-Related Variables

Researchers have found direct connections between music education and academic-related variables such as IQ, academic skills, general student achievement, student achievement in math, and student achievement in ELA-related subjects. These connections are presented in the following related discussions. It should be noted that no researchers whose work appears in this section have claimed direct causality between music education and the student characteristics or variables they explored. In addition, some researchers have explicitly cautioned against making claims of causality based on correlative research (e.g., Cabanac, Perlovsky, Bonnoit-Cabanac, & Cabanac, 2013; Corigall, Schellenberg, & Misura, 2013; Hallam, 2014; Hash, 2011; Schellenberg, 2011). However, researchers have inferred that such a relationship is possible, and results of the studies included in this section do provide insight and additional data that can be considered along with the previously discussed neurologically based research demonstrating the connections between learning in music and brain functions in other cognitive domains to provide support for the claim that engagement in music education has positive benefits for students.

IQ

Participation in music education has been shown to be associated with improved IQ. In a group of boys ages 8-9, Hille et al. (2011) found a significant relationship between music and IQ. In this study, Hille et al. specifically examined nonverbal IQ and found that the significant relationship between the variables remained consistent when controlling for students who did not have access to an instrument at home, a condition assumed to impact the amount of time a student could spend practicing and thus the extent of engagement in musical activity. Also, in a study of children ages 4-6, Moreno, Bialystok, et al. (2011) found that students who participated in a music program that consisted of listening to music to learn and identify musical characteristics demonstrated improved verbal IQ when compared to students who participated in an audio-visual program. The underlying correlation between brain plasticity and verbal IQ found as the result of participation in the music program was evident after only 20 days of participation, leading Moreno, Bialystok, et al. to conclude that even short periods of exposure to music education could be beneficial to students with regard to verbal intelligence.

Other research on general IQ has shown similar outcomes with regard to music education. In a group of 90 students ages 9-12, Degé et al. (2011) found a significant relationship between musical training and general IQ, a relationship mediated by students' inhibition and selective attention. This relationship remained significant while controlling for various demographic factors (Degé et al., 2011). Schellenberg (2011), who studied students in the same age group as Degé et al., found a significant

relationship between engagement in music education and IQ, a relationship Schellenberg described as "substantial (10.3 points, or more than two thirds of one SD)" (p. 291). However, Schellenberg cited students' IQ as an underlying characteristic associated with students who participate in music education, implying that students with higher IQ measures, and other positive characteristics associated with academic achievement, tend to choose to participate in music education programs. Schellenberg concluded that it is most likely genetic predispositions, enhanced by environmental influences, that contribute to IQ, and that while music education could be one type of environmental influence that helps enhance IQ, other equally challenging learning experiences could be as influential in enhancing IQ.

Academic Skills

In a variety of capacities, student engagement in music education has been associated with the transfer of skills learned in the musical setting to other cognitive domains associated with academic skills (Baker, 2012; Catterall et al., 2012). The research included in this section shows an association between music education and general learning skills, math-related skills, and ELA-related skills. The general learning skills noted here pertain to choral instruction in particular. Parents of children who "sing in choirs are significantly more likely to report that their child has many other qualities conducive to learning and development than parents of children who don't sing, including, among others, good memory, good practice and homework habits" (Chorus America, 2009, p. 5).

Rauscher and Hinton (2011) suggested that there is an association between music education and skills used in math-associated activities. When Rauscher and Hinton studied differences between children who participated in music education and those who did not, the researchers found that children who participated in music education had higher levels of numerical reasoning, a math skill associated with computation. The researchers suggested this connection was related to improved capacity for spatial-temporal reasoning among students who participate in music education. "Spatial-temporal reasoning is the ability to visualize spatial patterns and transform them mentally over time in the absence of a physical model" (Rauscher & Hinton, 2011, p, 215). Rauscher and Hinton explained that this connection was likely due to the fact that spatial-temporal reasoning is employed both when people make music and perform mathematical computations. When engaging in music, people must conceptualize notes, tempo, and pitch as parts of a whole to achieve appropriate musical rhythm, a process similar to working with fractions, decimals, and percentages during mathematical computations (Rauscher & Hinton, 2011). It is the use of spatial-temporal reasoning for both musical and mathematical functions that promotes the transfer of skills between these domains (Rauscher & Hinton, 2011).

The research also shows an association between music education and various ELA-related activities, including spelling, reading, listening, speech, and verbal intelligence. Among third grade boys, for example, Hille et al. (2011) found that participation in music education was associated with improved spelling skills. Music education also has been found to be associated with both improved listening (Baker,

2012) and visual-auditory processing skills, the latter association attributed to students' exposure to reading music (Moreno, Friesen, et al., 2011). Both listening skills (Baker, 2012) and visual-auditory processing skills (Moreno, Friesen, et al., 2011) are essential for learning to read.

The ability to process speech is essential for verbal literacy. Music can impact speech because "the higher demands that music places on certain sensory and cognitive processes shared with speech . . . set the stage for neural enhancements in speech processing" (Patel, 2014, p. 103). This improved capacity for speech processing is evident in musically trained students' superior coding and verbal fluency skills (Zuk, Benjamin, Kenyon, & Gaab, 2014). Improved verbal literacy also may be promoted through improved verbal intelligence, which also has been shown to be associated with music education. According to Moreno, Bialystok, et al. (2011), participation in a music program, characterized predominantly by music listening experiences, improved verbal intelligence for children ages 4-6. Students who learn foreign languages also may benefit from participation in music education. According to Posedel, Emery, and Souza (2011), students who participate in music education have superior ability to perceive pitch, a skill helpful when students are learning foreign languages (Posedel, Emery, & Souza, 2011).

General Student Achievement

While student engagement in music has been associated with the transfer of skills learned in the musical setting to other cognitive domains associated with isolated academic skills, there is also evidence that student engagement in music education is associated with improved general academic achievement. These outcomes have been

identified for a variety of populations and in a variety of educational settings. The results also include varied types of musical experiences.

One example of improved academic achievement associated with participation in a music program is evident in a study by Baker (2012), who explored 37,222 Grade 8 students in Louisiana. Students in the study either received instruction in music, visual arts, or both music and visual arts or received no instruction in arts at all (Baker, 2012). Of the students enrolled in the various programs or not enrolled in any program, students in the music program demonstrated the highest levels of academic performance on standardized state test (Baker, 2012). These results were evident regardless of students' race (Black or White) or socioeconomic status (low/middle or high). Like Baker, Young et al. (2013) found that socioeconomic status did not impact the relationship between participation in an after-school music program and achievement on a standardized test. However, this relationship was only apparent for students who had access to a musical instrument at home (Young et al., 2013). Like Hille et al. (2011), Young et al. suggested that the improved academic performance for students who had access to a musical instrument at home was due to the fact that students who had access to a musical instrument at home were able to spend more time practicing music, and thus reaping the benefits of engagement in musical activities.

Unlike Baker (2012) and Young et al. (2013) who did not explore differences within any particular socioeconomic group, Catterall et al.'s (2012) work was specifically focused on Grade 8 students from low socioeconomic backgrounds. The data used for the study were archival and from four longitudinal studies dating from 1988-2002 (Catterall

et al., 2012). When compared to students who had low levels of engagement in arts programs, students who had high levels of engagement in arts programs had higher grade point averages (2.41 vs. 2.63, respectively; Catterall et al., 2012).

Students in choral only music programs also have shown improvement in achievement. According to study results from Chorus America (2009), among parents of students who participated in choral programs, 61% reported overall improvement of students' academic performance after participating in some type of choral program. Teachers who participated in the study supported these claims (Chorus America, 2009).

While research has shown that music education is associated with positive academic outcomes for students, some researchers have questioned this connection. For example, in an initial analysis of 13,500 students, Elpus (2013) found that music students significantly outperformed nonmusic students on the SAT test. However, that difference was not evident after controlling for the effects of students' socioeconomic status and prior academic achievement as well as for whether or not students received an individualized education plan through special education services. Elpus also was unable to duplicate his original positive findings using these same covariates and an alternative standardized test.

Like Elpus (2013), Hash (2011) also found a positive connection between students' participation in music education and their scores on a standardized test in initial research but ultimately concluded that no real relationship existed. In a study of 353 students, some who had received 5 or more years of pullout instruction ($n = 61$), some who dropped out of band before 8th grade ($n = 61$), and some who never participated in

music (n = 61), Hash found that students who had received five or more years of pullout instruction significantly outscored both music students who dropped out of band before 8th grade and students who never participated in music. However, when Hash compared test results for students who had received five or more years of pullout instruction and those who never participated in music, Hash found no difference between the students who had received five or more years of pullout instruction and the highest achieving students who never participated in music. Additionally, Hash found that students who chose to take music early on during elementary school were the highest achievers in their classes and that 8th grade students who continued with pullout instruction through their elementary and middle school careers were the most academically successful students in the study. Based on these findings, Hash concluded that the connection between music education and student achievement was more likely the result of students' inherent academic capacity and their propensity to choose to participate in music education than participation in music education in and of itself.

In a study of *International Baccalaureate* students' enrolled in a secondary school in Quebec, Cabanac, Perlovsky, Bonnoit-Cabanac, and Cabanac (2013) also found a correlation between student engagement in music education and achievement. Like Elpus (2013) and Hash (2011), however, Cabanac et al. (2013) concluded that the relationship between the two conditions was most likely the result of choice, whereas higher achieving students chose to participate in music education. Corrigall et al. (2013) and Schellenberg (2011) also argued that an inherent student characteristic was more likely to be the underlying variable responsible for the music education/academic achievement

connection they found in their own studies. Corrigall et al. hypothesized that a student's choice to engage in music education was likely to be promoted by the student's "*conscientiousness*, which involves self-discipline, organization, and achievement-orientation, and/or by *openness-to-experience*, which describes the tendency to have an active imagination, to appreciate the arts and literature, to prefer change and variety over routine, and to be intellectually curious" (p. 2).

Student Achievement in Math

Some evidence in the literature specifically demonstrates a connection between participation in music education and math. In a study of 6,026 high school students from Maryland, Helmrich (2010) explored the relationship between participation in a music program and student performance on a state high school level algebra assessment. Helmrich chose to explore the relationship between music education and algebra in particular because of previous research in which significant relationships had been found between these two variables. While Helmrich found that both students who played instruments and those who sang in the chorus had higher performance scores when compared to students who did not participate in any music program, students who played instruments had mean differences almost three times those of students who sang in the chorus (13.34 vs. 3.82, respectively).

In more current research, Baker (2012) and Thornton (2013) found that students who participated in performance-based music education performed better on state standardized math assessments when compared to students in a control group who did not participate in any additional arts programs. Thornton's results were based on data for

students in Grade 5, 8, and 11 from 11 schools in one district. In Baker's study, students who participated in performance-based music education also performed better when compared to students who participated in visual arts education or both music and visual arts, and neither race (Black or White) or socioeconomic status (low/middle or high) had an impact on the relationship between student participation in music education and performance in algebra (Baker, 2012).

Other researchers have shared more general findings. For example, Catterall et al. (2012) found that high school students who have studied music report higher GPAs in math than students who have not studied music. Also, with regard to participation in a choral group in particular, 57% of parents of students who have participated in a choral group claimed that their children's math performance improved after they began to participate in the choral program (Chorus America, 2009).

While this evidence is compelling, not all research supports the connection between music education and math performance. In a survey of 100 students, parents, music teachers, and nonmusic teachers, Vitale (2011) found that teachers, as compared to the other stakeholders, did not agree that music education helps improve student performance in math (or science). Vitale acknowledged that this finding was counterintuitive and neither supported by his own experiences nor the published research on the connection between music education and math performance. Elpus (2013) also did not find a connection between music education and standardized math scores, even after controlling for the effects of students' socioeconomic status, prior academic achievement, and enrollment in special education services.

Student Achievement in ELA-Related Activities

Some evidence in the literature specifically demonstrates a connection between participation in music education and ELA-related activities. With regard to overall ELA performance, Thornton (2013) found that students in Grade 5, 8, and 11 who participated in a music program significantly outperformed other students who did not participate in a music program on a standardized test. Similarly, Baker (2012) found that students who participated in music education (mean score = 327) outperformed students with no participation in music education (mean score = 319; Baker, 2012) on standardized tests for ELA. Students from middle and high socioeconomic backgrounds (mean score = 341) benefited more than students from low socioeconomic backgrounds (mean score = 315), and White students (mean score = 340) benefited more than Black students (mean score = 314; Baker, 2012). Among parents of students who participated specifically in a choral program, 64% said that their children's performance had improved in ELA since they began participating in the program (Chorus America, 2009).

Results from other studies have shown relationships between participation in music education and reading specifically. Among 6-9-year-old children considered to be reading at grade level, length of music training predicted reading comprehension (Corrigall & Trainor, 2011). This relationship remained significant even after controlling for additional variables, including socioeconomic status (Corrigall & Trainor, 2011). Corrigall and Trainor (2011) suggested that their findings demonstrated far transfer of skills developed through participation in music education.

While other researchers have considered the mediating impact of socioeconomic status on the relationship between music education and outcome variables, other studies have been focused specifically on students with low socioeconomic backgrounds. Catterall et al.'s (2012) study is one of those studies. In that study, the focus was on the degree of music education and associated outcomes specifically among Grade 8 students from low socioeconomic backgrounds. Data from the study showed that students who had high levels of engagement in arts programs demonstrated greater proficiency in writing when compared to students who had low levels of engagement in arts programs (Catterall et al., 2012).

The Value of Music Education: Perspectives from Professionals in the Field

Many proponents of music programs have expressed their professional perspectives about the positive outcomes associated with music. For instance, professionals in the field of music have claimed that engagement in music education and training has the capacity to create opportunities for social interaction (Miksza, 2013) and a place to promote confidence by emphasizing students' individual musical strengths (Green & Hale, 2011; Sindberg, 2016).

It is also the perspective of professionals in the field of music that participation in music education can help students learn about other cultures and promote tolerance of diversity and nurture "social justice in our schools and communities" (Fitzpatrick, 2012). According to Pascale (2011), it is a typical practice for music teachers to include in music course curriculums music from diverse cultures. Through exposure to both vocal and instrumental music of different cultures, students can gain insight into those cultures

(Pascale, 2011). In learning about music of other cultures, students gain awareness not only about the differences of others but of their own differences as well (Joseph, 2012). Through this process, students may develop respect for diversity in all students (Joseph, 2012). Bazinet and Marshall (2015) have encouraged educators to incorporate music across curriculums, in particular math, as a means of engaging in "culturally responsive teaching" (p. 9).

In an after-school music program developed to supplement existing programs for underserved students, Sindberg (2016) claimed that the students, who were offered the opportunity to compose and improvise as part of the program, began "to identify as musicians" (p. 62). Gamso (2011) and Gruenhagen and Whitcomb (2014) also claimed that by creating new arrangements and learning the skill of improvisation, students practice the art of creativity. Wright (2014) claimed that in creative situations where students are not expected "to 'play the perfect notes' for the teacher, . . . a sense of autonomy and freedom developed to allow the students space and a sense of responsibility" (p. 30). Sindberg envisioned that the promotion of students' musical creativity in this capacity would lead to long-term pursuit of music opportunities on the part of the students.

Proponents of El Sistema, a well-known and well-respected international after-school music program in Venezuela considered to be highly successful, have claimed that the program is beneficial because students learn music skills and how to perform as a group in a musical ensemble (Lesniak, 2012; Tunstall, 2013). The program also is civically important in the community because it offers a safe environment for students,

the majority of whom are socioeconomically challenged and living in unsafe neighborhoods" (Lesniak, 2012). While Lesniak (2012) has questioned the transferability of this program to settings in the United States, Tunstall (2013) has claimed that music educators in the United States have much to learn from the principles and practices of the El Sistema program.

One reason that after-school music programs may benefit students, at-risk students in particular, is that they provide a positive environment in which students may engage in positive behaviors. Hall and Charmaraman (2011) claimed that an after school empowerment program for at-risk boys was successful because the program served as an extension of the school day, where positive influences from the academic environment could be transitioned into the program setting. Increasing the boys' exposure to positive influences provided continued support and structure for students from challenging circumstances (Hall & Charmaraman, 2011). While this program was not a music program, the philosophy that exposure to positive influences in an after-school setting can provide structure for at-risk youth may be applied to music programs that take place in the after-school setting.

Summary

The literature included in this chapter demonstrates that a relationship exists between engagement in music education and a variety of positive student characteristics and both nonacademic-related and academic-related outcomes. Positive student characteristics associated with engagement in music education include emotional stability, socially acceptable behavior, civicmindedness, and high levels of self-esteem

and self-concept. Students who engage in music education also are more academically and professionally minded. Nonacademic outcomes associated with engagement in music education include affective outcomes and implicit rewards; imagination; creativity; social skills; emotional reaction; a general sense well-being; cognitive flexibility and speeds at which the brain completes cognitive functions; and improved nonverbal memory, image recall, and executive processes. Academic outcomes include improved levels of IQ, academic skills, general achievement, achievement in math, and achievement in ELA-related activities.

While evidence exists demonstrating the relationship between engagement in music education and a variety of dependent variables, these relationships are complex and not always well-understood. While brain-based research has shown that brain plasticity is associated with engagement in music education and that skills learning during music education may transfer to other cognitive domains, a variety of other factors may mediate this transfer. Continued research in this field may help clarify the ways in which music education can positively impact student outcomes.

Chapter 3: Research Method

The purpose of this quantitative, causal-comparative study was to determine the impact a music program had on student achievement in ELA and math, as evidenced by differences in MAP assessment scores between students who participated in the music program and those who did not. This chapter includes discussions related to the research method and design used to explore the impact the music program had on student achievement at the focus school in this study. Specifically, I discuss the research design and rationale, the methods used to conduct this study, threats to validity, and procedures followed to ensure that ethical research practices were carried out during the completion of this study. This section concludes with a summary.

Research Design and Rationale

For this study, I used a quantitative, causal-comparative design. I made the choice to conduct quantitative research and to use a causal-comparative design because those choices made sense considering my research questions, which were focused on differences in student scores (archival data) between students who participated in the music program and those who did not. Quantitative research is useful when researchers want to measure variables associated with specific populations (Kraska, 2010), and causal-comparative research is valuable when researchers want to examine preexisting data to look for relationships between variables (Brewer & Kuhn, 2010). In addition, I chose to conduct a causal-comparative study to explore the relationship between music education and student outcomes because other researchers have used this design to

explore the relationship between these variables (e.g., Baker, 2012; Cabanac et al., 2013; Hash, 2012; Helmrich, 2010; Thornton, 2013).

The independent variable was student participation in the music program, which was considered an intervention for the purposes of this study. The dependent variables were the 2012-2013 ELA and math MAP scores, and the covariates were the 2011-2012 ELA and math MAP scores. Because I used archival data, there were no time or resource constraints associated with the research design.

Methodology

In this section, I present discussions of topics related to my study methods. There are eight topics divided into six sections. The topics, by section, are population, sampling and sampling procedures, intervention, archival data, instrumentation and operationalization of constructs, and data analysis plan.

Population

The target population for this study was Grades 4-8 choir and band students from a small, rural K-8 school in Missouri enrolled during the 2011-2012 and 2012-2013 school years. Students in Grades 4-8 may participate in choir. Students in Grades 5-8 may participate in band. Since 1996, the percentage of students at the focus school who participate in the free and reduced-price lunch program has ranged from almost 50% to 72% (MDESE, 2015). While the participation rate for the 2012-2013 school year was the highest of all the years for which data on this demographic are available, the rate for the 2011-2012 school year was only the fifth highest (MDESE, 2015). In the 2 years of interest in this study, approximately 200 students attended the focus school each year.

Sampling and Sampling Procedures

The sample for this study was a sample of convenience because I drew the sample from the school at which I worked. However, I specifically chose this sample because I wanted to determine the impact of the music program particularly at the focus school. Using student scores from another school would not have yielded the data necessary to determine the impact of the music program at the focus school.

The sample for this study was made up of archival data representing student performance at the focus school. Two sets of scores were retrieved. For the 2011-2012 school year, ELA and math MAP scores for students in Grades 4-7 were retrieved and for the 2012-2013 school year, ELA and math MAP scores for those same students in Grades 5-8 were retrieved. Data were provided to me by the school principal, who received the data from the MDESE as part of its normal data reporting processes. This process is described in further detail in the Archival Data section of this chapter.

Because the music program was first implemented during the 2012-2013 school year, the scores from the 2011-2012 school year represent baseline scores prior to the implementation of the music program. These baseline MAP scores were for students who were in Grades 4-7 during the 2011-2012 school year and the MAP scores after the first year of implementation were for those same students who advanced to subsequent grades and were in Grades 5-8 for the 2012-2013 school year. Only students who had both ELA and math MAP scores for both years were included in this study. No other inclusion or exclusion criteria were considered.

An appropriate sample size needed to determine significance in this study was 52. To determine this sample size, I conducted an a priori analysis for an *F* test (ANCOVA: Fixed effects, main effects, and interactions) using G*Power Version 3.1 software. For the parameters, I used a significance level of .05, a power of .80, and a large effect size of .40.

Intervention

When I originally implemented the music program at the focus school during the 2012-2013 school year, I did not do so solely as a means of improving student achievement. However, the music program can be considered an intervention for the purposes of this study because it had the potential to impact student outcomes for those students who were achieving below the state average and who self-selected to participate in the music program. In addition, because some students chose not to participate in the music program, I was able to consider those students the control group.

The music program was made up of two components. A choir component, offered to students in Grades 4-8 on Monday of each week, and a band component, offered to students in Grades 5-8 on Thursday of each week. The program was not open to students in lower grades because, as an experienced music teacher, I have found that children in Grade 3 and below do not have the mental or emotional fortitude to participate in programs such as these that require prolonged attention and a certain degree of dedication.

The choir component of the music program consisted of introductory training for semiannual choir performances as well as less formal performances given during school

events such as basketball games, volleyball games, and assemblies. During choir practice, students learn the fundamentals of breathing and pitch production. Types of music to which students are exposed during the music program include Baroque, classical, romantic, and contemporary genres of music. Students learn to read the music notation for the pieces to which they are exposed. The accompanying verses may be in English, Latin, Hebrew, or French. In some instances, I include lessons on the cultures associated with the music's history or the story the music expresses. In addition, once a year, students participate in a music clinic sponsored by the Missouri Music Educators Association where they take part in a day of intensive practice (6-8 hours).

Like the choir component, the band component of the music program consisted of introductory training for semiannual choir performances as well as less formal performances given at assemblies. Students also may participate in local parades. During band practice, students learn the basics of how to use their mouths to create sound with woodwind and brass instruments (embouchure), play percussion instruments, produce accurate tone, read music notation, and follow a conductor.

Archival Data

The original data from which the archival data for this study were drawn were generated by the focus school using the ELA and math MAP assessments developed by the MDESE. The focus school administers MAP assessments once a year, typically during April and May. MDESE scores the assessments and provides the school with a student performance report, typically in July. All students in Grades 2-12 who attend schools in Missouri are required to take MAP assessments.

The archival data I used in this study were obtained through the principal at the focus school. To obtain these data, I requested them from the school principal via e-mail. After requesting the information, the principal replied with a letter of cooperation and then signed a data use agreement giving me permission to use the data he supplied. The principal instructed an office assistant to gather the information for me and to ensure that it was de-identified. Once the data were gathered, the office assistant provided me with a printed copy of the data sets.

Instrumentation and Operationalization of Constructs

The original data from which the archival data for this study were drawn were generated by the focus school using the ELA and math MAP assessments developed by the MDESE. As defined earlier, the MAP is an assessment tool used to measure student performance in ELA (Grades 2-12), math (Grades 2-12), and science (Grades 3-9; NWEA, 2014). The tests also can serve as a predictor of student performance on college entrance exams (NWEA, 2014).

The MAP test is administered electronically, and the questions are computer generated. Students begin the tests with general grade-level questions. If a student answers a question correctly, the subsequent questions become more difficult; conversely, if a student answers a question incorrectly, the subsequent questions become less difficult (NWEA, 2014, p. 6). Students are given a composite score for their results (Cordray, Pion, Brandt, Molefe, & Toby, 2012).

The ELA and math portions of the assessment were of interest in this study. The ELA score is made up of "word recognition, structure and vocabulary, and reading

informational texts [reading items, and] craft structure and evaluation, grammar and usage, and writing conventions [language usage items]" (NWEA, 2014, p. 9). The math score is made up of "algebra, geometry, measurement, problem solving, reasoning, and proofs" (NWEA, 2014, p. 9). MAP scores are measured on an interval scale (continuous; Cordray et al., 2012, p. 4). The scales for each grade are independent, but define additional nongrade-specific categories of performance: below basic, basic, proficient, and advanced (NWEA, 2014). The score ranges and categories are presented in Table 2.

Table 2

MAP Score Ranges and Performance Categories for Grades 4-8

Grade	*Below Basic*	*Basic*	*Proficient*	*Advanced*
			ELA	
4	470-611	612-661	662-690	691-820
5	485-624	625-674	675-701	702-840
6	505-630	631-675	676-703	704-855
7	515-633	634-679	680-711	712-865
8	530-638	639-695	696-722	723-875
			Math	
4	465-595	596-650	651-687	688-805
5	480-604	605-667	668-705	706-830
6	495-627	628-680	681-720	721-845
7	510-639	640-684	685-723	724-860
8	525-669	670-709	710-740	741-885

Note. Data interpreted from "Missouri Assessment Program Grade-Level Assessments. Guide to Interpreting Results. Communication Arts, Mathematics, and Science," CTB/McGraw-Hill, 2013, Retrieved from https://dese.mo.gov/sites/default/files/asmt-gl-gir-spring-2013.pdf

Before an item is included in the MAP assessment, it is field tested with thousands of students nationwide (NWEA, 2014). Also, because the MAP assessment scores are measured using an equal interval, vertically aligned scale, they align well-aligned with state content standards and state Common Core Standards (NWEA, 2014). Data from multiple studies also show that MAP assessments are valid and reliable instruments. In a longitudinal study of students in Grades 3-10 from 50 states, Wang, Jiao, and Zhang (2013) used repeated measures analyses to determine the validity of ELA and math MAP assessments across grades and over time. Having found no variance among the grades or over time, Wang, Jiao, et al. concluded that the MAP assessments were valid measures of student growth in these content areas. In a similar study, Wang, McCall, Jiao, and Harris (2013) conducted factor analysis to examine the content validity of the ELA and math MAP assessments among varying grade levels. Results of their analyses led Wang, McCall, et al. to conclude that the MAP assessments were valid instruments for measuring student performance across grade levels.

In this study, the dependent variable for Research Question 1 was students' 2012-2013 ELA MAP scores, and the covariate was students' 2011-2012 ELA MAP scores. The dependent variable for Research Question 2 was students' 2012-2013 math MAP scores, and the covariate was students' 2011-2012 math MAP scores. Because the data I received from the focus school were composite scores, the concepts expressed in the descriptions of my operationalized variables are only partially folded into the composite score and not examined separately. In this study, ELA MAP scores were operationalized as composite scores of the ELA MAP concepts (a) text structures, (b) vocabulary, and (c)

ideas. Math MAP scores were operationalized as the composite scores of the math MAP concepts (a) reasoning and analyzing skills in mathematics; (b) spatial skills in geometry; and (c) understanding patterns, relations, and functions.

The independent variable for both research questions in this study was student participation in the music program, which was considered an intervention for the purposes of this study. Participation in the music program was measured as a dichotomous variable (categorical), yes or no. Students were considered active participants in the music program if they had an attendance rate of at least 70% during the 2012-2013 school year.

Data Analysis Plan

The research questions posed for this study were

RQ1: Does participation in a music program impact students' performance in ELA as measured by differences in ELA MAP scores between students who participated in a music program and those who did not?

H_o1: Participation in a music program does not significantly impact students' performance in ELA as measured by differences in ELA MAP scores between students who participated in a music program and those who did not.

H_a1: Participation in a music program does significantly impact students' performance in ELA as measured by differences in ELA MAP scores between students who participated in a music program and those who did not.

RQ2: Does participation in a music program impact students' performance in math as measured by differences in math MAP scores between students who participated in a music program and those who did not?

H_o1: Participation in a music program does not significantly impact students' performance in math as measured by differences in math MAP scores between students who participated in a music program and those who did not.

H_a1: Participation in a music program does significantly impact students' performance in math as measured by differences in math MAP scores between students who participated in a music program and those who did not.

SPSS Version 21 was used to analyze the data in this study. I conducted descriptive analyses on the demographic data, gender, grade, ethnicity, and education type (special education vs. general education), as well as the student performance scores. For the descriptive data, I reported frequencies and means.

To generate the data necessary to answer the research questions, I analyzed the student performance data using ANCOVA, with students' scores from the year prior to their participation in the music program serving as the covariate. I chose this analysis plan for the inferential data because ANCOVA is one of the most common methods for analyzing data in causal-comparative studies (Brewer & Kuhn, 2010). Also, Mertler and Vannatta (2005) described the use of pretest scores as covariates as a "classical application of ANCOVA" (p. 95). In this study, the pretest scores could be considered an equivalent to the preintervention scores. The ANCOVA model also has been used by

other researchers whose studies included analysis of the impact of music education on student performance (e.g., Helmrich, 2010; Hille et al., 2011; Rautenberg, 2015).

Before I conducted the ANCOVAs, I verified the assumptions of the ANCOVA. Then, I ran two ANCOVAs, one for the ELA MAP scores and one for the math MAP scores. Mertler and Vannatta (2005) stated that "the narrative of results should also include ANCOVA results (*F* ratios, degrees of freedom, *p* values, and effect sizes) for the main effect of each factor and covariate as well as the interaction of factors" (p. 101). In addition, figures and tables can be used to help readers understand the results (Mertler & Vannatta, 2005). Following this guidance, I reported the results of the ANCOVAs in tables. I included *F* ratios, degrees of freedom, *p* values, and effect sizes as well as the mean square and the sum of squares values.

Threats to Validity

Archival data I used in this study originally were generated using a valid and reliable instrument, as previously discussed. For this reason, there was no threat to construct validity with regard to levels of student understanding of ELA and math as measured by the MAP assessments. However, threats to the study's internal and external validity exist. A discussion of these threats are presented here. Attempts to mitigate the impact of those threats when possible also are discussed.

Internal Validity

Internal validity refers to the extent that an outcome is related to the intervention in question as opposed to another or other extraneous variables (Lodico et al., 2010). In

this section, I discuss two threats to internal validity. Those threats are maturation and statistical regression.

Maturation. Maturation refers to growth or change in a sample population that may occur naturally over time (Creswell, 2012). For instance, over time, participants inherently grow older, but also may become mentally, physically, emotionally, and socially more knowledgeable, in other words, "wiser, stronger, and more experienced" (Creswell, 2012, p. 304). These changes threaten the internal validity of a study because they, as opposed to or in combination with the intervention under study, may impact measured outcomes (Creswell, 2012). The measures of student performance on the MAP assessments used in this study occurred 1 year apart from each other, and it is likely that students at the focus school matured during that time. However, a researcher can use a control group to mitigate the impact of maturation on study outcomes (Lodico et al., 2010). Because it is likely that students who participated in the music program and students who did not participate in the music program would have similar maturation experiences, it could be assumed that any difference found between the two groups of students could be attributed to the impact of the independent variable (Lodico et al., 2010). By using a control group in my study (the students who did not participate in the music program), I was able to mitigate the threat of maturation in my study.

Statistical regression. Statistical regression refers to differences in pre- and posttest results due to "the tendency of scores to move toward the average score, bringing the higher scores down and the lower scores up" (Locido et al., 2010, pp. 194-195). This condition usually occurs when participants in a sample have extreme scores, either very

high or very low. To control for this threat, I removed outliers before analyzing the data. By doing so, I was able to mitigate the threat of statistical regression in this study.

External Validity

External validity refers to the extent that findings from a study can be generalized to a larger population beyond that in a study (Lodico et al., 2010). In this section, I present two threats to external validity. Those threats are selection-treatment interaction and experimenter effects.

Selection-treatment interaction. According to Lodico et al. (2010), selection-treatment interaction occurs when "differences between groups due to lack of random assignment or use of already-formed groups interact with the treatment variable, limiting generalizability to the general population" (p. 192). This threat existed in my study because I used a group that was preexisting: students in the music program. The risk of using an already-formed group as a sample population results because it is possible that the people who make up that preexisting group have particular characteristics that could impact the outcome of a treatment or intervention (Lodico et al., 2010).

In the case of the impact of music education on student performance, for example, researchers have suggested that students who choose to receive music education may inherently be better students and, therefore, that differences in academic performance between students who choose to receive music education and those who do not are not due to students' engagement in music education (e.g., Elpus, 2013; Hash, 2011; Schellenberg, 2011). One method for controlling for selection-treatment interaction is to measure groups before, as well as, after a treatment or intervention (Lodico et al., 2010).

To this effect, I used the covariate 2011-2012 MAP scores to determine if differences between the groups were evident prior to the students' participation in the music program. By doing so, I was able to mitigate the threat of selection-treatment interaction.

Experimenter effects. Experimenter effects refers to the impact that the presence of or actions taken by the experimenter may have on outcomes of the study (Lodico et al., 2010). In addition, the experimenter's personality, behaviors, and expectations may impact study participants and thus the outcomes of a study (Lodico et al., 2010). As the music program instructor at the focus school, I regularly held students to high expectations of positive behavior during program hours but also encouraged this behavior off campus. I encouraged students to do their homework and excel in their studies as a means of earning music scholarships. For obvious reasons, students who did not participate in the music program were not afforded this support. It is possible that the additional encouragement I gave my music program students led them to apply more effort to their studies, which could have positively impacted their 2012-2013 MAP assessment scores. There was no way to mitigate the potential impact of experimenter effects in this study.

Ethical Procedures

At all stages of this study, I ensured I used ethical procedures to collect and manage the student data. In accordance with Walden University requirements, I obtained approval from the Institutional Review Board to conduct my research (approval number: 08-26-15-0360575). The principal of the school where the study took place signed a letter of cooperation and data use agreement indicating his approval for me to obtain the MAP

test score data for the 2011-2012 and 2012-2013 school years. All data I received were de-identified. For this reason, informed consent was not needed, and there was no concern about harm to the participants.

Summary

In this study, I used a quantitative causal-comparative design. The independent variable was student participation in the music program, which was considered an intervention for the purposes of this study. The dependent variables were the 2012-2013 ELA and math MAP scores, and the covariates were the 2011-2012 ELA and math MAP scores. The target population for this study was Grades 4-8 choir and band students from a small, rural K-8 school in Missouri enrolled during the 2011-2012 and 2012-2013 school years. Archival data were used to answer the research questions in this study. To complete my data analysis, I conducted ANCOVAs to generate the data necessary to answer the research questions. For the inferential data, I reported *F* ratios, degrees of freedom, *p* values, and effect sizes as well as the mean square and the sum of squares values. I also conducted descriptive analyses on the demographic data, gender, grade, ethnicity, and education type (special education vs. general education), as well as the student performance scores. For the descriptive data, I reported frequencies and means. The results of the descriptive and inferential analyses are presented in Chapter 4.

Chapter 4: Results

The purpose of this study was to determine the impact a music program had on student achievement in ELA and math, as evidenced by differences in MAP test scores between students who participated in the music program and those who did not. The research questions for this study reflected this purpose. Research Question 1 was focused on the impact of students' participation in the music program on students' ELA MAP scores, and Research Question 2 was focused on the impact of students' participation in the music program on students' math MAP scores. The hypotheses express whether or not students' participation in the music program had a significant impact on student performance in ELA and math. This chapter includes three sections, data collection, intervention fidelity, and presentation of results, and ends with a brief summary.

Data Collection

Data used in this study were archival, and my data collection process did not deviate from my original plan. The data were collected from an office assistant at the focus school at one time in October of 2015. The ELA and math MAP scores originally were generated by the school in April and May of 2012 and 2013. I originally recruited students to participate in the music program during August and September of 2012. Inclusion of the covariates ELA and math MAP scores for the 2011-2012 school year were justified in this study because differences in student achievement between students who participated in the music program and those who did not could not be calculated without them.

Baseline Demographic Characteristics of the Sample

Baseline demographic characteristics of the sample are presented in Table 3. Approximately two thirds of the music participants were female, while the nonparticipating students were almost equally divided between male and female students. The majority of both groups were White. Of the program participants, 27% received special education services, while only 8% of the nonparticipants received special education services.

Baseline Descriptive Characteristics of the Sample

Because I used scores from the total population, minus outliers and students with missing data, my sample can be considered an accurate representation of the total population of students at the school. However, ELA and math MAP scores for both the 2011-2012 and the 2012-2013 school years were only available for 81 of the total 101 students at the school. Of those remaining 81 students, 7 were removed as outliers during the data screening process. Ultimately, scores for 74 students, 34 music program participants and 40 nonparticipants, were used. Descriptive data for these students are presented in a subsequent section.

Intervention Fidelity

A description of the intervention was provided in a previous section. While I did not implement the music program intervention as part of this study, I did design the program and supervise its implementation, and while I did have help from a colleague, because I was the school music teacher during the 2012-2013 school year, I was the primary facilitator of the program. As the primary facilitator of the music program, I can

attest to the fidelity of its implementation. All music program activities were conducted as originally planned and conducted during the originally planned time periods.

Table 3

Baseline Demographic Characteristics of the Sample

	Participant		Nonparticipant	
Variable	*n*	%	*n*	%
Gender				
Male	20	38.5	25	51.0
Female	32	61.5	24	49.0
Ethnicity				
White	49	94.2	46	93.9
Other	3	5.8	3	6.1
Special education status				
No	37	71.2	45	91.8
Yes	15	28.8	4	8.2
Grade				
4	8	15.4	11	22.4
5	17	32.7	4	8.2
6	11	21.2	14	28.6
7	9	17.3	11	22.5
8	7	13.5	9	18.4

Presentation of Results

Before conducting any analyses, I cleaned and screened the data. To clean the data, I excluded participants who were missing critical data. For example, the following

music program participants were excluded because they were missing 2011-2012 ELA and math MAP scores: Participants 27, 46, 66, 71, 100, 101, and 102. The following music program participants were excluded because they were missing 2012-2013 ELA and math MAP scores: Participants 55, 85, 90, 94, and 99. And finally, the following music program nonparticipants were excluded because they were missing 2012-2013 ELA and/or math MAP scores: Nonparticipants 7, 13, 16, 44, 58, 77, 91, and 93.

To screen the data, I removed outliers from the sample. Stem-and-leaf plot analyses were used to identify these outliers. From the ELA MAP 2011-2012 data of music program participants, Participants 29 and 40 were removed. From the ELA MAP 2012-2013 data of music program participants, Participants 33, 75, and 98 were removed. From the math MAP 2012-2013 data of music program participants, Participant 15 was removed. From the ELA MAP 2011-2012 data of music program nonparticipants, Participant 87 was removed. Then I conducted descriptive and inferential analyses.

Descriptive Analyses

Descriptive statistics were conducted on both the demographic variables and ELA and math MAP scores both prior to participating in the music program and after participating in the music program for 1 year. Results of the demographic analysis are presented in Table 4. Results of the analysis of MAP scores are presented in Table 5.

As demonstrated in Table 4, there were twice as many female students as male students who participated in the music program. However, there was an equal number of nonparticipating female students and male students. Both music program participants and nonparticipants were primarily White. While nearly one-third of the students who

participated in the music program also received special education services, the majority (92.5%) of nonparticipating students did not receive special education services. As demonstrated in Table 5, mean ELA MAP scores for participants and nonparticipants varied between approximately 4 (2011-2012) and 6 points (2012-2013), while mean math MAP scores varied between approximately 5 (2011-2012) and 6 points (2012-2013), respectively.

Table 4

Descriptive Statistics of the Student Sample

	Participant		Nonparticipant	
Variable	*n*	%	*n*	%
Gender				
Male	11	32.4	20	50.0
Female	23	67.6	20	50.0
Ethnicity				
White	33	97.1	37	92.5
Other	1	2.9	3	7.5
Special education status				
No	28	67.6	37	92.5
Yes	14	32.4	3	7.5
Grade				
4	7	20.6	8	20.0
5	13	38.2	4	10.0
6	8	23.5	12	30.0
7	4	11.8	10	25.0

8	2	5.9	6	15.0

Table 5

MAP Reading and Math Scores Prior to and After 1 Year of Music Program Participation

	Participant			Nonparticipant		
Test year	*n*	*M*	*SD*	*n*	*M*	*SD*
	Reading					
2011-12 (prior to music program)	34	663.9	23.7	40	667.8	22.2
2012-13 (after 1 year of music program)	34	673.9	17.4	40	679.9	26.3
	Math					
2011-12 (prior to music program)	34	652.2	32.1	40	657.9	36.4
2012-13 (after 1 year of music program)	34	671.4	29.3	40	677.9	30.9

Presentation of Statistical Assumptions

Before conducting the ANCOVAs to generate the data needed to answer the research questions, I verified six assumptions of the ANCOVA. Assumption 1 for ANCOVA was that the control and treatment group scores are independent of each other. For this study, every participant's MAP scores were included in either the control or treatment group, and no participant's data appeared in both groups. Therefore, Assumption 1 for ANCOVA was met in this study.

Assumption 2 for ANCOVA was that the scores of the dependent variables are normally distributed. To test this assumption, I used the Kolmogorov-Smirnoff test. Results indicated that the ELA MAP scores for music program participants and

nonparticipants were normally distributed, $D(34) = 0.09$, $p = .200$ and $D(40) = 0.14$, $p = .054$, respectively. Results also indicated that the math MAP scores for music participants and nonparticipants were normally distributed, $D(34) = 0.07$, $p = .200$ and $D(40) = 0.11$, $p = .200$, respectively. Therefore, Assumption 2 for ANCOVA was met in this study.

Assumption 3 for ANCOVA was that there is homogeneity of variance for the dependent variable scores. To test this assumption, I examined the output of the Levene's Test of Equality of Error Variances. Results were $p = .066$ for ELA and $p = .138$ for math, which indicated the variances between scores of the dependent variable were not significantly different. Therefore, Assumption 3 for ANCOVA was met in this study.

Assumption 4 for ANCOVA was that there is a linear relationship between the dependent variable and the covariate. To test this assumption, I generated scatterplots of the dependent variable and the covariate. I ran two scatterplots each for ELA and math so that I could run the participant and nonparticipant groups separately. Visual inspection of the scatterplot mapping ELA and math MAP scores for music program participants during the 2011-2012 and 2012-2013 school years showed that there were linear relationships between the dependent variable and covariate (see Figure 1 and Figure 2, respectively). Visual inspection of the scatterplot mapping ELA and math MAP scores for music program nonparticipants during the 2011-2012 and 2012-2013 school years also showed that there were linear relationships between the dependent variable and covariate (see Figure 3 and Figure 4, respectively). Therefore, Assumption 4 for ANCOVA was met in this study.

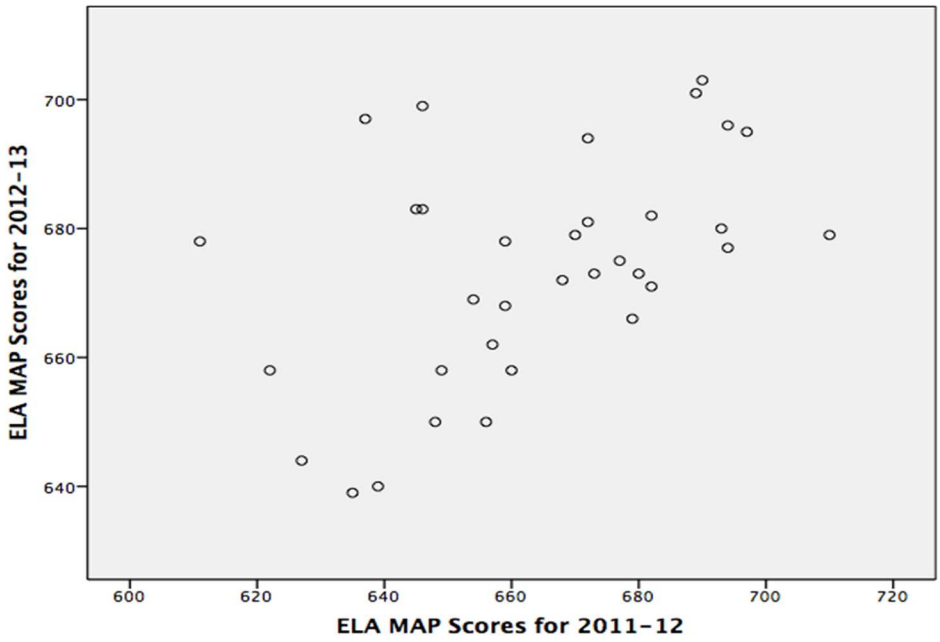

Figure 2. Scatterplot for music program participants comparing the dependent variable, 2012-2013 ELA MAP scores, and the covariate, 2011-2012 ELA MAP scores.

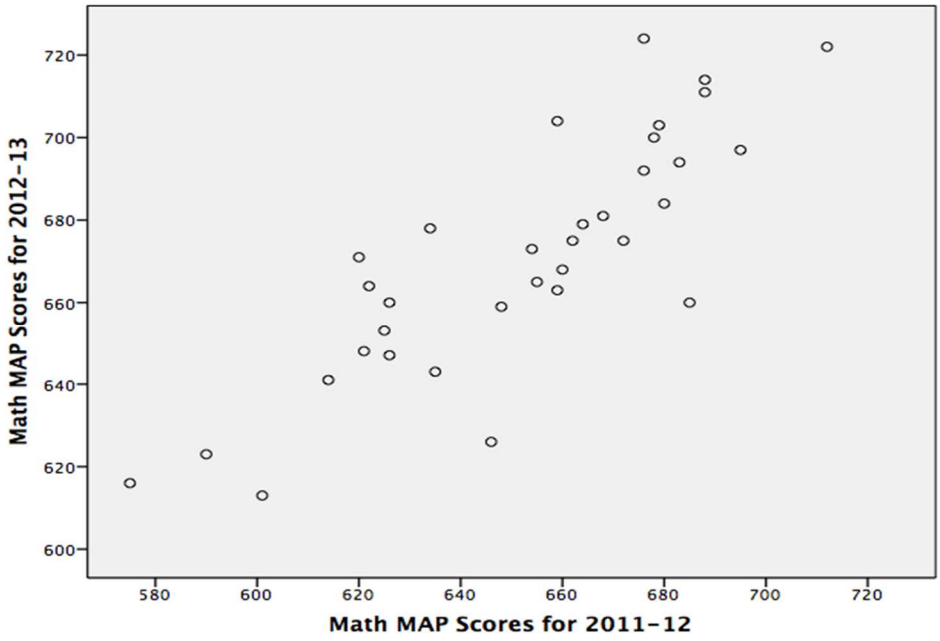

Figure 3. Scatterplot for music program participants comparing the dependent variable, 2012-2013 math MAP scores, and the covariate, 2011-2012 math MAP scores.

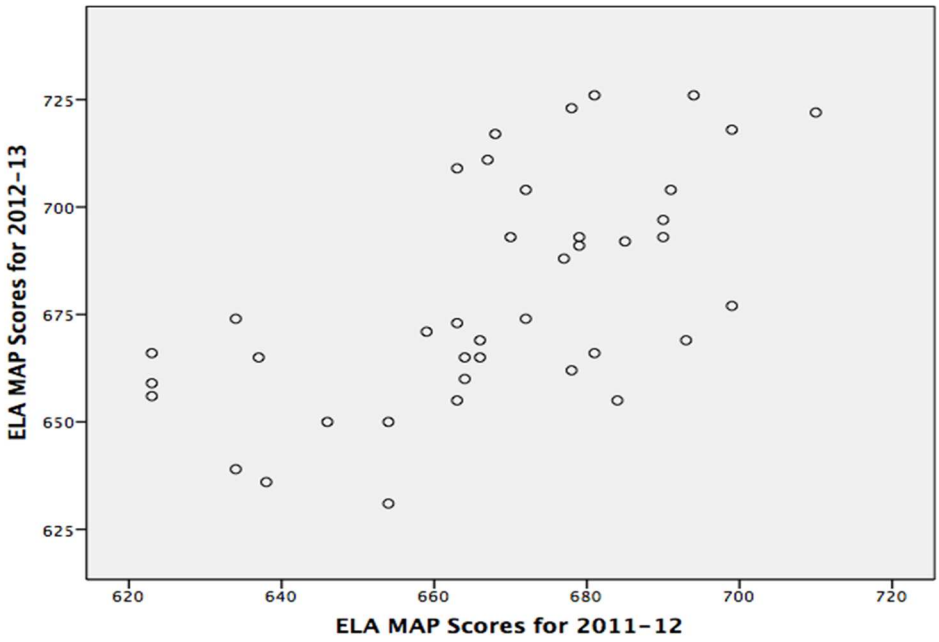

Figure 4. Scatterplot for music program nonparticipants comparing the dependent variable, 2012-2013 ELA MAP scores, and the covariate, 2011-2012 ELA MAP scores.

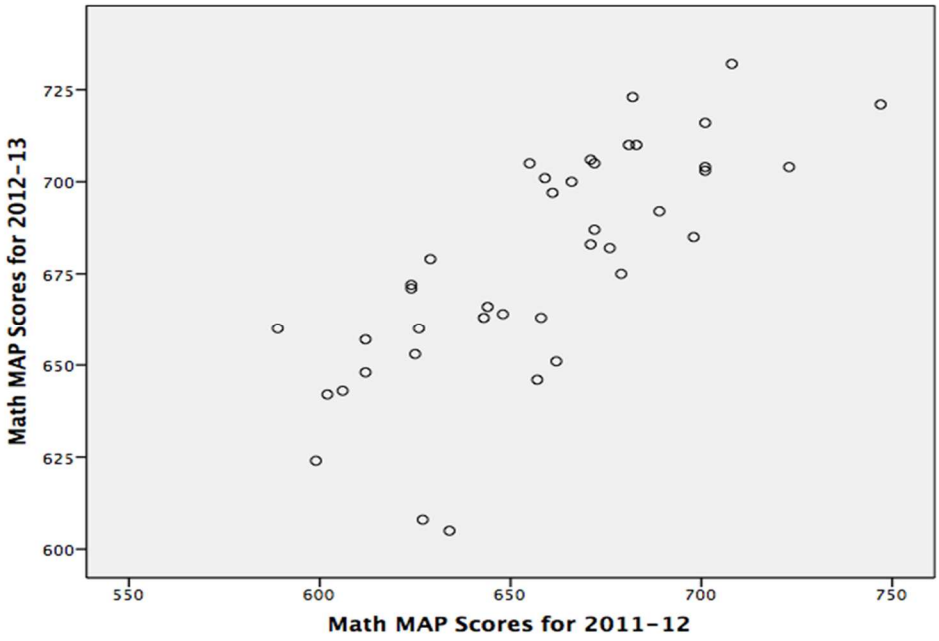

Figure 5. Scatterplot for music program nonparticipants comparing the dependent variable, 2012-2013 math MAP scores, and the covariate, 2011-2012 math MAP scores.

Assumption 5 for ANCOVA was that the covariate and treatment effect were independent of each other. To test this assumption, I conducted two independent samples *t* tests, one using the 2011-2012 ELA MAP scores (pretreatment scores) and the other using the 2011-2012 math MAP scores (pretreatment scores). For the covariate and intervention effect to be independent, the baseline dependent variable measures between the control and treatment groups must not be statistically significant. For both *t* tests, therefore, the music program participants' scores were compared to the non-program participants' scores. Because both *t* tests were nonsignificant, $t(72) = 0.73$, $p = .469$ and $t(72)= 0.71$, $p = .482$, respectively, this indicated that the covariate and treatment effect were independent of each other. Therefore, Assumption 5 for ANCOVA was met in this study.

Assumption 6 for ANCOVA was that the regression slopes for the treatment and control groups are homogeneous. To test this assumption, I ran a two-way ANOVA with music program participants x 2011-2012 ELA MAP scores introduced as an interaction term. Results of the analysis indicated the interaction term was not statistically significant $F(54, 74) = 1.34$, $p = .246$. Therefore, Assumption 6 for ANCOVA was met in this study for 2011-2012 ELA MAP scores. Then I ran a two-way ANOVA with music program participants x 2011-2012 math MAP scores introduced as an interaction term. Results of the analysis indicated the interaction was significant $F(63, 74) = 5.06$, $p = .004$. Therefore, Assumption 6 for ANCOVA was not met in this study for 2011-2012 math MAP scores, and significant results should be interpreted cautiously.

Inferential Analyses

While Assumption 6 for ANCOVA was not met for 2011-2012 math MAP scores, Porter and Raudenbush (1987) claimed that for ANCOVA the assumption of equal slopes across treatment and control groups can "be violated without invalidating the statistical estimation and hypothesis testing procedures" (p. 384). Therefore, I continued with my inferential analyses. To conduct the inferential analyses, I ran two ANCOVAs, one for ELA MAP scores and one for math MAP scores. Results of these analyses are presented in Table 6. Neither the ELA MAP scores nor the math MAP scores were significantly different between students who participated in the music program and students who did not participate in the music program.

Table 6

Analysis of Covariance Results for the 2012-2013 MAP Achievement Scores of Music Participants and Nonparticipants

Source	*df*	*SS*	*MS*	*F*	*p*
		ELA			
2011-12 MAP score (covariate)	1	11,070.89	11,070.89	30.31	<.001
Music program participation	1	276.36	276.35	.76	.387
Error	71	25,930.47	365.22		
		Math			
2011-12 MAP score (covariate)	1	41,148.83	41,148.83	120.44	<.001
Music program participation	1	123.75	123.75	.36	.549
Error	71	24,258.53	341.67		

For the ELA MAP scores, ANCOVA results indicated no significant effect for music program participation, $F(1,74) = 0.76$, $p = .387$. This means that the ELA MAP scores of students who participated in the music program did not differ significantly from scores of those students who did not participate in the program. Also, the 2011-2012 ELA MAP scores (covariate) did significantly influence the 2012-2013 ELA MAP scores (dependent variable), which indicated that those students with higher 2012-2013 ELA MAP scores also had higher 2011-2012 ELA MAP scores.

For the math MAP scores, ANCOVA results indicated no significant effect for music program participation, $F(1, 74) = 0.36$, $p = .549$. This means that the math MAP scores of students who participated in the music program did not differ significantly from scores of those students who did not participate in the program. Also, the 2011-2012 math MAP scores (covariate) did significantly influence the 2012-2013 math MAP scores (dependent variable), which indicated that those students with higher 2012-2013 ELA MAP scores also had higher 2011-2012 math MAP scores.

Summary

Results of the ANCOVA indicated that students who had higher 2012-2013 ELA and math MAP scores also had higher 2011-2012 ELA and math MAP scores. Results also indicated that there was no significant effect on ELA MAP scores for music program participation. Based on these data, the null hypotheses for Research Question 1 was accepted. Similarly, there was no significant effect on math MAP scores for music program participation. Based on these data, the null hypotheses for Research Question 2 was accepted. These results are discussed further in Chapter 5.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this quantitative, causal-comparative study was to determine the impact a music program had on student achievement, as evidenced by differences in MAP test scores between students who participated in the music program and those who did not. The independent variable was student participation in the music program, the dependent variables were the 2012-2013 ELA and math MAP scores, and the covariates were the 2011-2012 ELA and math MAP scores. This study was conducted because at the time of this study, no research had been conducted to determine if the implementation of a music program had had an impact on the academic achievement of students at the focus school who had participated in the program. An understanding of the impact of the music program on student performance was needed to ensure that valuable human, physical, and fiscal resources were not being wasted and that other opportunities to support student achievement were not being overlooked. Results of my analyses showed that while students with higher 2012-2013 ELA and math MAP scores also had higher 2011-2012 ELA and math MAP scores, neither the ELA MAP scores nor the math MAP scores were significantly different between students who participated in the music program and students who did not participate in the music program.

Interpretation of the Findings

Results of the ANCOVAs conducted for this study indicated no significant effect for music program participation with regard to either ELA MAP scores, $F(1,74) = 0.76$, $p = .387$, or math MAP scores, $F(1, 74) = 0.36$, $p = .549$, when compared to no music program participation. Much of the current research does not support this finding. As

indicated previously, Miendlarzweska and Trost (2014) theorized that, mediated by a variety of factors, participation in music education can result in different academic, social, and cognitive outcomes in students. In addition, researchers have found significant relationships between students' participation in music programs and their general academic achievement (e.g., Baker, 2012; Chorus America, 2009). However, in some cases, this relationship was only evident for students who had access to a musical instrument in the home setting (e.g., Hille et al., 2011; Young et al., 2013). Researchers also have found significant relationships between students' participation in music programs and student achievement in both math (e.g., Baker, 2012; Catterall et al., 2012; Chorus America, 2009; Helmrich, 2010; Thornton, 2013) and ELA (e.g., Baker, 2012; Catterall et al., 2012; Chorus America, 2009; Corrigall & Trainor, 2011; Thornton, 2013) in particular.

On the other hand, to some degree, these findings are supported in the literature by other researchers who have failed to find significant relationships between participation in music education and academic outcomes. As indicated previously, stakeholders in Vitale's (2011) study failed to indicate an observed connection between music education and improved outcomes in math, and Elpus (2013), who originally found that music students significantly outperformed nonmusic students on the SAT test, later found that that difference was not sustained after considering the impact of students' socioeconomic status, prior academic achievement, and receipt of special education services. In addition, Elpus was unable to duplicate his original positive findings that music students significantly outperformed nonmusic students. Like Elpus, Cabanac et al.

(2013) and Hash (2011) also concluded that no relationship existed between music education and student performance despite original findings to this effect.

Elpus (2012), Cabanac et al. (2013), Corrigall et al. (2013), Hash (2011), and Schellenberg (2011) all have suggested that a more accurate interpretation of the apparent link between music education and student performance is that students who are more academically inclined are more apt to choose to participate in music education. This, however, was not the case in this study, where more than four times as many students who received special education services participated in the music program when compared to students who did not participate in the program. Because I did not control for special education services, I cannot rule out the potential impact of special education services on student outcomes in this study and thus can neither corroborate nor refute the theory that students who choose to participate in music education may be better academically performing students than students who choose not to participate in music education.

It also is possible that I did not find significant differences between students in my study who either participated in or did not participate in music education because I implemented the music program at the middle school level rather than at the elementary school level. Researchers have agreed that students demonstrate the most significant gains from music education when they start at a younger age (Hanna-Pladdy & Gajewski, 2012; Merrett et al., 2013). Miendlarzweska and Trost (2014) referred to this ideal learning period as “the window of opportunity” (p. 3). Skoe and Kraus (2013) found this sensitive period in music learning was aligned with sensitive periods of development of

cognitive processes, which appeared sooner in children with musical experience. Penhune (2011) and other researchers (Wilson et al., 2012) have suggested that music training is most beneficial when children begin their training before the age of 7. However, the students in my study ranged in age between 9 and 14 years of age. Perhaps because the students in my study were past the sensitive learning period for music, more time would be required in order for an impact to be observed. Based on the literature pertaining to the influence of the extent of musical training on learning during music education (Wilson et al., 2012), IQ (see Degé et al., 2011), academic self-concept (Degé et al., 2014), and academic skills (see Corrigall & Trainor, 2011; Penhune, 2011; Strait et al., 2012), all factors associated with academic performance, this explanation is plausible.

Another reason that I did not find significant differences between students in my study who either participated in or did not participate in music education may be related to student gender. Some researchers have found that male students demonstrate greater neural plasticity as the result of music education when compared to female students (Merritt et al., 2013). In this study, there were almost exactly twice as many female students who participated in music education than there were male students ($n = 23$ vs. $n = 11$, respectively), while there were equal numbers of female and male students in the nonparticipation group. While other researchers have not found gender to be a mediating variable in the relationship between music education and student outcomes (Merritt et al., 2013), the potential for gender to have impacted the outcomes of this study cannot be ruled out.

Finally, it is possible that I did not find significant results in my study because students who participated in the music education program did not have sufficient support. According to Miendlarzweska and Trost (2014), parents play a role in the degree of learning students achieve during music education and impact the extent to which skills transfer from one cognitive domain to another. In this study, the extent of parental support in the home was unknown. Also, the impact of students' participation in music education on academic achievement may only be realized for students who have access to a musical instrument at home (Hille et al., 2011; Young et al., 2013). Because the majority of students in the focus school are economically challenged, as indicated by their participation in the free and reduced-price lunch program, it is feasible to assume that the majority of those students did not have access to an instrument in the home. Instruments, even if they are used, are costly, and it is likely that such an expense would not be a priority for a family that is economically challenged.

The use of school resources to effectively support student achievement is especially critical at the focus school because the majority of students in the school are economically challenged, as indicated by their participation in the free and reduced-price lunch program. Poverty has been found to be associated with poor academic achievement (e.g., Ratcliffe & McKernan, 2012; Young, et al., 2013) and low enrollment in postsecondary education (Catterall, et al., 2012).

Limitations of the Study

As noted in previous chapters, lack of data beyond the first year of implementation of the music program and lack of generalizability were limitations in this

study. Lack of generalizability of study results were noted due to a potentially small sample size, lack of random sampling (students self-selected to participate in the music program), and the potential for experimenter effect based on my personal influence on students as their teacher. No changes to either identified limitation occurred as the result of having conducted this study. Because of the lack of data beyond the first year of implementation of the music program, I still was unable to examine any potential influence the music program may have had on student performance during subsequent years of participation. While I did achieve the needed number of participants to determine significance of my results, lack of random sampling, and the potential for experimenter effect remained as considerations regarding my inability to generalize results. However, after having conducted this study, additional data only provide insight with regard to the lack of random sampling due to student self-selection in the program.

Lack of random assignment limits generalizability in causal-comparative studies (Lodico et al., 2010). Researchers in causal comparative studies generally select a population of participants who are comparable in some respects while differing on their relationship to the independent variable (Lodico et al., 2010). However, self-selection among participants, as a condition that prohibits lack of random sampling, can impact the generalization of results because the treatment and control groups may be characteristically different (Leo-Urbel, 2013). Although the participants in this study were characteristically similar with regard to ethnicity (97.1% of music program participants and 92.5% of nonparticipants were White), they were less homogenous with regard to gender and special education status. Not only were there more female students

in the music program participation group when compared to the nonparticipation group (67.6% vs. 50.0%, respectively), there were more female students than male students in the participation group (67.6% vs. 32.4%) but an equal number of female and male students in the nonparticipation group. Among students who participated in the music program, 32.4% received special education services, compared to 7.5% of students who did not participate in the music program. These underlying differences in student characteristics may have been a result of self-selection among students in this study and contribute to the lack of generalizability of study results.

Recommendations

While the findings in this study do not support the relationship between music education and improved academic performance in math and ELA and Miendlarzweska and Trost (2014) have questioned the value of comparing data for a population whose brains are highly heterogeneous, evidence in the literature does support this relationship. In addition, it is possible that the lack of significant findings was the result of mediating variables indicated in the literature, not only with regard to academic-related skills and student achievement in general but also to academic achievement in math and ELA in particular. For these reasons, I recommend that additional research be conducted at the focus school to consider additional variables that may mediate the impact of music education on academic performance in math and ELA, including gender, parent support in the home, access to a musical instrument in the home, previous exposure to music education, type of musical training, grade level, and extent of music training, the last of which would require a study of student performance over time. Also, because the

literature has shown that participation in music education is associated with a variety of positive student characteristics and social outcomes, I also recommend that studies be conducted to explore the potential impact of music education on variables of this nature.

Implications

While results of this study did not demonstrate a relationship between participation in the music program and improved student outcomes in math and ELA, this study still has value. As demonstrated in the literature review for this study, the literature regarding the impact of music education on student outcomes, including academic outcomes, is mixed. In this sense, the results of this study underscore the need for additional research on this topic, both at the local level and in larger educational settings. Because the literature also has shown that participation in music education is associated with a variety of positive student characteristics and social outcomes, administrators in the focus school also may be prompted to explore this relationship as well. Further study of this nature at the local level could provide additional information that school administrators could use to make informed decisions about the music program.

Conclusion

Results of studies have shown connections between participation in music education and both positive student characteristics and outcomes. When compared to students who do not participate in music education, students who engage in music education have been found to be more emotionally stable and academically, professionally, and civicminded. They also are more likely than their counterparts who have not participated in music education to demonstrate higher levels of socially

acceptable behavior, self-esteem, and self-concept. Engagement in music education also has been shown to help improve affective outcomes and implicit rewards; imagination; creativity; social skills; emotional reaction; general sense of well-being; cognitive flexibility; cognitive processing speeds; nonverbal memory, image recall, and executive processes; IQ, academic skills, general achievement, achievement in math, and achievement in ELA-related activities.

The results of this study, like results in some of the literature, did not demonstrate significant differences between students who participated in the music program and those who did not participate in the music program. However, it is possible that limitations in this study contributed to the lack of significant findings. An understanding of this condition coupled with the research that shows a relationship between music education and positive student outcomes underscores the value of promoting ongoing discussion and conducting additional research on this topic at the focus school. This study may serve as a starting point for those discussions and that research. In this way, administrators in the focus school may be proactive with regard to understanding ways in which they can best support the personal and academic growth of the students they serve.

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