ABSTRACT

MCCAMMON, WILLIAM LODGE. Chemistry to Music: Discovering how Music-Based Teaching Affects Academic Achievement and Student Motivation in an 8th Grade Science Class. (Under the direction of Carol Pope and Candy Beal.)

Teachers should have access to new and innovative tools in order to engage and motivate their students in the classroom. This is especially important as many students view school as an antiquated and dull environment – which they must seemingly suffer through to advance. School need not be a dreaded environment. The use of music as a tool for learning can be employed by any teacher to create an engaging and exciting atmosphere where students actively participate and learn to value their classroom experience. Through this study, a product and process was developed that is now available for any 8th grade science teacher interested in using music to enhance their content. In this study 8th grade students (n=41) in a public school classroom actively interacted with modern songs created to enhance the teaching of chemistry. Data were collected and analyzed in order to determine the effects that the music treatment had on student achievement and motivation, compared to a control group (n=35). Current literature provides a foundation for the benefits for music listening and training, but academic research in the area of using music as a tool for teaching content was noticeably absent. This study identifies a new area of research called "Music-based Teaching" which results in increases in motivation for 8th grade students learning chemistry. The unintended results of the study are additionally significant as the teacher conducting the treatment experienced newfound enthusiasm, passion, and excitement for her profession.

Chemistry to Music: Discovering How Music-Based Teaching Affects Academic
Achievement and Student Motivation in an 8th Grade Science Class

by
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BIOGRAPHY

William Gavin Lodge McCammon Jr. was born in Chicago, IL. in 1977 on Mother's Day. He grew up in Barrington (a northwest suburb of Chicago) and began Suzuki Violin School when he was two years old. In diapers, McCammon performed for large audiences at The Orchestra Hall in downtown Chicago and has vague memories of waiting backstage in the green room and attempting to squint through the bright lights to locate his parents in the crowd.

McCammon's mother was the Director of Barrington Suzuki Strings and she considered it her responsibility to "encourage" him to keep playing. When McCammon was ten years old he switched to the cello and had the fortune of being instructed by Don Moline, a Grammy Award-Winning cellist from the Chicago Symphony Orchestra. During this time, Lodge's father owned, operated, and was a producer at Hedden West one of the most popular recording studios in the Chicagoland Area. Some notable clients that McCammon was around at an early age were Jerry Garcia, Survivor ("Eye of the Tiger"), and The Beach Boys.

During his middle and high school years, McCammon toured with a chamber orchestra to Russia, Germany, Switzerland, Italy, Holland, and Austria. In 1991 this chamber group competed in front of a crowd of five thousand people at the Youth World Music Festival in Vienna. McCammon's group took second place, worldwide.

Also during high school, McCammon became interested in commercial music, recording, production, and performance. He started composing and recording music in his

parent's basement (retrofitted with cutting-edge studio equipment) and played in a number of bands.

Fortunately, McCammon's early experience with music made it possible for him to quickly learn new instruments. By the time he graduated from Maryville College in Tennessee with a degree in Economics (naturally), he was a proficient studio musician playing cello, guitar, drums, piano, banjo, bass, and had hundreds of studio hours as a singer.

After college, and some time spent in Los Angeles and Nashville, McCammon decided that he was driven to get involved in education. His middle and high school years were somewhat dark and depressing, and he believed that he could play a role in changing that for other students. So, in 2002 he went back to Maryville College to complete courses in order to be awarded teacher licensure. During this year he also began and completed a Masters of Science in Education from The University of Tennessee. McCammon had a crazy idea. If he could integrate music into the classroom, then maybe students would learn to value the public school experience.

In 2003 McCammon took a job teaching AP Economics and Civics at Wakefield High School in Raleigh, NC. He taught for two years integrating music, video, the Internet, and humor into the curriculum. While teaching, he noticed that these "tools" engaged students and made the classroom a better place for both the students and teacher. With this newfound knowledge, McCammon enrolled in a Doctorate program in the College of Education at North Carolina State University majoring in Curriculum and Instruction, with a focus in Curriculum Development. McCammon's key interest is in developing scalable

solutions for teachers to integrate music, video, and/or Internet tools into the classrooms in

order to enhance the experience for both teachers and students and to prepare a new

generation for life and work in the 21st century.

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CHAPTER I: INTRODUCTION

In a 1999 statement to the House Education Caucus in the US House of Representatives, Joan Schmidt stated that the National School Board Association "supports raising student achievement and we know music can do that. Students who participate in music can earn higher grades and score better on standardized tests" (Schmidt, 1999). What has been widely debated, and altogether unclear in the research, is the definition or explanation of the phrase "participate in music."

There are two major areas of study that are cited when answering the question "does music make you smarter?" The first area deals with listening to music and its effects on short-term spatial temporal reasoning skills. These studies suggest that simply listening to music increases one's ability to perform more complex cognitive tasks, but does not necessarily increase academic achievement (Raucher, Shaw & Ky, 1993). The other area of study centers on music training. This area purports that students who receive music instruction and training experience increased academic achievement, motivation, standardized test scores, as well as improved spatial temporal reasoning (Raucher, Shaw & Ky, 1993; Cutietta, Hamann & Walker, 1995; Rauscher, 1995).

This study addresses the gap in the literature about the impact of music participation on student achievement. Research reveals that the act of only listening to music does not increase academic achievement and motivation, while music training almost guarantees it. This study explains the academic benefits of music in the middle ground between listening and training. Students had the opportunity not only to listen but also to participate by singing

songs and analyzing lyrics created from the 8th grade chemistry unit in order to determine the effects of this activity on their academic achievement and motivation.

American Adolescence and Music

For many students in America the adolescent years start the downward spiral in their academic achievement and motivation (Anderman & Maehr, 1994; Carnegie Council on Adolescent Development, 1995). Given this trend, the link between music, motivation and academic achievement, and the relationship of music tasks and students' success can be employed to help solve this issue (Morrison, 1994). This study took place in a middle school with 8th grade students. It is critical that students be engaged and inspired in the middle grade years so that they enter high school knowing they can achieve and succeed. To motivate students to achieve, as educators we must recognize what engages them and what is required for them to be successful.

Among the many diversions that engage students outside of school is music. Of the students surveyed in the "Having Our Say" project, 83% stated that they are high frequency users of music outside of the classroom. That percentage was even greater than playing video games and using a cell phone (Spires, Lee, Turner, & Johnson, 2007; Pew Internet & American Life Project, 2005). The use of music for teaching and learning infrequently occurs in classrooms despite the fact that a number of middle school students relate highly to it.

Music can be an important and effective tool when used properly in the classroom. Music not only engages students but it also affects their brains. The part of the brain that processes sound has frequency specific neurons that turn on and turn off based upon what

sound the person is experiencing. Eventually these frequency neurons form groups of similar cells, and it results in a sound map in the brain (Rauscher, 1993). Similarly, Piaget's theory if applied to music and learning would support the belief that when students develop a mental schema around western tonal music this helps them categorize and process new songs that they hear in a familiar way (Dowling, 1993). Music also has the ability to increase spatial reasoning and stimulate thought processes, which are both necessary components for academic achievement (Rauscher, 1995). Rauscher argues that if a curriculum is developed that motivates and engages a student's interest, that curriculum will likely lead to academic achievement. Dowling (1993) agrees and further suggests that teachers should talk less to students and have them sing more. He postulates that having students sing promotes active involvement and engagement in the curriculum. However, these findings are not without their critics. The main studies that fuel much of the argument supporting the power of music on achievement have used small sample sizes, and the benefits recorded were temporary (Demorest & Morrison, 2000). This study informs the existing literature by implementing an innovative use of music and by testing its effects on academic achievement and motivation.

Assumptions and Rationale for Study

This study was motivated by a commitment to developing innovative music-based teaching tools for educators in order to help them engage and motivate their students. One of the study's major goals was to examine and discuss how music can be used in a middle grades classroom to motivate students and increase academic achievement. As a former teacher I had implemented this pedagogical strategy and wanted to test its portability.

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Therefore, I initiated the study assuming that any teacher could implement a music-based lesson and have a successful experience with his/her students regardless of grade level, content area, or musical ability. Accordingly, I chose to look at 8th grade science, a grade level and subject matter most foreign to my experience.

Purpose

The purpose of this study was to determine the effects of using original music in teaching chemistry to 8th grade science students. The treatment was implemented in two 8th grade science classes; two additional classes were used as the control group for the study. The study relied on mixed methods for investigating the effect this music-based teaching had on students' motivation and academic achievement. Ultimately, the findings of this study will be used to critically analyze this method of teaching so that other research can be conducted around this teaching process and accompanying curriculum.

Research Questions

This study addressed two research questions:

1.   Does music-based teaching increase academic achievement in science?

2.   How does music-based teaching affect student motivation for learning science?

The first question involves the use of an in-class test/retest scenario. The students took a pre test of the information in chapter 13 of the state mandated text (Prentice Hall *Science Explorer: North Carolina Grade 8*). The treatment was then administered, and the students then took a posttest consisting of the same questions. Academic achievement was determined based upon repeated measures analysis of variance (rmANOVA).

The second question involved having the students respond to a prompt about how the music motivated them to learn. These qualitative data were analyzed for emerging themes from the written responses. Based upon those themes, additional, more detailed questions were developed, and representative students were asked to take part in a focus group. Because of the innovative nature of the treatment, it was important to hear directly from the students as they responded to the issues of motivation. A series of follow-up interviews were conducted with the teacher to enhance the qualitative data of the study.

Significance of the Study

This study is significant for two reasons. First, the music-based teaching process is set in an authentic classroom and carried out by a "regular" teacher. Moreover, this study provides the curriculum materials, explanation of the music-based teaching process, and the research foundation necessary for its implementation in any 8th grade classroom. This unique set of attributes associated with this study provides the possibility of this teaching process to be both generalizable and scalable. Second, the study fills a gap in the current research dealing with the effects of music-based teaching on student achievement and motivation. Literature is available on the academic effects of listening to music as well as the effects of music training. However, the academic effects of music participation have been largely unexplored in the current literature. As a result of the connection between the practical use of these materials and the research foundation, this study can make recommendations about the value of music in academic settings.

Pilot Studies

This study relies upon an original theoretical framework developed by the analysis of four music-based pilot studies. These four studies took place between October 2005 and December 2006. The graphic representation of the framework and its explanation, along with the description of the four pilot studies, are included at the end of this chapter. The theoretical framework reveals a theory derived from the process and observed outcomes of the music-based teaching process.

The first pilot study (TOP2005) focused on the content of the novel *The Outsiders.* This study took place in the fall of 2005. A song called *Reaction* was created based on the content of the book. The second pilot study (Details) took place in a public school 2nd grade classroom. This project took place in the spring of 2006. The song, *Details,* was written to reinforce the information needed for writing a three-paragraph story. The third pilot study (Depression) was a collaborative project between the researcher and an AP Psychology teacher. This study took place at the end of the school year in 2006, after the AP exam had been administered. The song, *I Love Depression,* was written to reinforce the concept of depression in psychology. The final pilot study (TOP2006) took place in the fall of 2006 and was a replicated study of TOP2005. However, there was a different song written in 2006 called *Flashback.*

The four pilot studies reflect the development and testing of a music-based teaching process. Each relied on the creation of an original song and lyrics that were then used to teach academic content to students in the classroom. The details and challenges of writing

original music, lyrics and melody is an issue all its own. Additionally, producing and recording that music has its own set of challenges and issues that make for yet another topic of lengthy discussion. However, across the four pilot studies all the collaborators were satisfied that the song simply appeared. Though the writing and recording of the song remain somewhat of a mystery, it is important to discuss how the lyrics were created and how both the genre and quality of the song were deliberate.

In each of the four studies the students had a voice in creating the lyrics of a song closely connected to the content being studied in the classroom. During *The Outsiders* project in 2005 the researchers simply circulated around the room collecting key phrases from conversations. Those key phrases became the basis for the lyrics of the song *Reaction*. During the writing phase of the song *Details* with the 2nd graders, the students actually brainstormed and turned in sheets of possible topics/concepts/lyrics, and those ideas became the basis for the lyrics. Similarly, the AP students at a local High School researched and tried their hand at writing actual song lyrics (after being given a sample lyric). The students handed in lyric sheets that were used for the song *I Love Depression*. The Outsiders project in 2006 was a bit different because the undergraduates and middle school students were instructed on how to write lyrics, given a worksheet, and provided with most of a class period to create some potential lines for the song. These sheets were then collected, and some of the content was used to write the song *Flashback*. The benefits of collaborating with the students on the song lyrics are yet undefined. There was no evidence to suggest this collaboration was

a necessary component of using music-based teaching in the classroom, except for the importance of involving students in the process.

Each of the four songs created for the pilot studies was unique, but they shared certain key aspects. When creating beat and melody for students, it is important that the genre of what is created is within their musical schema. The song must be similar to other popular culture pieces of music so they can be immediately familiar with the basic style and structure. Dowling (1993) suggests it is important to capture this western genre in order to engage and motivate the American student. There are many components of the western style of music that are similar and recognizable to the common listener.

Genre is not the only recognized component to spark the interest of the students in a class. Throughout these pilot studies it was imperative that the music that was produced was of the highest quality. In order to compete for the students' attention, the music must be competitive, both in genre *and* quality, with what they hear on the radio or download from iTunes. If the songs are inferior in quality, they are inferior in impact. A notable reason for the success of the pilot studies was the fact that the songs shared a similar quality with popular commercial music.

Discussion of Four Studies

As evident in much of the literature in chapter 2, many believe that music instruction makes one smarter and can have many diverse benefits if used effectively in the classroom. However, there is a significant gap in the literature supporting the concept that using music in a dynamic way to teach can increase achievement and motivation for learning. Therefore,

these pilot studies were conducted and anecdotal data was collected and analyzed in order to discover what type of music-based teaching could have a desirable outcome for students and teachers.

The first *Outsiders* project illustrated evidence that music can engage 7th grade students and activate their memories. When the song *Reaction* was first played for the students in their classroom, it was apparent that many of them were skeptical about the musical genre. Many stated that it sounded like "country music." This was not necessarily a good thing seeing that a large number of the students preferred rap and R&B as their music of choice. Regardless of how they initially felt about the style of the song, two days later, each one of the students had the song memorized when they met with the undergraduates. The song lyrics were filled with literary terms and definitions, character names, and dates pertaining to the novel. Within two days of hearing the song they were singing it out loud without help from printed lyric sheets.

The 2nd grade students participating in the song *Details* at Derring Elementary had a similar experience to those who sang about the *The Outsiders*. The song was given to the teacher a week before the students were asked to perform it. According to the teacher, they listened to it only a few times in class before the recording day. However, when it was time for the students to sing the song and be recorded, each student had memorized the lyrics to such an extent that they needed no prompting or lyric sheet to remind them of the words. The content in the song *Details* was rich with information about what to include in a three-paragraph story. Included in the lyrics were vocabulary terms, suggestions about ways to

start and finish a story, and important reminders like "please don't forget to indent." Even days after the filming and recording, the teacher reported that the students could be heard singing parts of the song while in line for lunch, walking down the hallway, or during quiet reading time. Though the latter would be deemed a nuisance, the benefit, according to the teacher, outweighed the cost.

The 11th and 12th graders in a high school AP Psychology class exhibited similar results. The students were required to memorize the lyrics for two reasons. First, they were going to have a quiz on the words, and second they had to perform and lip-sync the lyrics to a portion of the song in front of the camera. The teacher played the song only a few times for the students in class. However, the students were given an Internet link to the song so they could review it at home. The lyrics covered, in detail, the four schools of thought around the concept of depression (cognitive, psychoanalytic, medical, and humanistic). These AP students had already studied the concept of depression earlier in the semester; many of them reported that this song was a much more memorable and effective way of learning the curriculum - more so than simply reading the text and taking notes. One student explained that "it's much easier to memorize something if it is in music with a good beat." She continued by stating that the quiz of the lyrics was one of the best scores she had received thus far in the course.

The second Outsiders project (TOP2006) was certainly no exception to the power of music as it applies to memory. Unlike the first song, which the students thought was "country," this song was a more noticeably modern genre. It was not rap or R&B but had

aspects of techno, rock, and pop. The teacher reported that the students took to this song right away. Two days later, when the middle school students met with the university undergraduates, the 7th graders had the song memorized and sang it enthusiastically for the audience of college students, professors, and graduate students. Similar to the song *Reaction*, the 2006 version *Flashback* was filled with the language of literature, vocabulary terms, themes, characters, scenes, and dates from the novel.

Across the four pilot studies it was apparent that students remained attentive, focused, and involved whenever the music was playing. When the song was delivered to the instructor, during its first unveiling, each student sat completely silent. They either read over their lyric sheet, or they listened closely to the beat, chords, and melody of the song. In either case, they were captivated. This reaction can most definitely be attributed to a few things. First, each group had been a part of the creation of the song, in some way or another, so they might have been somewhat invested in it. Next, the songs were musically interesting and fit in with the western tonal music structures that they were used to hearing. Even if they had never heard the song before, students recognized the structure of the song and were able to connect the feeling to that of other songs with similar structure. Finally, they remain engaged for the first playing because it was a departure from the traditional teaching practice. The song was new, different, and many times, loud and certainly unique compared to a traditional lesson.

Each time the song was played in each class, most students were either silent or engaged for its duration. The students were usually doing one of three things: 1) looking over

and learning the lyrics, 2) singing along, or 3) looking around the room to see who was singing. In any case, the students were absolutely engaged while the music was being delivered.

Eventually the students got to the point where they were comfortable enough with the music, and they began to sing along with the recording. Most students cannot sing very well and end up just talking along with the music or attempting to sing. These are both viable alternatives to actually carrying a tune. The times when the students were most engaged were when the whole class is participating in the singing of the song together.

Each pilot study had a music-based outcome where there was a product generated from the performances. Whether the product was the song with everyone's voice recorded singing along, a music video, or a documentary of the process, the students were actively engaged in listening or viewing this final product. Each and every student throughout the four studies was intensely engaged in listening for their voice or the voice of a friend among the crowd. Students were elated when they watched the video and saw themselves or their classmates participate in this unique experience. This method of teaching offers a music-based process that truly engages the attention of students through its use. From the initial playing of the song to the listening or viewing of the final outcome, the students were a captive audience for music-based teaching in the classroom.

Creative Expression

The wild popularity of social networking sites is a testament to the human tendency for creative expression. Millions of people set up their personal web pages to mirror their

personality by including pictures, stories, and facts about their lives. Many of these pages are put together in creative ways so that a potential "friend" will be lured in to learn more. The desire for creative expression knows no age limit and is certainly not lacking in students.

Along with social networking sites, many students use music to express themselves. Whether listening to hard rock as a rebellion against conservative parents or defining more refined tastes by enjoying Beethoven, students define themselves by their choice in music.

Creative expression associated with music does not stop with people using it as an identifier. The phenomenon of spontaneous dancing, the tapping of feet, the rapping of hands on thighs or a nearby table are all forms of creative expression connected with the playing of music. In addition, we recognize that students today are part of the MTV generation where they literally *see* music in dancing, acting, and visual representation. The desire to act out the lyrics and create a visual expression of the music is a logical concluding step in people creatively interacting with a song. Each of the pilot studies illustrated the students expressing themselves creatively in different ways.

The Outsiders projects (2005 & 2006) were excellent examples of creative expression in dancing and movement. Evidence from the music videos show that students innately created dances to correspond with the song. Students danced to express themselves as individuals, to illustrate the meaning in the lyrics, and to express the uninhibited movement that is modeled in popular culture when music is played. Each student had an individual style of expression, some more subtle that others, and felt as though they could express themselves

freely without judgment or consequence. Creative expression to a piece of music cannot be right or wrong.

The second graders were a bit different in their creative interpretation of the song *Details*. Having much less experience with MTV and the popular culture of creative expression and being less self-conscious, these students were less reserved about their movements. Their dancing had very little interpretive quality, but was almost completely spontaneous as a human reaction to the beat of the song. It was as if their minds heard the song and told their body what to do with no mechanism to restrict the outcome. Thus, when each group was singing the song, the rest of the class was in the back of the room dancing their feet off.

Dancing was not the only form of creative expression that came from the project with the elementary school. The students also created visual representations such as posters and cutouts of key phases from the lyrics. For instance, the song poses the question: "Were you with a pink elephant?" Many of the students had created little posters with a picture of a pink elephant on it that they would hold up at the appropriate time during the song. This type of visual representation is creative expression that is cognitively appropriate for the age group.

The high school's two AP classes expressed themselves creatively in an entirely different way. These students were abstract thinkers and could handle complex meaning, create a storyline, and act it out. There is evidence of this ability in the final music videos. Unlike the three other projects, when these students were in charge of creating visual meaning for the song, they expressed themselves by dancing and acting out the words as if

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they were a story. The students brought in scenery, costumes, and props to help tell the story of *Depression*. Many of the interpretations included both the acting out of the story of the song and dancing. Similar to *The Outsiders* projects, the high school students seemed to draw from popular culture and the associated norms for dancing to music. Having more experience with these popular culture norms, their dancing, however, was much more reserved.

Anecdotal Teacher Data

During and after the use of music in the classroom throughout the pilot studies, each teacher expressed individually that the students were more comfortable with their surroundings. They were more willing and eager to participate in class because they had shared a common set of circumstances with their peers that helped define their unique personalities. This response speaks directly to the fact that participating in a music-based experience in school boosts students' self esteem and their ability to see themselves as talented and valuable resources in the process of education.

The most common theme reported by the teachers associated with these pilot projects was that using music-based teaching in the classroom built community among the students. The teachers reported that the students were a stronger team as a result of participating in these studies. Being placed in a non-judgmental environment, where their personality was allowed to show and flourish, proved to be beneficial for all students from 2nd to 12th grade. Evidence from the documentaries, podcasts, letters, and music videos expressed one of the cornerstones of 21st century learning; the students were having so much fun they did not realize they were learning.

A main point in developing this music-based teaching curriculum is to even the playing field and introduce a way of delivering content that promotes self-esteem. Most students cannot interact with music in a "professional" manner - singing, dancing, performing. Therefore, most of the students in the classroom learn through music, starting at about the same place. Most students do, however, have a cursory background in singing, dancing, and performing to music at the amateur level through their listening and interacting with western tonal music throughout their lives. Classrooms are the ideal venue for implementing group singing to build self-esteem and motivation in students. It is a captive, and most times, willing audience where self-esteem and motivation is important to academic success.

<div align="center">Theoretical Framework</div>

The current literature suggests that listening to music results in an increase in spatial temporal reasoning (Rauscher, Shaw, Levine, Wright, Dennis, & Newcomb, 1997). There is much debate over the validity of these findings, as will be discussed in chapter two. There are also findings that have gone uncontested that recognize the academic value of musical training. Among some of the benefits of this training are increases in spatial temporal reasoning, creativity, originality, self-esteem, academic achievement, and motivation. This research will also be discussed in chapter two.

The theoretical framework in figure 1 postulates that music-based teaching results in increased academic achievement and motivation. The small circle on the left labeled "music listening" summarizes the finding in the literature that suggest listening to music results in

increased spatial-temporal reasoning skills. The largest circle in the diagram indicates the literature-based findings that music training, whether instrument or singing, results in all attributes in the smaller circles as well as increased creativity and self esteem.

Figure 1. *Theoretical Framework*

This study hypothesizes that music-based teaching can be used as a way of increasing academic achievement and motivation in the classroom without music training. The students listen to content related music but also participate in singing to that music. As illustrated in

Figure 1, this study suggests that music-based teaching will result in increased academic

achievement and motivation for students in learning 8th grade science content.

"When I open my eyes, I can only sigh, for what I see is contrary to my creed: and I must despise the world for not perceiving that music is a higher revelation than any wisdom or philosophy. It is the wine that inspires new creations…"

- Ludwig Von Beethoven

CHAPTER II: LITERATURE REVIEW

The assertion that music makes people smarter has been widely debated in the recent literature. Many studies support or refute the validity of this claim, but no definitive answer exists. Controversy abounds about which type of music, if any, increases intelligence and whether or not simply listening to music is enough – it is even possible that music training is necessary for the true benefits to be achieved. This literature review focuses on three main areas dealing with the benefits of music. First, there will be an exploration of the controversy stimulated by the seminal studies suggesting that listening to music, as well as music instruction, can cause increases in intelligence. The second area focuses on recent studies that show a wide range of benefits derived from using music in the classroom as an instructional tool. Finally, the data from three pilot studies provide additional foundational information for this research by suggesting that the use of music-based teaching may effect student motivation for learning and academic achievement.

Listening vs. Training

Music appears to have a magical power over many people; however, music may not be magic at all. When one listens, plays or performs music, the frequencies actually change the physiological organization of the listener's brain. The part of the brain that processes sound has frequency specific neurons that turn on and off based on the unique sound. Eventually these frequency neurons form groups of similar cells, and this grouping results in a sound map in the brain (Rauscher, 1993). In each person a mental schema formed by listening to music. Therefore, when music is heard, the brain has a framework for processing

and categorizing the harmonic structure of that sound (Dowling, 1993). Dowling contends that "western tonal music" has a pattern to it that is imprinted upon our brains from years of listening. The activation of this part of the brain is not explicit, but rather implicit, as familiar chords elicit memories and feelings. He explains that these changes in the brain develop through years of listening, and are not innate, because an individual's brain only processes the music of a specific culture for Northern Americans; he calls this familiarity western tonal music. If American students were to experience music-based teaching in another country, their brain schema would not process the music effectively. This phenomenon is largely due to the fact that there is a connection between the structure of music and certain cognitive activity. Many studies were conducted in the early 1990's that attempted to define this connection. These studies were able to quantify the connection and also suggested that music results in higher brain functioning (Leng, Shaw, 1991; Leng, Shaw & Wright, 1990).

The seminal study linking listening to music and an increase in cognitive ability was conducted and reported by Rauscher, Shaw, and Ky (1993). These researchers found that playing a portion of a Mozart piece for a group of undergraduates at the University of California at Irvine caused them to have short-term increases in spatial reasoning skills. The researchers dubbed the term "The Mozart Effect." These researchers, in a larger study, applied the treatment in 1995 with seventy-nine undergraduates taking a spatial reasoning test from the Stanford Binet Intelligence Scale. These students took this test immediately after listening to a Mozart piece for ten minutes. The same results were found as in the 1993 study. Though the Stanford Binet Intelligence Scale is used to measure IQ, a much broader

scale for measuring intelligence, the findings inspired much additional research into the connection of music training and intelligence (Yamaha Corporation of America, 1999). Immediately following the release of these data, other researchers attempted to run similar studies, but were unable to replicate the prior significant findings (Castens, Hasking & Hounshell, 1995; Newman, Rosenbach, Burns, Latimer, Marocha & Vogr, 1995; Steele, Brown & Stoecker, 1999; Chabris, 1999). Each of these studies attempted to apply similar conditions and treatments to undergraduates but found no significant increases in spatial temporal skills after listening to pieces of classical music. Despite the debate that arose from these conflicting findings around whether or not listening to music actually increases cognitive abilities, researchers, authors, and the popular press began discussing the powers of music to increase intelligence.

The popular book, *The Mozart Effect* (Campbell, 2001), is based upon the research of Rauscher, Shaw, and Ky (1993) and claims a connection between music and intellectual development. Its popularity also reflects how pop culture can adopt misleading research findings. In fact, a whole industry of videos and toys have grown from this misunderstanding. Among the book's assertions is that classical music aids in the development of certain parts of the brain in young children. It further suggests that listening to music has the ability to make real and important changes to the physiology of the brain and thereby increase intelligence. Caution must be used when making assertions about one European composer having the ability to increase intelligence for all people, especially if we intend to shape academic curricula using these assumptions (Reimer, 1999). The short-term

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benefits of listening to music, and a very specific type of music, may not provide the promised increases in intelligence. Also, these findings would be more powerful if they were successful on a population other than college undergraduates.

The findings connected with musical training, consisting of music lessons and performance, have shown different results entirely. Listening to music has been shown to affect the brain in positive ways (Rauscher, Shaw & Ky 1993). Since musical training is both playing and listening, it would stand to reason that the performance of music would have similar or more significant results. The existing research supports this contention by suggesting that the playing and singing of music increases human intelligence much more than simply listening or appreciating (Rauscher, Shaw & Ky 1993). Thus, to promote the performance of music in school would be to encourage the increase of human intelligence. In particular, singing music produces learning by accessing and engaging the western tonal schema in the brain of the participating students. The advantage is that the students are more receptive of information that is wrapped in a familiar musical structure (Dowling, 1993).

The seminal study, dealing with musical training and performance, also conducted by Rauscher, Shaw, and Ky (1993) began a "land rush" of research connecting music instruction to increased intelligence and achievement. This musical training-based study provided piano instruction for nineteen preschoolers, for eight months, while fourteen preschoolers were kept as the control group. After four months, and then at eight months the children were tested. The testing consisted of having the students assemble objects as an assessment of spatial reasoning skills. The resulting data showed that these children who had received the

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piano instruction were able to perform higher on these spatial reasoning assessments than those in the control group.

In a later study, Rauscher, Shaw, Levine, Wright, Dennis, and Newcomb (1997) observed three groups of preschoolers, each with a different music training experience. The first group received piano training, the second received training in singing, and the third received no training at all. The researchers reported that individuals with the piano training received significantly higher scores on spatial-temporal reasoning tests. This ability comes from the part of the brain that allows us to think abstractly and solve complex, multi-leveled problems. To what degree, or the length of time in which this ability is strengthened by music is still undetermined.

Therefore, if research were to determine that "music stimulates thought processes and enhances spatial reasoning, which are essential for academic achievement" (Rauscher, 1995), then music would be a valuable educational tool. There have been numerous studies that connect musical training to academic achievement. Morrison (1994) analyzed data taken from the National Education Longitudinal Study of 1988 which involved over 18,000 sophomores in high school from over 1,500 public and private schools. The research compared the participation in music to academic achievement measured two ways - academic awards or honors received and actual grades in math, science, english, and history. The findings showed that there is a positive correlation between students' involvement in school music programs and their receipt of academic awards and notably higher grades in the core areas than those students not involved in music. Cutietta, Hamann and Walker (1995)

confirm this finding in their comprehensive review of literature, outlining the positive correlations between music training and academic skills. Their review asserts that students who participate in music programs in school excel in reading, language, math, and in overall achievement.

Music training has an effect upon grades and achievement and can be measured by standardized instruments. For example, the Scholastic Aptitude Test (SAT) scores are standardized scores affected by music participation (Cutietta, Hamann, & Walker, 1995). The researchers looked at the data for high school students who were active in some school-associated music program. These students received significantly higher SAT scores than those who had no music association in high school. Specifically, the students who participated in active music performance or appreciation scored 35-40 points higher in verbal and 10-37 points higher in math, above other students with no music experience (Cutietta, Hamann, & Walker, 1995).

Other researchers found that music makes a positive contribution to the academic environment by increasing both grades and standardized test scores (Asmus, 1991). Given that positive contribution, logic would suggest that further utilizing music appreciation, participation, composition, and performance in the classroom would continue to increase academic achievement. Kalmar (1982) analyzed and discussed a study conducted by Kodaly (1965) where a group of elementary school children were either assigned to an experimental group or a control group. The experimental group received singing lessons for three years while the control group received no musical training. The experimental group not only

showed increases in academic achievement, but also showed significant increases in abstract thinking, originality, and verbal skills. This study reveals the potential that increased amounts of singing can have upon children. It also suggests the value of integrating music into the classroom in order to enhance curriculum and learning.

A review of the research in the area of music listening reveals that music can result in a temporary increase in spatial temporal reasoning skills. On the other hand, musical training and performance can result in long-term spatial temporal reasoning skills, academic achievement, and a range of other valuable academic skills. Therefore, the research must be identified that follows the aforementioned seminal studies to reveal the additional benefits to both music listening and training.

<div align="center">Music in the classroom</div>

In an effort to better understand the impact of using music in the classroom, much research has followed the seminal studies dealing with spatial temporal reasoning and academic achievement. These more recent studies illustrate the significant benefits of students' participating in music-based activities. Many of these studies suggest that using music in the classroom increases motivation, self esteem, community in the classroom, and enthusiasm. Each of these studies suggest that the benefits offered by musical participation are greater than for simply listening to music, but less than the benefits available through musical training.

Motivation and Engagement

Motivation is an important contributor to academic achievement (Ames, 1990). Anderman and Maehr (1994) declare that motivation is specifically a key issue for middle grades students. It is an critical time in these students' lives because the middle grades years are when students make important decisions - such as what type of students they will be in the future and what careers they will pursue (Anderman & Maehr, 1994). Therefore, it is important that student motivation for learning be increased during the middle grades years in order to have successful students who value a commitment to life-long learning *and* the attainment of skills (Ames, 1990).

Often the reputation of a school is based on student achievement as determined by standardized test scores. However, we must look for more than student achievement when evaluating how our schools are doing in teaching. Building a student's commitment to learning, attaining skills, and being open to the process of education are all-important for students to be successful in the future (Ames, 1990). Students who opt into upper level science courses in high school because they want to learn more, and not because they believe they can simply be successful is an example of students' making intrinsically motivated decisions and is a sign of students being open to the process of education (Ames, 1990). These are the types of students who will be the leaders in the 21st century.

Schools are social environments, places where we need to appeal to students as unique and complex individuals, to meet them on their level in order to make a connection. When we fail to motivate students, or meet them on their level, we run the risk of their being

dis-engaged or dropping out. It is the teacher's job to find tools and methods to keep each student physically and mentally "plugged in."

Trying to motivate students to take ownership of the content is quite possibly the most challenging aspect of teaching (Ames, 1990). Teachers employ the use of diverse tools, methods, and experts to engage and motivate their students. A tool often overlooked is music. Research conducted by Dowling (1993) found that elementary students could make accurate judgments about the western tonal structure of music, even at such a young age. These children, both musical and non-musical, were given a series of notes and were instructed to predict which note was to follow. Both groups of children were able to make accurate predictions based upon their pre-existing western tonal schema of music understanding. Dowling (1993) continued that there are classroom implications of such a schema and suggests that singing in the classroom is one of the most effective ways to get students actively involved. He found that having students sing about academic topics is a fun, engaging, and effective form of communication for the modern classroom. Using music in the classroom was an effective way of utilizing the students' pre-existing knowledge.

Barry (1992) conducted a study at Auburn University with elementary school children that found that art programs and activities, integrated into classrooms, can "provide student opportunities to develop pride and satisfaction, and help students develop a sense of ownership and involvement." This study surveyed at-risk children and administered the Piers-Harris Children's Self-Concept Scale and found significant increases in overall self-concept in students participating in arts programs. The conclusions were that art, and

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specifically music, becomes an emotional outlet to increase student engagement and reduce the rate of both mental and physical drop-out. Students who are motivated to learn express a willingness and interest in mastering new concepts and information. These students become independent learners and know how to regulate and improve their own achievement (Ames, 1990).

The creation and use of western tonal music, with its popular themes and historical contexts can be used to generate discussion and increase student engagement while learning (Dowling, 1993; Martinez, 1994). Dowling's research with young children suggests that using western tonal music to learn results in engagement due to the students' ability to access their music schema that can develop from both listening and participating in music. Martinez suggested that using music as a pop culture tool in the classroom generates excitement and interest, thus increasing motivation in his undergraduate students. Tinari and Khandke (2000) echoed this finding by adding that undergraduate freshman students involved in the analysis of modern lyrics from popular genres of songs enjoy this challenging type of lesson. The students reported that the music made the content easier to grasp because it is delivered in a familiar way. Tinari and Khandke's (2000) study involved integrating popular modern music in an economics course. Each student was required to analyze popular songs to determine how their lyrics pertain to economic concepts. At the end of the project, students were asked to briefly discuss their reaction to the music-based teaching process. The researchers found that the students enjoyed the process of using music in the classroom, and that its inclusion "likely enhanced their learning of economic ideas" (Tinari & Khandke, 2000). Students are

involved in the world of music outside the classroom; therefore, it is evident that most of these students grow up with western tonal music as a large part of their cultural identities (Spires, Lee, Turner, & Johnson, 2008; Dowling, 1993). It is evident through the research that appealing to the musical part of students' cultural identity can result in a wide range of academic benefits.

A related study conducted by Leck (2006) at The University of Pittsburgh at Bradford explains that psychology professors used music to teach personality theories. The basis of their research was that music was a powerful conduit for relating to students on a personal level. Students were required to analyze the lyrics of suggested songs and provide a detailed explanation of how that song illustrated a personality theory. For example, "When I Grow Up" by the Beach Boys illustrates the concept of personality change over time, and "Imagine" by John Lennon illustrates Maslow's Eupsychia. The resulting grades from the assignment and test suggested that the students found the assignment beneficial to learning, more fun, and interesting (Leck, 2006). Both the Tinari and Khandke (2000) and Leck (2006) studies demonstrate a trend with popular music being used in the classroom.

Much of the current literature regarding the use of music is practitioner-based, small studies, conducted in classrooms to inform practitioners on best practices. Few large scale or higher education studies are being conducted on music and intelligence. For the past seven years visual and performing arts have taken a back burner to the focuses set by Annual Yearly Progress (AYP) and No Child Left Behind (NCLB) legislation. These federal mandates have been concerned with standardized test scores, especially in the sciences and

math. Little federal research money has been given to researchers interested in studying the arts and music. This circumstance further explains why there are practitioner-based, action research studies surfacing from time to time, similar to the two discussed above and the Bryant-Jones study below, which do not require federal grant money to be conducted. As a result, companies like *Flocabulary* are using avenues like the popular press to promote and disseminate their innovative pedagogy.

The company *Flocabulary* is made up of two young New Yorkers who found a way to integrate rap music effectively in education. This company writes, records and distributes content-based songs in order to motivate students to learn vocabulary. Their concept is that many students in schools across the country are able to memorize hundreds, if not thousands, of song lyrics, but have trouble with the definitions of ten SAT terms. Blake Harrison and Alex Rappaport founded the company based on the notion that students are able to memorize and retain vocabulary words if those words are packaged in a way that is engaging and familiar - in this case, packaged in rap music. Thus far there is no research available dealing with the effectiveness of this music program in schools, however this literature review would suggest that using music to engage students and access their memory is an effective tool.

The study *Having Our Say* (Spires, Lee, Turner, & Johnson, 2008) surveyed 4000 middle schools students. These students were asked questions to determine what they believe they need out of school in order to be successful in the 21st century. Among the top ways that these students stated they could be engaged outside of school is through music (Spires, Lee, & Turner, & Johnson 2008). Middle grades students expressed that music is a genuine

interest and thus could be used to motivate and engage them if it were implemented in the classroom.

Multiple Intelligences

Howard Gardner (1983) defines intelligence as the ability to solve problems. He identified eight intelligences that everyone possesses - a kind of toolkit for solving problems. Gardner argues that intelligence is a dynamic collection of these many different intelligences. Each of these intelligences can be strong, moderate, or weak in every student. Music is one of these eight identified intelligences. Integrating different forms of music in the classroom both utilizes the capabilities of this intelligence and peaks the students' interest, especially those students strong in the musical intelligence (Weaver, 1993). If music is its own intelligence (yet one which everyone possesses), then to interact with music will surely increase students' problem-solving capabilities. While there is limited data to prove or refute the existence of these intelligences, it is always safe to take a pragmatic approach. The researcher can look at music-based activities implemented in the classroom in order to assess the level of student success. If a student does better in activities involving music, whether or not Gardner's theory is true, we must recognize that music is an important tool for learning.

One of the first examples that can be seen of a successful commercial venture to exploit this intelligence was "School House Rock." Schools and teachers teaching basic math and social studies concepts, mainly in elementary classrooms, quickly adopted this series of Saturday morning cartoons. School House Rocks is still being utilized today as a viable tool for increasing student motivation for learning math and fortifying important concepts.

Bryant-Jones, Shimmins, and Vega (2003) used Mozart, School House Rock, and teacher-made songs to engage low achieving second and fourth graders. The findings showed that the exposure to these three types of music in the classroom resulted in increased test scores and motivation. The question then remains about which of the three musical interventions was the most influential. Weaver (1993) ran a similar study looking at how using original music in a foreign language classroom can increase achievement and engagement. This study shows that instructors can utilize music that is specifically written for a content area. This type of lesson builds enthusiasm, which, in turn, motivates the student to be engaged in these dynamic lessons.

<div align="center">Creativity</div>

Music changes the way students interact in class, whether giving them a voice, aiding in their achievement or increasing their self-worth. There are a number of studies illustrating how music is beneficial to the creative mind (Uptis, 1992). These studies tend to show that people involved and engaged in music are usually considered to have an increased level of creative ability and awareness. Hamann, Baurassa, & Aderman (1991) used the Guilford and Guilford Consequences Form A-1 inventory to measure creativity in those high school students associated with music programs. They found that students who had increased and varied self-reported levels of musical experiences, such as training in an instrument or singing, rated higher on these scales than others with less musical experience. The study clearly suggested that the high school students who reported musical backgrounds had an increased creative capacity.

Wolff (1979) conducted a similar study dealing with music and the measurement of creativity. This study looked at the effects that 30 minutes of daily music instruction had upon first graders. This instruction consisted of simple rhythm tasks using percussion instruments, listening, basic music theory, and singing. Students were given these basic music lessons for one year, measured before the treatment and after the treatment using the Torrance Tests of Creative Thinking and with the Perdue Perceptual-Motor Survey. The findings showed significant increases in both creative thinking and motor skills, compared to the control group. This study also indicated that the creativity and physical expression of children could be enhanced by basic music education or participation.

Creative problem solving has been identified as a 21st century skill by the partnership for 21st century skills (http://www.21stcenturyskills.org/). The 21st century skills are attributes that corporations and businesses want students to possess as they enter the workforce from school. The Partnership for 21st Century Skills expresses a need for students to display creativity and innovation as they graduate. These students also need the ability to apply creative solutions to complex problems in order to be successful workers in the future. The onus is on the school system and teachers to build these skills in our students. It is evident that music builds creativity, which opens the mind to complex problem solving, so it could be considered a powerful tool for enhancing the instruction of 21st century skills.

<div align="center">Self Esteem</div>

Along with the motivation to succeed, and a better self-concept, it was found in another study that when students participate in a successful musical outcome, as a group, it

directly increases the student's self esteem, as measured by the Self Esteem Inventory (Vander Ark, Nolin & Newman, 1980). In a related study, Greenberg (1970) placed non-trained singers into a successful student choral group. Even though these non-trained singers could not stay on key or rhythm, they still had experiences that increased their self-concept. The students remained poor singers but felt good about their part in the final performance. Anshel & Kipper's (1988) study agrees. The findings from the test they ran showed that involvement in singing generates trust among people. They continue to find that trust and cooperation can be built through active participation in music more specifically, group singing. An essential element of student achievement, motivation and self esteem is that the diverse range of students in a typical classroom are made to feel connected to the curriculum, their peers, and the teacher (Alderman, 2003).

<center>Music and the Development Theorists</center>

Erik Erikson

In Erik Erikson's (1950) stages of psychosocial development he suggests that during stage four, industry v inferiority, students are becoming aware of themselves as individuals. Thus, many students, as they approach the adolescent age, become rebellious in order to help them better define themselves. It is important for students to take initiative for their own learning and be successful in this time of uncertainty so that they will have the self-esteem to succeed in the future. During this stage the teacher can provide an unique classroom atmosphere using tools such as music. This addition tends to level the academic playing field in many respects. Most students will have a pre-existing schema around music, and many

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will have vast experience singing along with songs in the car, in their room, or with friends. They are also accustomed to moving, dancing, and being active when music is present. Music can be an excellent tool for a teacher to use in the classroom during this stage in order to interest and engage a wide range of students.

According to Erikson, adolescence continues into stage five, Fidelity - Identity v. Confusion. In this stage, adolescents are overly concerned with how they are viewed by others and tend to tie their identity to their peer group and school. To engage students who are otherwise preoccupied with social concerns, teachers can introduce innovative and risk-taking styles of learning. The music-based method of teaching is unique and different. This method enables students to engage in the exploration of themselves, their academic and social lives and sends the message that is acceptable to explore ways in which they learn best and how those ways of learning define them. During this stage the students appreciate the nonconformity of a teacher approaching education in unique ways. These types of unique school experiences, according to Erikson, will help students create a well-rounded identity.

Charity James

Charity James (1974) finds that students feel a need to be needed. She suggests that students feel more like spectators of culture nowadays - a culture that has shifted away from requiring young people to work on farms or in factories in order to live. The failure to recognize and value contributions that could be made by early adolescents, if given the chance, has diminished the connection of parents and students. Middle Schoolers are anxious

to share classroom experiences with parents, but they need a language in which to talk to their parents about these school experiences.

According to James, students also feel a need for physical activity. Adolescence brings with it restless and bottomless energy that needs to be channeled so that it can be used productively in school. There is a need to develop classroom activities that break the monotony of lectures, note taking, and worksheets. Finally, students feel a need for belonging. Just as with Erikson's identity stage, James believes students need to create an identity for themselves by fitting into a group. A teacher could use music as a tool in the class to build a risk free, supportive and positive classroom atmosphere, one that would enable students to more easily fit in and participate in the group.

<div align="center">Summary</div>

The literature discussed this chapter reveals that there are two extremes in the effects of music on intelligence, achievement, creativity, and self esteem. Short-term increases in intelligence can be achieved by listening to music, while music training can result in increased academic achievement, creativity and self-esteem. However, according to both the practitioner and pilot studies described in the previous chapter, it is possible that using music as a tool for instruction (music-based teaching) results in increased student motivation, engagement, and achievement. Therefore, this study and original theoretical framework in Figure 2 was designed hypothesize and determine the effects of music-based teaching on both academic achievement and motivation in an 8th grade science class.
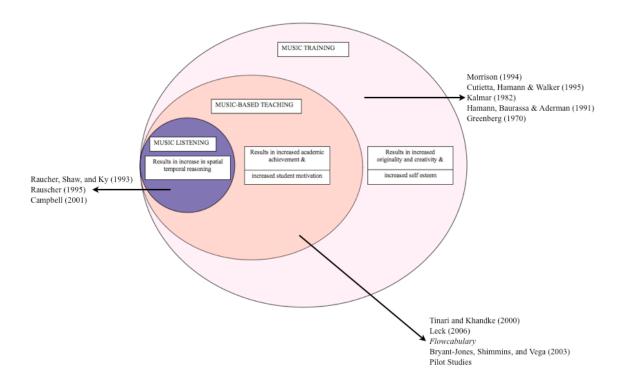
Figure 2. Theoretical Framework Including Literature and Pilot Studies

"Without music to decorate it, time is just a bunch of boring production deadlines or dates by which bills must be paid."

- Frank Zappa

CHAPTER III: METHODOLOGY

Research Goals and Questions

The purpose of this study was to determine the effects of using original music in teaching chemistry to 8th grade science students at a charter school in North Carolina. This mixed methods study looked at how academic achievement and student motivation are affected by the use of music-based teaching. The study was guided by two major questions:

Question One: Does music-based teaching increase academic achievement?

Question Two: How does music-based teaching affect student motivation for learning science?

The goals were to design a music-based teaching process that was tested to determine its impact on student achievement and motivation in an 8th grade science class. The 8th grade was selected for this study because it is a gateway year for students' in deciding about curriculum pathways when entering high school and then college. If students can be inspired to pursue science in high school, they are more likely to succeed in science courses in college.

The following sections provide an overview of the participants, mixed methods design, materials development, and data collection procedures.

Participants

The site where this study took place was a charter school in small suburban area just outside of a major city in North Carolina. According to the charter set forth by the state of North Carolina, the school has a maximum limitation of 100 students per grade. There are

approximately 1,200 full time students enrolled in this K-12 school, which has a strict dress code. School demographic data reveal that just over 90% of the school is Caucasian, which is well above the state average of 56% for North Carolina public schools. However, the student-teacher and male-to-female ratios are consistent for public schools throughout the state. More detailed information about the school and teacher will be provided at the beginning of chapter four.

The sampled group in this study included the 8th grade student population enrolled in science, a course that follows the North Carolina Standard Course of Study. The selection of the teacher for the study was based on convenience. Her participation was convenient and logical considering that she helped with the design of the content and supplementary materials for the music-based teaching process. She was also interested in implementing the process with her four science classes, regardless of the presence of a research study. The teacher has a master's degree in science education and has the highest regard for professional ethics and teaching standards as reported by her colleagues and administration. Though there may be issues of bias resulting from her connection with the development of the curriculum, the fact that all the classes that participated in the study had the same teacher removes issues associated with a teacher effect.

As a matter of further convenience, the teacher selected the student participants from her four 8th grade science classes. Two of the classes were randomly selected as the control group, and two were the treatment group. The details of this random selection are explained in the discussion around the study. The students were informed of the basic research goals

and procedures and then were given an informed consent form so that they and their parents could consider participation. Student participation was completely voluntary; however, the teacher conducted the treatment as part of her chemistry unit. Participation simply allowed the data from test scores and written prompts to be collected and analyzed.

Mixed Methods Design

A mixed method allows a researcher to collect a variety of data and make deeper, more meaningful connections than the use of one method alone. The use of qualitative and quantitative methods of data collection allows for both drawing a conclusion about the level of effect resulting from the treatment and telling the story behind the statistical data. According to Lancy (1993) a mixed methods approach is a superior methodology in many cases because of the rich conclusions that can be generated from its effective use.

The first question addressed in this study pertained to music-based teaching and its effects on academic achievement in science. One purpose of this study was to investigate the effects of the treatment on classroom test scores. Therefore, a repeated measures analysis of variance (rmANOVA) was conducted with the group (control or intervention) as the between subjects factor in order to determine differences in mean scores between the two groups, and time (pre and post) served as the within subjects factor to determine if the mean scores improved over time. A total sample of 76 students, including 35 control and 41 treatment students, was used for these analyses.

To answer the second question, students responded to a written prompt explaining the ways in which the music-based teaching motivated them. The teacher then selected students

based upon their favorable responses to the motivation and asked them to participate in a focus group. As the data were collected from the written prompts and focus groups, it was categorized based upon those responses dealing with motivation. Once these qualitative data were analyzed for emerging themes using a constant comparative analysis, the teacher was interviewed in order to confirm or refute these qualitative findings providing the third data source necessary for a grounded theory approach (Glaser, 1978). During the process of data analysis, a theory emerged from the mixing of these data sources. This method of data collection and analysis allowed the researcher to conduct a modified constant comparative method of generating a theory about the ways in which the music-based teaching process affects student motivation while constantly redefining the theory as new data comes in from the students. This grounded theory approach allows the researcher to operate in an experiment without being tied to a fixed theoretical framework - and possibly missing some essential data points because it does not fit into that framework (Bogdan & Biklen, 2003).

Integrating a qualitative component to this study was imperative to both the findings and the methodology. Because of the innovative nature of the intervention, it was important to hear the students' comments about how the music motivated them to learn. Such information cannot be simply extracted from quantitative analysis. It is just as important to discover the story behind what drives students, as it is to have found out what increases their achievement. The use of a qualitative writing prompt dealing with motivation was also necessary for the methodology because there were no valid and reliable instruments available

that would address these specific variables. The qualitative component further enhanced information about the innovative and new treatment.

Reliability

This music-based treatment is intended to be developed as a product that any teacher can implement in the classroom. Therefore, reliability is an imperative issue. Kerlinger and Lee (2000) liken reliability to dependable people, in that dependable people will be consistent with their behaviors. Reliability is necessary for this study because the researcher must be able to report that the outcomes will be consistent and reproducible if it is to be a product used in diverse classrooms.

Since the pre and post tests are identical, where the posttest is administered only two and a half weeks after the pre test, the reliability coefficient must be considered. Test/retest reliability can be a useful measure of stability over time as long as student attrition is low and the subjects are not experiencing profound developmental changes (Kerlinger & Lee, 2000). Both of these conditions existed in the study, thus the use of test/retest analysis was an appropriate approach when discussing reliability. There was no significant attrition and the treatment length was only two and a half weeks - not enough time for serious developmental changes to occur. Larkey and Knight (2002) found that the Birkman Method for measuring reliability was an effective measurement in a study where an identical test/retest was administered during a study dealing with personality assessments. The time between the test and retest was two weeks, and acceptable reliability coefficients were found. Therefore, it was reasonable to conclude that an identical standardized test/retest administered after two

and a half weeks would have similar reliability coefficients and would not have significant

reliability issues. Critics may suggest that a two-week test retest time frame is too short, as

student scores may improve simply because of their memory of the first test. This will be

accounted for and explained in the limitations.

Internal Validity

In order to report that it was, in fact, the music-based teaching that caused the change

in the dependent variables, threats to internal validity must be addressed and discussed.

Internal validity attempts to determine whether or not the treatment caused the significant

difference that was observed (Kerlinger & Lee 2000). Each threat to internal validity will be

explained and dealt with in order to ensure that the treatment caused the change in academic

achievement and motivation, and not a "rival hypothesis" (Graziano & Raulin, 1993).

First is the possibility that the test itself had an effect upon the students in the study.

Testing the participants, in and of itself, can change them (Kerlinger & Lee, 2000). However,

the pre and post tests that the students took for the study were similar to the tests that they

had taken throughout the course. Since the tests were so similar, this threat was diminished

because students were already conditioned to the in-class testing format. Even though the test

was a similar format, the students were taking the same test twice with the test/retest. This

pattern poses a problem because if a test is taken, and then two and a half weeks later taken

again, the participants are likely to remember the content (Kerlinger & Lee, 2000). To guard

against this threat to internal validity, Larkey & Knight's (2002) advice was taken, and the

students were not informed that the pre test was the same as the post test. In addition,

according to their study, they found that reliability coefficients were acceptable when giving identical pre and post tests, when administered two weeks apart.

Instrumentation threat can be an issue for two reasons. The first issue is if the instrument changes over time, causing the subjects to interact with the instrument in a different way (Kerlinger & Lee, 2000). This is not a threat to this particular study because the instrument is identical in pre and post form. The instrumentation threat can also be a problem if the students are more efficient with the test because it is given more than once. The outcome could be the result of their becoming better at answering these particular type questions and learning the general testing format (Kerlinger & Lee, 2000). This can be guarded against in two ways. The first way is to ensure that the format of the test is similar to what they have grown accustomed to throughout the course. This will alleviate the threat that the student performance was significantly improved just based on their familiarity with the testing format. The second way was to randomize the questions and answers in the post test, which was implemented. This created the illusion that the tests were different. It is additionally important not to inform the participants that the pre and post tests are identical (Larkey & Knight, 2002). This study suggested that the reliability coefficients were acceptable when giving an identical pre and post test in the course of a two week time span. All methods intended to limit the threat of instrumentation were implemented.

Second, the internal threat of selection can be an issue in studies where there were multiple participants who were selected and placed in either the control or experimental groups. To alleviate this threat, it is important that the researcher conducted random selection

of participants into groups and ensured that the groups were equal before the beginning of the treatment begins (Kerlinger & Lee, 2000). The teacher was selected out of convenience, which means that the students were also the result of a sample of convenience. However, the four participating classes were placed in either the experimental group or the control group at random, as discussed earlier in chapter three. In addition, the students were enrolled at the same school where there is no structured method by which the administration designates certain students to certain class periods. Therefore, periods four and seven can be considered as an equal group to periods one and three according to the parameters of this study. Statistical methods for testing whether or not the groups were equal will be discussed later in the limitations. The fact that the teacher was the same for all four classes helped further alleviate the selection issue. While this constant eliminated the teacher effect, it may have resulted in teacher/researcher bias as the teacher may have had more enthusiasm for the administration of the treatment. This will also be discussed further in the limitations.

The third foreseeable threat to internal validity was the result of social interaction between the experimental and control groups. The students were in two groups, but across the groups there would most definitely have been discussions and sharing of the treatment. In an attempt to control for this threat, two guards were implemented to minimize the effect of social interaction. First, the music-based treatment deals with both listening and interacting with the song. The music, taken out of context of the classroom and supplementary assignments, is not the entire treatment. If students were to share the song, then they would also have to explain the concepts, in context, and share the associated notes and homework in

order for the song to have the deep educational meaning and impact which the experimental group received. The likelihood of that happening is rather small with 8th graders. In addition, the students signed a waiver at the beginning of the treatment stating that they would not share the treatment with the other classes until the study had been concluded. Because of the ease of distribution of music, especially over the Internet, it is impossible to guarantee that the students would not share the songs.

External Validity and Associated Limitations

Once findings were reported it was important to consider whether or not those findings could be generalized to a larger population. If the social atmosphere in which the experiment took place was changed, then it was imperative to comment on whether or not the outcome might or might not remain the same (Kerlinger & Lee, 2000). The issue of external validity and its associated limitations was a concern in a study such as this - a study where the desired conclusion was to suggest that any teacher could use this method to increase academic achievement and motivation in their classroom. Each threat to external validity limits the generalizability of the study and was classified as limitations to the study.

The participating school was a self-select charter school in North Carolina. Parents filled out an application, and then applications were selected in a lottery to decide what students would be accepted. This was an anomaly among other K-12 schools in North Carolina, as a self-select school tends to be more homogeneous than a typical public school. As a result, there is limited ethnic diversity throughout the classes and the classes were kept small. The experimental group was made up of two science classes where *N=41*. Similarly,

the control group was also made up of two classes where *N=35*. This school was also unique in that it has a strict dress code, another characteristic not common among other North Carolina public schools. Finally, as discussed earlier in the sampling section of this chapter, this school was selected by means of convenience sampling. The participating teacher was a co-creator of the music-based curriculum and a colleague of the researcher. These factors are limitations in generalizing this study to any non-charter public schools, and more research may be needed in order to find if the same conclusions would be found in more "standard" schools.

Quasi experimental design places limitations on how the results could be generalized beyond the study. The fact that individual students, based on their fixed strata, could not be randomly assigned to the two groups studied could be seen as a limiting factor. However, in an effort to ensure that the experimental and control groups were equal before the treatment, statistical measures were implemented. A one-way analysis of variance was conducted on the pre test scores to ensure that there was not a statistically significant difference between the means of the treatment and control. This ensured that the final statistical analysis was appropriate and accounts for the differences between the groups.

The teacher effect, though somewhat controlled because of the participation of only one teacher, must be closely considered as a limitation. The possible presence of teacher bias, because of her close connection with the design of the treatment, could shape the outcome of the student's scores and reports about motivation. The teacher also played an integral part in the creation of this method and these materials, and it should be noted that she may have

brought a heightened enthusiasm to the treatment group that was not present in the two control classes. In addition, it is important to ensure that the teacher was upholding the integrity of the treatments; was she doing what she was supposed to be doing? Thus, to assure treatment integrity, the researcher made two unannounced visits during the treatment to observe how the study was being carried out.

The fact that 8th grade students might have been inclined to share the music-based treatment, and the ease at which the treatment could be shared, was both a threat to internal reliability and a limitation to the study. It would have been difficult to report and generalize results if part of the outcome were related to students sharing the treatment. Therefore an agreement was created and handed out by the teacher, signed by the students, and returned. This agreement stated: "as a participant in this study I agree not to share the music with the other classes until the study is over." It was difficult for the students not to play the song for their classmates, but the length of the study was short enough for this signed agreement to be effective, according to the teacher.

<div align="center">Materials Development</div>

The topic of chemistry was chosen based on a number of discussions the researcher had with various 8th grade science teachers. When asked, "What is the most difficult topic of the students to grasp in the 8th grade?" each teacher surveyed reported that, because of difficult terminology and the increased requirement for abstract thought, chemistry was the most difficult unit of study. Therefore, it was decided that a significant impact could be made in helping students with this challenging content if a teaching process could be applied that

lowered the barrier to learning 8th grade chemistry. The researcher then established a partnership with an 8th grade public school teacher and a professor from North Carolina State University; together they identified the key lessons from the first chapter of the chemistry unit. After the information was determined, the researcher wrote and recorded two songs that included within the lyrics all the curriculum information to meet the North Carolina Standard Course of Study, simultaneously the teacher designed a worksheet that explained the lyrics, line by line. The teachers' four classes were chosen randomly and placed into two groups (Treatment and Control). The treatment group used the music and lyrics worksheet to learn the material for the chapter, while the control group was taught in the traditional method that included lectures, notes, worksheets, and labs.

Data Collection Procedures

The study took place in early March, 2007, and lasted two weeks. During these two weeks the teacher implemented the music-based treatment with two of her classes, while continuing the traditional methods with her other students. This section will explain the independent and dependent variables, random sampling procedures, and a more detailed description of the process of data collection.

Four 8th grade science classes were selected to participate in this study. The four classes were placed into two groups using random selection. Four pieces of paper displaying "Period 1, Period 3, Period 4, Period 7" were placed into a basket. Two pieces of paper were drawn from the basket at random. These two drawn first were placed into the experimental group. Thus, periods four and seven became the experimental group. Periods one and three,

by default, served as the control group. The treatment group had an N of 41 (Periods 4&7), while the control group had an N of 35 (Periods 1&3). The treatment and control groups both had students of mixed abilities. In the treatment group there were five students with either Individualized Education Programs (IEPs) or Education Remedy Plans (504s) and required additional curriculum assistance courses, while the control group had seven students with similar modifications.

Once the groups had been randomly assigned, the treatment began. Each student in both the experimental and control group was required to take a thirty question pre-test consisting of questions taken from either the NC standard course of study test bank, supplied with the standardized text, or end-of-grade standardized review questions. The scores were collected and entered as pretest data. The teacher then used the recording of the song for the first two sections of chapter 13 as an introduction to the unit of chemistry with the experimental group. The students were supplied with lyrics, a web link to the song, and/or a CD so that they could listen and learn the music outside of school. The teacher used the song as an introduction each day of class and implemented the alterative notes (music-based handouts) for teaching the content with the experimental group. The "alternative notes" covered exactly the same information that was taught to the control group in their traditional, overhead notes. The organization of the content was slightly different for the alternative notes because they followed the pattern of the song.

The treatment spanned a full chapter, which consisted of four sections. Thus, the experimental group was required to interact with two songs and two alternative music note

sheets. All other requirements such as labs, quizzes, worksheets, review guides, and homework were completed by both the control and experimental group. In addition, both the control and experimental groups spent exactly the same in-class time on this chapter and took the same concluding test, on the same day, at the end of the treatment.

The posttest consisted of the same questions as the pretest and student data were collected. Following the posttest, the students were asked to answer this prompt in writing: "How did the use of music in science class motivate you during this chapter?" That data were collected and the teacher read through the responses to identify a group of students who would be better able to express their opinions orally. Once the teacher identified those students, she approached them about being part of a focus group. The purpose of the focus group was to extract a deeper understanding of how the use of music affected student motivation. Ten students were identified to participate in a structured focus group, which was conducted by the teacher, filmed, and then later transcribed by the researcher. The following questions were posed to members of the focus group.

1. What types of normal activities, in any class, motivate you?

2. How did the music motivate you during this chapter?

3. How did the songs help your remember the material?

4. Was this a good way to teach this part of 8th grade science? Explain.

5. If we had done one song for each chapter, would it have gotten old?

6. Was it easier or harder to learn using music than traditional teaching methods?

7. Did these music-based lessons motivate you to care more about science?

8. How did the music-based teaching change your view of the teacher?

Four methods were used to collect data for this study including pre and post tests, written prompts, a focus group, and an interview with the teacher. These methods were used to examine the effects on the dependent variables - academic achievement and student motivation for learning chemistry. The quantitative method addressed potential changes in academic achievement. The standardized questions taken from the North Carolina Standard Course of Study and end-of-grade review questions resulted in statistics that reveal the difference in student achievement between the control and experimental groups, between pre and post tests. Because there were no valid and reliable instruments to address the specific variables for this unique music-based treatment, the second, third, and fourth methods for collecting data were qualitative components used to analyze the student motivation portion of the study.

The first qualitative method resulted in data based on students' responses to a written prompt about how the use of music-based teaching motivated them to learn. The second data collection method was focus group interviews of students identified by the teacher. The focus group allowed for the collection of deeper answers to how the music motivated the students during this chapter. The final qualitative method was an interview with the teacher about the themes that emerged from the written prompts and focus group data.

Students' written responses to a prompt, focus group discussion, and the follow-up interview of the teacher allowed the researcher to conduct a constant comparative method of generating a theory about the ways in which the music-based teaching affects student

motivation while constantly redefining the theory as new student and teacher data were

analyzed. A Grounded Theory approach allowed the researcher to conduct the experiment

without being tied to a fixed theoretical framework - and possibly missing some essential

data points because that specific data point did not fit into a fixed framework (Bogdan &

Biklen 2003). Because of the innovative nature of the intervention, it is important to hear

both the students' and teacher's remarks and to document them using a Grounded Theory

approach to tell the story behind the statistical information.

CHAPTER IV: FINDINGS

Chapter four provides the data as well as a discussion of the findings from the mixed methods approach of data collection and analysis as described in chapter three. Following a detailed description of the teacher and student participants, the rest of the chapter is divided into two major sections that correspond with the research questions of this study. In each of these sections, findings related to the research questions are presented and explained.

Participants

Teacher

The teacher who conducted this study, Marie, taught 8th grade science at a charter school in a small suburban town in North Carolina, within 20 miles of a major city. She received her undergraduate degree in biology from a small private school in Pennsylvania. After college she attended a state University and completed a Masters of Arts in Teaching, specifically in Science Education. She moved to North Carolina and taught 9th grade earth science and 11th grade physical science for two years at a large public high school in a major city. After two years teaching high school, she transitioned to her current employment at this charter school teaching 8th grade science and technology.

Marie chose teaching because it required only a one-year masters program after she completed her undergraduate degree. Completion of the masters would enable a teaching career. In her first two years of her career, Marie approached teaching as a job. Teaching was a means to an end – a way to have a job and make money. Marie explains that "I would just

get through the day and not do any more than I was expected to do. I was not a bad teacher, by any means, but I just did enough to get by without getting noticed."

When Marie started working at her current school, she still followed the same pattern as her previous employment until she was asked by the researcher to partner for this study. Her participation in this study required her to co-create songs, learn a new style of teaching, and use a new and innovative music-based curriculum. Marie pointed out that this was "kinda the turning point in my teaching career. Because once I started working with [the researcher] and became a part of making the songs and developing the curriculum…I got excited about it. That excitement came off in the classroom because this was a curriculum that we developed together and I was an integral part of it." From that point on, Marie no longer did the minimum. She went above and beyond what a lot of other teachers do and was at the opposite end of the spectrum in terms of extra participation and feeling pride in her teaching career. She has been so inspired by the work she has done with this study and other projects as a result, that she has taken a lead role in training other teachers at her school to use some of the tools that have been developed as a result of this study.

This study dealt heavily with music and song writing. For the purposes of generalizability, it was important that the teacher was as "normal" as possible in regard to music training. Most teachers across the country are not musicians, but they enjoy listening to music. Thus, Marie is representative of those teachers. She is an avid music listener but has no training in either instrumental or choral music.

Fuller Academy, the charter school where the treatment took place, was a K-12 public school in North Carolina. The school opened in 1997 as a K-2 charter school and was founded by an entrepreneur. The students attending K-5 at Fuller Academy were taught following a strict direct instruction model, including scripts for teachers and choral responses by students. In grades 6-12 the instruction deviates from the direct instruction and teachers are encouraged to diversify their instructional techniques to appeal to a wide range of learners.

The school does not have a diverse ethnic population. Approximately 90% of the students who attended the school are Caucasian, and the other 10% are minorities. Students who attend Fuller Academy were primarily from surrounding areas – rural North Carolina towns – and have parents who were often blue-collar workers. However, there were a significant number of parents who do not work and volunteer at the school.

One of the most unique attributes of Fuller Academy was that there was a high level of parental involvement. The school did not support bussing, thus parents must supplied a means for their students to get to school. This requirement raised the barrier for families wanting to attend. An additional barrier was that each family who wanted his/her student to be admitted to Fuller Academy must fill out an application. There are no requirements for admission, and there is a lottery to determine who is accepted each year. Despite these barriers, there are thousands of applications each year for only a few openings. For instance, in 2008 Fuller Academy would not accept any outside families. The school would conduct a

lottery to determine which siblings of current students they would accept into kindergarten and the few open spots in other grades.

<div align="center">Quantitative Findings</div>

Research Question One: Does music-based teaching increase academic achievement in science?

In this study *academic achievement* referred to classroom test scores – scores derived from teacher-assembled pre and posttests. These tests consisted of questions taken from either the North Carolina Standard Course of Study test bank, supplied with the state science text, or end-of-grade standardized review questions. A one-way analysis of variance (ANOVA) was initially conducted to determine if there was significant difference between the mean pre test scores of the control ($M=50.74$) and treatment ($M=51.05$) groups. Using the standard deviations in table 1, with the degrees of freedom (1,74), it was calculated that the F-statistic ($F=.008$) resulted in little confidence that there was statistical difference between the means of the pre test scores. The resulting *P-value* (.928), confirmed that there was no statistical difference in the pre test scores based upon significance of $p<.005$.

A repeated measures analysis of variance (rmANOVA) was conducted with the group (control or treatment) as the between subjects factor in order to account for differences in mean scores between the two groups, and time (pre and post) as the within subjects factor to determine if the mean scores improved over time. A total sample of 76 students including 35 control and 41 treatment students was used for these analyses. The means for the data used in the analysis appear in Table 1.

Table 1

Mean Test Scores (pre and post)

Group	Pre	Post
	M *(SD)*	M *(SD)*
Control (*n* = 35)	50.74 (11.27)	74.11 (11.56)
Treatment (*n* = 41)	51.05 (17.48)	75.63 (12.67)
Total (N = 76)	50.91 (14.85)	74.93 (12.11)

The means represented the average scores achieved by the two groups (control or treatment) on the tests (pre and post). Table 1 illustrated that the treatment group's mean (*M*=51.05) is slightly higher than the mean of the control group (*M=50.*74) in the pre test, thus the treatment group's scores, on average, were higher at the outset of the study. Additionally, the treatment group's mean score on the posttest (*M*=75.63) was higher than the control groups mean (*M*=74.11) suggesting that the students in the treatment group consistently perform higher overall.

Table 2

Summary of Analysis of Variance

Source	F	df	p	η^2
Group	0.11	1, 74	0.74	0.001
Time	271.17	1, 74	0.00	0.79
Time*Group	0.17	1, 74	0.69	0.002

Note. Significance computed using $p<0.05$

The repeated measure analysis of variance illustrated in table 2 shows the differing effect that time has on the intervention among different groups. Because there was a control group, there needed to be a two-way repeated measure ANOVA conducted to determine whether or not there was a significant difference in the changes of scores (pre and post) between the treatment and control groups. Looking at the p-value of the Time*Group ($p=0.69$), based on a significance being measured by $p<0.05$, illustrates that there was no significant increase or decrease in test scores of the treatment group compared to the control group. Additionally, the results of the rmANOVA revealed that the time main effect ($M=0.00$) was the only significant effect indicating that overall students showed significant improvement from the pretest to the posttest. However, the interaction between time and group was not significant.

Marie reported throughout the two-week music-based teaching intervention, while she was teaching using the music, that the students were struggling to adjust to a radical new way of learning. Prior to the 8th grade, many students had advanced successfully at Fuller

Academy where strict adherence to didactic direct instruction was often championed. Therefore, an innovative teaching method may require more than the usual adjustment time.

According to Marie, this treatment was quite a shock to many students attending a rather conservative, academically focused school. The teacher and students, just back from spring break, launched into singing and using lyrics of a song to learn science content – a strategy none of the participants had ever experienced. Throughout the two-week treatment, according to the teacher, students slowly adapted to the fast-paced teaching style and began to accept and participate in a new learning environment. The first few days were difficult as many students suggested that the teacher revert back to teaching with notes and workbooks, a process to which they were accustomed. However, the data collected in the qualitative writing prompt at the end of the study reveled that a high percentage (73%) of the students preferred the music-based teaching process to the traditional lessons.

Within the first week of the treatment, following the initial reports that the students were not comfortable with the music-based teaching process, it would not have been surprising if the findings had shown a decrease in achievement of the treatment group as compared to the control group. However, no decrease in the scores was present in the data.

<center>Qualitative Findings</center>

Research Question Two: How does music-based teaching affect student motivation for learning science?

The second question addressed in this study pertains to music-based teaching and its effects on student motivation. The data to answer this question were gathered through three

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qualitative means: 1) a written prompt which asked the students to answer the question: "How did the use of music in science class motivate you during this chapter?" 2) a focus group of ten students selected by the teacher based upon their ability to better express themselves orally, and 3) a cross-validation interview with the teacher once the data prompt and focus group data had been collected and themes had been identified in order to further explain the themes. The focus group was conducted and filmed by the teacher – the researcher was not present during the focus group. The students in the focus group were each asked eight questions, written by the researcher, related to the written prompt. The teacher sought to extract more in-depth information about how the music-based teaching affected their motivation.

The following guiding questions used to collect qualitative data for the study.

1. What types of normal activities, in any class, motivate you?

2. How did the music motivate you during this chapter?

3. How did the songs help your remember the material?

4. Was this a good way to teach this part of 8th grade science? Explain.

5. If we had done one song for each chapter, would it have gotten old?

6. Was it easier of harder to learn using music than traditional teaching methods?

7. Did these music-based lessons motivate you to care more about science?

8. How did the music-based teaching change your view of the teacher?

<center>Student Motivation</center>

Students' written responses to a prompt, focus group discussion, and the follow-up

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interview of the teacher allowed the researcher to conduct a constant comparative method of generating a theory about the ways in which the music-based teaching affects student motivation while constantly redefining the theory as new student and teacher data were analyzed. A grounded theory approach as outlined by Glaser (1978) allowed the researcher to conduct the experiment without being tied to a fixed theoretical framework - and possibly missing some essential data points because that specific data point did not fit into a fixed framework (Bogdan & Biklen 2003). As the data were transcribed and analyzed from the written prompts and focus groups, it was categorized based upon those responses dealing with motivation.

Each statement from the motivation prompt and focus group was analyzed and coded to determine if it applied to the students' motivation during these two weeks. What resulted were statements from the 41 students who responded to the written prompt and data from the focus group which suggested the different ways in which they were motivated by the music. From the data sets, five distinct themes emerged. As reported by the students in the treatment group, the music-based teaching process motivated them to learn science, participate in classroom activities, attend class, attend school, and to talk about science with their parents. Table 3 below summarizes the themes related to motivation that emerged from the students' written responses and focus group discussions.

Table 3

Themes derived from student motivation data

Intervention Motivated students	# of respondents (N=41)	% of reported responses	Examples derived from written prompts and focus group resulted in sub categories: the music…
…to learn science	15	37%	• Changed the classroom routine • Made learning fun • Lowered the barrier to learning
…to participate in classroom activities	6	14%	• Made the class more active • Made the material more fun and engaging
…to attend class	20	48%	• Made class more exciting • Made class more fun • Created a better learning environment
…to attend school	4	12%	• Made school more interesting
…to talk about science with their parents	13	32%	• Created excitement about sharing • Gave something in common to talk about • Compelled the students to teach the content
…in at least one of the categories listed above	34	83%	

The data in Table 3 were derived from a collection of unique responses from students

taken from a combination of both the written prompt and focus group. Each student response

in the written prompt and/or focus group was analyzed to determine what connection, if any,

there was between the music and their reported motivation during the chapter. A majority of the students (34 of the 41) reported that the music motivated them in at least one of five ways shown in table 3. The descriptive statistics are not meant to measure the efficacy of the treatment, but to help clarify the themes and how students responded to the prompt and focus group questions.

To learn

More than one third of the students reported that using this music-based teaching method motivated them to take a more active role in learning science. The students expressed an excitement about learning science and describe how they were motivated during the two-week treatment. An analysis of the written responses revealed that 37% of the students reported the music-based teaching motivated them to learn by changing the classroom routine, making learning enjoyable, and lowering the barrier to learning.

Students reported that the music-based teaching method motivated them to learn because it changed the traditional classroom routine. This routine, in the view of students, consisted of listening to lectures, taking notes, and completing worksheets. During the two weeks of this treatment the music created a dynamic environment that appealed to students with many different learning styles. For instance, Steven expressed in his written response that "[the music] was better than writing notes every day. It made me think more and understand [the content]." Timmy had a similar reaction to the music-based teaching method when we wrote: "the music in science motivated me to learn, because you don't just take notes the whole time."

The data also suggested that the music resulted in some students' paying more attention in class and attending to the details of the content because the process was unique and interesting. It was a welcome change for many students like Jeni who wrote in her response that she "enjoyed coming to class because we didn't do anything boring. I think since I love music so much that it made me want to learn." This strategy did not only motivate those students who were excited about new learning techniques, but also affected students like Cathy who expressed in the focus group that the music-based teaching did not make her care more about science, "but the change in every day class made me more interested in learning about science." These statements suggest that there were a variety of students who found that the music motivated them because it appealed to their desire for change in the classroom.

Marie reflected upon the experiment and shared her thoughts about the nature of the students' willingness to learn. During the interview she acknowledged that changing her classroom routine of notes and worksheets had a significant impact on students motivation for learning science. Her comments are included below:

> Specifically, it [music-based teaching] motivated them to learn because it changed up the classroom routine every day. Instead of coming into class and answering questions to a written warm up, they would come in, sit down, and I would play the songs and they'd get to sing. If they were well behaved, they might get to dance a little bit too. Once we got through the warm up, instead of doing overhead notes where they just copied and I just talked about them, we would use the lyric

worksheets to do notes and it was more engaging for them, it required more thinking because there were questions they had to answer. So, that was a change. I think with middle school kids the reason that changing up the routine may have motivated them was because as much as they crave consistency they also like change. So, I made a change but it was a consistent change. In that, we're going to change it to this, but every day you're still going to come in and listen to the song. And instead of doing notes, we're going to do the lyrics worksheet. It gave them that change but still kept the routine factor in there.

This concept of consistent change that Marie talks about is important. She was able to offer the students a unique experience, but still upheld the structure of the classroom that middle school students rely upon in order to be successful. Marie's comments not only mirror the student's comments about the music-based teaching but also reflect her understanding of her students, their needs, and the value of change with consistency.

Students also reported that they were motivated to learn because this teaching method made science content enjoyable during these two weeks. Donna wrote: "the music motivated me by learning in a fun way." Class was now a fast-paced learning environment with activities ranging from listening to the song to discussing the lyrics -akin to activities students tend to enjoy outside of the classroom such as listening to music and singing along. Kristen explained in her written response that "the music was so much fun! It motivated me to want to learn because the music was lively, fun and interesting." Monica's answer to the written prompt agreed, simply stating that "It was a lot easier to learn this way and I had

more fun doing it." This treatment transformed the typical science classroom into an enjoyable environment where students were sharing their enthusiasm for the content and were having fun being at school. Jeni further pointed out, writing that "it helped because I could sing it over and over again knowing that it was science, but it was fun. It also seemed that we had a lot more fun during class too and everyone enjoyed it!" Similar to Jeni, Karen found the songs to be motivational, but stated during the focus group that the music "helped me a lot on the test but the songs were a lot more fun, and I wanted to come to science class to learn the song or understand the lyrics better and then start memorizing the song." Timmy further suggested in his written response that the music made class more enjoyable: "it is much easier to learn when you are having fun." Timmy and Karen's comments suggest that not only did the students' enjoyment of the music result in their being motivated to learn, but it also made learning the chemistry material easier.

Marie commented on the notion that students are motivated to learn when they are enjoying what is happening in the classroom. Her reflection helps further explain how students reacted to this new teaching process.

It made it fun because they would go home and listen to the song. Listening to the song was learning the content just by repeatedly singing the songs and singing the words. A couple of them told me that they didn't mind doing the workbook because they had already done the lyrics worksheet, and the lyrics worksheet already taught them everything they needed to know so they actually enjoyed going home and doing

workbook assignments because they could do it so easily and they did not have to refer back to their textbook.

Marie's comments echo the student responses in that they enjoy learning through music, but also suggest that students were taking advantage of a lower barrier to learning the introduction to chemistry unit. The treatment group would go home and listen to the song, thus increasing their knowledge of their subject matter outside of the classroom because it was an enjoyable way to learn.

The final way that the music-based teaching method motivated these students to learn was that it lowered the barriers to learning the science content. Wendy responded to the written prompt by stating that "the use of music motivated me by making me want to remember everything. It is easier for me to remember the songs with information in them rather than just memorizing the information." This common phenomenon is the result of a concept discussed in chapter two. Dowling (1993) suggests that each student in America possesses a Western tonal musical schema which enables students' to learn through the listening of and interacting with music. This research would agree that using music in the classroom to learn content would result in student's accessing their musical schema in order to successfully retain the information in a song. Two students from the focus group explain this best. Brian said that "it is not like you hate the song and you try to get it out of your head, you try to keep memorizing it" while Wilson agreed that "there was so much to memorize and it was easy to memorize." There was ample evidence from the student responses both written and oral that showed that these students were utilizing this schema in

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order to better connect with and learn the introduction to chemistry content.

As evidenced in the written responses and focus groups, students found that using music made learning the information more attainable. Jeni commented in her written response that "I hate having to read chapters because I have problems focusing, but [the music] comes so easily" while another student, Brooke, wrote that "once you hear the song a few times it gets stuck in your head [and] that made for an easy way to remember what we were learning about." Both of these responses speak directly to the fact that packaging the chemistry content in a way that is engaging and familiar to the students made the material easier to digest. Craig wrote that the "biggest change in motivation was to study with the music – I studied more by listening to it." Craig' comment explains the ability music has to increase the amount of time a student is willing to study because studying takes on a whole new meaning when listening to music. Karen's comment agreed when she wrote, "the song helped me study. Every day I would come home after school and play the song. I wish the songs would not end because they really motivated me to learn and they were a lot better than notes." Another student, Kristen, had a similar response about how the music made studying more accessible and relevant by writing that she listened to "the cds or iPod as much as I could so I could study. The class is my fav[orite] due to the music." Donna also commented about how the music helped her study by writing that "the songs are easy to remember and easier to help me study. Every time I hear the songs, it made me want to sing it over and over again. So, by then I would understand everything in the song!" These comments explain how the music lowered the barrier to learning outside of the classroom.

On the other hand, Luke expressed in the focus group how the music lowered the barrier to learning in the classroom by stating that the music "was more motivating because I could actually follow what was going on in class and that's better. It made me want to learn more." This comment suggests that the music lowered the barrier to learning in the classroom as well.

During the interview with Marie, she theorized that the reason students were able to utilize this method of learning was that it offered a lower barrier to the information – a hurdle that many students could successfully tackle. She suggested:

> It lowered the barrier to learning because a lot of students in middle school and people in general are afraid to fail and if they think they're going to fail, especially in middle school, they would rather just not do anything and fail than try, and then fail. With this music, they know they can memorize songs so there was no reason they would have failed at this. So, they were willing to listen to the songs, sing the songs, and it resulted in [their] learning.

The music-based teaching resulted in an increased level of motivation for learning without the fear of failing. Kristen, Donna and Karen are students who indemnify this willingness to try without fear of failure that Marie is discussing. Their responses about motivation explain a "head-first" approach to this new method of teaching in that they jumped right in to using the music at home and connecting it with their lives outside of school by using their iPod as a tool for learning.

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To participate in classroom activities

A few students reported that this teaching method motivated them to participate more in class and to take an active role in singing, dancing and talking about the science content in the songs. Across the written prompts, 14% of the students reported that the music-based teaching motivated them to participate. Although only six students responded that the music motivated them to participate, Marie's statements about these specific students illustrates why this is significant. The motivation prompt responses suggest that students were motivated to participate more in class because they felt that they were more actively engaged in class, singing and dancing, while receiving the information and they found it easier to participate because the class and material were more enjoyable.

This teaching method resulted in students like Elizabeth being active participants in their learning instead of passive recipients of the information as evidenced by her writing that "it was fun to listen, dance and sing too." Students crave this physical activity and being active in their learning. The act of singing and the ability to move to the music motivated many of these students to engage and participate in class. Craig shared that "I also listened [in class] more. I participated more by singing instead of drawing pictures." Wilson had a similar view in his written response: "I was able to participate more in class by singing and analyzing what the lyrics meant." Singing was an engaging activity as William points out in his written response that participating "in class activities by singing was fun" and Brooke sharing that "It was more fun also, and it was fun to participate more by singing." These written student responses provide evidence that the music-based teaching method got the

students physically and mentally engaged in the classroom activities and resulted in an increased level of participation.

During the interview with Marie, she pointed out that one particular student who reported in this theme deemed further explanation because of the extreme nature of his circumstances. She explains that:

A small percentage of students were motivated to participate in class as a result of using the music-based teaching. I think that it's important to note that the students who reported being motivated to participate were the ones who needed that extra motivation to participate in class. One student, William, was new to the school and did not have many friends and was pretty socially withdrawn until we did this curriculum. He really enjoyed it. He likes music. Doing something that he felt comfortable with allowed him to feel confident in answering questions and participating in class, and he got excited to come to class. I saw a totally different child in William doing the music than before.

This excitement that Marie witnessed was evident, though understated, in William's written response. However, his willingness to increase his level of participation was a significant motivator and Marie's desire is that this "totally different child" will develop into a new learner who takes advantage of school opportunities.

The second reason students offered for being motivated to participate in classroom activities was that class was more "fun." Students found it easier to participate in class when the activities were enjoyable and familiar. Listening to music, singing in a group and

analyzing lyrics were for many students' fun diversions from the norm, and this difference increased their willingness to engage in science class. Elizabeth stated in her written response that "it motivated me to participate more in class because it was funnier. It was funnier because of the music. The music was interesting. It was fun to listen, dance, and sing too!" In additional to being fun, Elizabeth was suggesting that the music-based teaching process was "funnier" – which meant that it was both entertaining and enjoyable. Similarly, William wrote that the different teaching style energized the class to participate by stating: "it motivated me by knowing we were going to do something fun in class. Since [this is] the last period. I am tired and coming to class was fun." Clearly William found the music to be an engaging and enjoyable diversion when he could look forward to participating in something fun at the end of a long day.

Getting students motivated and engaged is a necessary step for learning to take place. Though there were a small number of students who responded that the music motivated them to participate, the teacher reported that these were the students who needed to be motivated. Many of these students were the ones who were disengaged throughout the year, and the music-based teaching method helped them reconnect with classroom activities.

Marie offers a middle school teacher's perspective on the subject of what happens to participation when students are enjoying the learning environment. She said that:

> Whenever students enjoy doing something in class, they are going to want to participate. Especially middle school, if it's something they enjoy, they want to tell you, and they want to participate in whatever they enjoy. So, if they are enjoying this

music based curriculum and singing the songs, because the songs lowered the barrier to learning, not only do they enjoy singing it and learning it, they want to take that opportunity to answer questions that they know they have right. That makes them feel good, and it boosts their self-esteem. That's what every middle school student needs.

The notion that the students are eager to share their experience when they are having a good time in class is evident in these enthusiastic responses from the students. Again, it is notable that William is part of this group of students who is further motivated to participate throughout this music-based teaching process.

To attend class

Students reported throughout the written prompts and focus group that the music-based teaching method motivated them to come to class and be sure to show up on time. The song was used as an opener each day at the beginning of class, and students did not want to miss singing or hearing the song each day. Marianela points out that "it definitely motivated me to come to class too. Mainly because I would look forward to hearing [the song] and watching [the teacher] sing it!" Also, the statements from the written prompt and the focus group explained a general enthusiasm that the music-based teaching created, and 48% of those students responded that the music-based teaching motivated them to want to come to class. The three main reasons reported for being motivated to come to class were that 1) the students were excited about the music, 2) class was fun, and 3) the music-based teaching process helped create a better learning environment.

It is a significant challenge for a teacher to create genuine excitement in the

classroom. The types of entertainment and diversions students have outside of school make it increasingly difficult for teachers to appeal to the interests of students. However, the use of music in the classroom created a rare excitement among the students in the treatment group. Karen wrote about her excitement saying "it motivated me to come on time because I wouldn't want to miss singing the song! They were great songs." Ellen also responded in the focus group that "it made me run to class instead of taking my time and being late." Luke echoed Ellen's response in the focus group stating that the music "made you want to go to science. We are doing this tomorrow and I can't wait 'til this!" Other students like Cathy and Toni expressed excitement about the chemistry content writing that "I enjoyed the packets we did, and I did want to come to science class every day to see what we would learn next" and "during this chapter the songs motivated me by making me look more forward to doing science class." These students are expressing genuine enthusiasm for being part of a science class and a real excitement for learning.

This excitement not only motivated these students to come to class but also encouraged them to get to class on time. Melissa's written response agreed that "this way of using music in science class really motivated me to be on time to class and look forward to the next days of class." Throughout the motivation prompt and focus group responses there were ten students who responded that they were motivated to come to class and arrive on time because they were genuinely excited about this new way of teaching and learning. For example, Tammi wrote, "it motivated me a lot because you didn't exactly want to come to class. When we were doing [the] music experiment, class was more exciting and fun so I

didn't mind coming to class on time." Another student, Taylor, wrote that "the use of music in science class motivated me to get here on time every day. I didn't dread coming to class because we didn't have to take notes." Gavin also wrote that "this curriculum made what might have been a boring chapter into a fun one. This made me want to go to science and get there on time." This evidence shows that these students who were motivated to come to class, arrive on time, and they also seemed eager to learn.

Marie explains an additional theory for why a student showing up to class on time, or early, is significant. She commented that:

Students, while using the music, came to class on time. That's really big in middle school because it's cutting into their social time in the hallways and talking to everybody. The reason they wanted to come is because they were excited to come to science class. They knew that we were going to sing the song and listen to the song and do the lyrics worksheets. If they did not come to class when the bell rang, then they would miss the song because as soon as that bell rang, I started the song. They also came to class on time because they were excited about learning science.

The idea that students would miss out on social time in the hallways to ensure that they received the full classroom experience is important. Many middle school students define themselves by their social interactions at school. However the music seems to have provided some students with an alternative identity. By rushing to class to be there on time, the students see value in wrapping part of their identity in something school-related.

Learning environments necessarily compete with environments outside of the

classroom. These outside environments are media-rich, fast moving and highly entertaining. In order to engage students we must supply some enjoyable aspects to learning in the classroom. Timmy wrote that "it motivated me to come to class so I could see my friend sing, but also so that I could have fun learning about science." Evidence provided in the student responses suggests that the music-based teaching method provided a fun and entertaining learning environment in which students wanted to come to class and arrive on time. This evidence suggests that the classroom was effectively competing with the fun and entertaining environments outside of the classroom.

Students reported that they were motivated to come to class and arrive on time because class was fun. Donald points out that "the use of music actually made me want to come to science because I knew I wouldn't have to sit and just copy notes the whole time. We were actually able to get into the subjects and sing about it and have fun." Another student, Sue, agreed simply stating, "the music was fun! I enjoyed and looked forward to coming to class every day." These responses illustrate that the students were more willing to come to class when the classroom is a "fun" environment that speaks to their interests.

Marie shares her thoughts on the impact of an enjoyable classroom by stating that:
It also motivated them to come to class because they had fun. And kids enjoy having fun. That's what they like to do. Having fun in science meant that they wanted to come and be on time so they could get all 50 minutes of their fun time but still learned. That was a pretty big deal.

This sentiment of having fun and still learning was a theme throughout the students'

comments as well. Timmy and Donald provided evidence that shows that an enjoyable

classroom atmosphere helps them learn and get into the material.

There were three notable responses that suggest the students were motivated to come

to science class because the music created a better learning environment. Earl stated in the

focus group that the teacher should "do this all next year for the entire two semesters that

way people will actually want to come to science class. They will be happier in class like we

were if you do this more." Luke responded to Earl during the focus group and added that "it

gets in your head plus it makes you happy to go to science class unlike the last few years."

Whitney simply stated that "it was easier to come to a relaxed class at the end of the day

when I am tired." These responses suggest that students who feel like they are part of a

supportive classroom community are more open to learning. Teachers should strive to create

more positive learning environments for their students, and this music-based teaching method

is one way of achieving this.

Marie points out that a more positive classroom environment had a significant impact

on one of the students who responded the focus group.

One student in particular, Earl is typically pretty quiet. He complains a lot. He never

really enjoys school and complains about coming to school…but he comes. He

always seems to be looking for something to excite him at school. He always says it's

not fun, it's boring. Using the music-based teaching, he said that it totally changed the

learning environment for him, and it made it so he liked coming to class. He enjoyed

learning in class and was actually happier in class when we were using the songs. He was up singing and dancing around the room. Even a year later when he sees me now, he still tells me that he is singing the songs. He doesn't really talk to his other 8th grade teachers, but this music-based curriculum made a pretty big impact on him, and that was pretty cool.

The music had a positive impact on Earl, and now he has seen the possibilities that school has to offer. Before the music, he was disengaged from the school experience. However, he values the experience of school, even beyond the connection with a particular teacher. Earl still values the experience he had in 8th grade science and knows that school is not always boring.

To attend school

In the written responses 12% of the students expressed that the music-based teaching motivated them to come to school. Sam stated that "I wanted to come to school to learn about the song," while Ellen wrote that "to be here to hear the new songs made me want to come to school." Though the responses in this category were the fewest in number, they were significant given the respondents. According to the teacher, when shown the list of these five students who reported this, three of the five students were at risk for dropping out, and this catalyst to alter school made a critical impact on their staying engaged. One such student, Nicole, wrote, "I understood it and remembered the song, but I didn't get the learning out of it. But it does motivate me to come to school and try and learn this way." Keith, another student identified by the teacher as being at risk for dropping out, stated that "Doing this

whole music thing made me excited to come to school and sing instead of taking notes."

Frank, the third at-risk student wrote that the music also "makes me want to come to school because we would be doing something we enjoy." Teachers often acknowledge that it is difficult to motivate the students who are in danger of slipping through the cracks in the educational system. According to the student evidence above, offering alternative ways of learning, appealing to students' learning styles, we can reconnect them to the education system and keep them from disengaging or dropping out.

In the interview, Marie shared the brief stories of the three at-risk students who were motivated to come to school as a result of being a part of the music.

> Using this curriculum actually motivated students to come to school. Though it was only a couple of students, it's important to motivate those students that are just average and go with the flow. Nicole was a student who was constantly late to school because she was doing her hair or putting her make-up on. It took her an hour to get ready. When we were doing the music curriculum lo and behold, she miraculously found a way to get to school on time. Keith was another student who was constantly late to school. He had actually been held back two times previously and when we did the music curriculum, he was on time to school. That was a very significant change especially because he was a student who had been held back. Doing this new teaching method really motivated him, and that was important because we needed to move him out of middle school and into high school. Frank was another student who was constantly late to school because he played hockey. He would be at ice hockey until

10,11,12pm and then would just come late to school. When we started doing the music in class, he came on time to school because he was excited about getting to go to science class.

Even thought it only motivated these three students to come to school, it DID motivate three of them to come to school. It is not clear, because I did this at the end of the year, if this carried over into high school. It might have got[ten] them into the habit of coming to school on time, and teaching is one of those professions that you never know the impact curriculum has on a student years down the road. It's very possible that these students come on time every day just as a result of doing this curriculum."

This explanation truly encapsulates the power of being a teacher. Each student deserves a chance at being successful in a classroom, and sometimes one success can change the life of a student. As Marie points out, a teacher may not know the extent of that impact for years, but each at-risk student should get a chance.

To talk about science with their parents

The researcher received an email from one of the parents whose daughter was in Marie's class. It read "there are a half dozen 12-13 year-old girls at my house for a sleep over – [student's] birthday, you know. So, what are they doing now? Singing [the researcher's] greatest science hits. No joke." This statement was intriguing, and this parent was later asked about his experience as a parent with the music-based teaching. He explained that his twelve-year old sings the songs and watches the videos all the time, that his ten-year old has

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memorized the songs as well, and that his five-year old joins in and sings whenever he can, mostly when they are listening in the car. This parent quizzes his daughter on the content in the songs and she is able to provide thorough explanations citing the lyrics and also by remembering the "dance moves" a peer did in one of the videos that illustrated a science concept.

This theme is particularly interesting because the adolescent years are generally wrought with a lack of communication between student and parent. Anything school related that increases that communication would tend to be positive. The responses in this category also reveal that the students were motivated to talk about science at home, whether with their parents, siblings, or friends. In fact, 32% of the students responded, only in the written prompt (ironically), that the music-based teaching actually motivated them to talk with their parents because they were excited about the music; they realized they had something in common with their parents, or they were compelled to teach their parents the science material.

It has been a common theme throughout the qualitative data that the students' excitement for the music-based teaching method caused them to be motivated in many different ways. Perhaps the most interesting, given the constant dramatic tendencies of adolescence, is that using the music resulted in students being motivated to go home and talk with their parents about what was happening in science. Albert explained, "it helped also involve my parents in what I was learning at school. Before I showed and sung the song for them they really didn't know what I was learning. They were surprised by how much I knew

by just learning the song." Cynthia echoed that point when she wrote, "I talked about science more often at home because I was more interested in science." Keith continued this trend stating that "I talked about science a lot at home, well, at least a whole lot more than I would have before." Frank agreed and wrote that he got to "take [the music] home and talk about it with my mom and dad, and it was very easy to explain to them" while Daniel stated that "the song helped me to talk to my parents about the class, and it made the class more enjoyable." These students all reported that the music-based teaching helped them establish a method of communication with their parents around a school-related topic. Wilson went so far as to say that he "talked about science with my parents as well because I sung it to my mom. She liked it a lot!" This type of interaction between student and parent seems rare, as many students responded that the music served as a catalyst for more communication at home.

Continuing to open these lines of communication, Tammi wrote that "at home you could talk about science/school and have something good to say" while Kristen shared that she would "talk to [her] parents about what we were doing in class. They seemed to like the idea of music/science." Each of these responses is suggesting that the music was helping to build a positive line of communication between student and parent outside of the school environment.

Marie explains why students were motivated to talk to their parents based on her experience from doing the treatment, and comparing it to her experience this year.

Students were motivated to talk to parents because they were excited about the music. Not only to talk to their parents, but their siblings as well. Actually this year, doing

this music curriculum again, I have three siblings of students from last year. All three of them already know the songs. This was because last year the students doing the study made their families listen to the songs.

The students also suggested that the music provided a common language in which they could use to talk to their parents about what was happening in science class. Most people enjoy music and have deep connections with the melodies of what Dowling (1993) calls Western tonal music. Students reported that they were able to talk to their parents about the music in the classroom, and the parents were interested and could relate. The singing provided the alternative language for those students to be able to better communicate their learning with parents. Wilson wrote, "I talked about science with my parents as well because I [sang] it to my mom. She liked it a lot!" Heather had a similar experience stating, "I even got my family involved because I would sing to them!" Kevin also wrote that "singing songs motivated me because I sang to my family, and I actually got to do something fun instead of taking notes." Providing this neutral common language of song and singing seems to motivate students to connect with their parents thereby making it easier to communicate what was going on in their science classroom.

The final reason students reported being motivated to talk more with their parents was to teach their parents what and how they had been taught. Only two students wrote about this specific motivation, but is important to mention, based on the respondents. These two students were so moved and inspired by this music-based teaching method that they took it upon themselves to not only talk about it with their parents, but also attempt to teach their

parents by using it. Carol pointed out that "I also never talk to my parents about science, and it motivated me to talk to them more and that also helped me teach my parents." Karen stated a similar desire stating, "the music motivated me a lot. I loved teaching my family about the songs."

Marie explains the back-stories of two responding students. The two students have very different home lives, but had similar experiences while interacting with this music-based teaching.

Karen is a very energetic person, so it makes sense that it motivated her to teach her parents the content connected to the song. She's very talkative. It made sense that she would go home and talk to her mom and sister. She was always very animated in class, always singing the songs and trying to get everyone else to sing along. She has a great relationship with her family, so it's no surprise that she would want to go home and teach what she had learned, using the songs.

However, another student, Carol also reported that using the music curriculum motivated her to talk to her mom. Not only talk to her mom, but also teach her the content. That one surprised me because Carol's mom has some alcohol abuse problems, and there was a recent divorce in the family. There was lots of tension between her and both of her parents. It's significant for Carol that she was able to find something to talk to her mother about. Especially in middle school because girls crave that relationship with their mother. Even more than just teaching content, it helped to build her home relationship, which is something schools are always aiming to do –

we just don't really know how to do it. It was significant that Carol was able to use

the music curriculum to start to rebuild that relationship with her mother and father."

The idea that it is the school's responsibility to help sustain and build the relationship

between the child and parent is a concept that has unfortunately been buried by the large

school systems throughout the country. Teachers do not have the time to teach to the test, let

alone know the family situation enough to help. Marie's comment is important because she

was able to use engaging content to increase her ability to serve not only the student but the

parent as well.

CHAPTER V: DISCUSSION

The purpose of this study was to determine the effects of using original music in teaching an introduction to chemistry unit in an 8th grade science class. This mixed method study looked at how academic achievement and student motivation were affected by the use of music-based teaching. The study was guided by two major questions:

Question One: Does music-based teaching increase academic achievement?

Question Two: How does music based teaching affect student motivation for learning science?

The goals of the study were to design a music-based teaching process and test it in a public school classroom in order to measure its impact on student achievement and motivation. The quantitative data, consisting of pre and posttests, were analyzed using a repeated measures analysis of variance (rmANOVA). The qualitative data were collected from the students through a writing prompt and focus group. These data were transcribed, coded and analyzed to determine themes. Once those themes were identified, the teacher was interviewed for cross check validity in order to obtain more detailed information about the themes and student responses.

This chapter will discuss the results of the study and the mixed methods data. These data were analyzed and can be used to inform the current literature about the importance of music-based teaching as a process that has similar results to actual music training. However, additional information will suggest that the unintended data from this study have the most impact for the use of music in the classroom. This discussion will end with suggestions for

further practice and research as a result of these new and innovative ideas about music-based teaching.

Discussion of Findings

Much of American education is seen as disconnected, dull, and antiquated in the eyes of many students. Their dislike for the traditional rote memorization, note taking and the worksheet-driven classroom is apparent in some of the responses collected in this study (Ames, 1990). However, it is also clear that the students are accustomed to traditional methods of learning but are able to appreciate learning in new ways. They realize that it is important for the teacher to create a positive, active, and unique learning environment for them to be motivated and engaged. It is also imperative that teachers motivate and engage students for them to be successful in the 21st century, given that motivation is the key for middle school students' future success (Anderman & Maehr, 1994). This study was a successful attempt at motivating students and their teacher by using a new, innovative method for teaching and learning, using music.

Marie reported that she found that using the music-based curriculum appealed to those students who normally are not excited about learning: this music motivated those "students that usually just come to class and do their thing." It is extremely important to find teaching methods that appeal to those students who fall in-between the educational cracks in order to provide a valuable learning experience for all students. Marie continues, stating that "there are gifted programs, and special education programs for students at the extreme ends of the spectrum, but there is not a lot geared toward those kids that just come to school and

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go through the motions and don't get as much out of it as they could." This music-based curriculum motivated the adolescent student who may see school as disconnected, dull and antiquated.

Question One: Achievement

Question one addressed student achievement and required a quantitative method in order to measure these data. The pre and posttest data were measured in order to test for changes in student achievement as a result of this treatment. The repeated measures analysis of variance (RMANOVA) showed no significant change in test scores, from pre to post, between the treatment and control groups. This section explores possible reasons for the lack of significance.

Dr. Chris Dede, the Timothy E. Worth professor at Harvard University, was the discussant of a symposium "Navigating New Literacies" at the American Educational Research Association (AERA) in March, 2008 where this study was first presented. Dede is a well-known researcher in the fields of learning technologies and educational innovation and is connected with both research and development of new tools for 21st century classrooms. Following this presentation, Dede remarked that he was not surprised by the lack of quantitative results from the data collected in this study. He continued by suggesting that it is important to develop new and innovative curriculum that peaks the interests of students today. Music, he said, "is an interest that appeals to almost every learner". However, using new and innovative approaches in teaching has a fundamental problem when attempting to measure their effects using standardized means. The teacher-created test used in this study

may not be robust enough to measure the effects of music-based teaching method. The music may be creating a variety of educational benefits that cannot be measured by a standardized instrument. For instance, the literature suggests that simply listening to music creates a short-term increase in spatial-temporal reasoning skills – however, these cognitive skills are not measured by today's standardized tests. A standardized measure only successfully assesses mainstream, traditional ways of learning. Thus, by being presented with such an unconventional method of teaching, it is no surprise that the students in the treatment group did not perform significantly higher on the standardized measure of achievement.

The setting of the study, Fuller Academy, is a conventional school, and innovative teaching is not common practice in the classrooms. The environment is a traditional one which has a strict dress code and regimented adherence to the direct instruction model for teaching and learning, for all students, up to the fifth grade. Direct instruction is a didactic and structured way of teaching that is embedded in Fuller Academy students during their formative years and results in many focused and high performing individuals. However, direct instruction does not lend itself to creative expression in the classroom and might be a detriment to the students' success in the 21st century workplace – an atmosphere that requires creative problem solving and critical thinking.

When the treatment began, the teacher immediately reported that many of the students were uncomfortable with such a drastic change to their classroom routine. In fact, a few students in the treatment group asked if they could switch back to learning with overhead notes and lectures, even going so far as to say that they were scared that they were going to

fail the test because of the new way of teaching. However, by the end of the two-week treatment, most of the anxiety had disappeared, and the students were enthusiastic participants in this innovative method of teaching and learning. According to the teacher and the students' written responses to the motivation prompts, only two high achievers still had complaints about learning through music. These two students reported that they preferred learning with lectures and notes; their grades, however, did not suffer during those two weeks.

With the presence of this anxiety, the students' slow acceptance of the music-based method of instruction and such a short treatment, it is somewhat surprising that the RMANOVA did not show a decrease in academic achievement for the treatment group. This experiment lasted only ten consecutive school days and, according to Marie, it took many of the students two or three of those days to adjust. Therefore, with 20-30% of the treatment time being transition or adjustment time, it is probable that the study, if repeated without that period of adjustment, would have found significant quantitative results showing an increase in academic achievement for the students in the treatment group.

The two-week time span of the study was additionally problematic because it is generally difficult to determine significant changes between groups in such a short period of time. This amount of time was selected based on instructional convenience and the limited amount of materials. When including teachers in a study, researchers must be flexible in the amount of time they can ask a teacher to spend away from testing preparation and pacing guides. Thus, it was most convenient for Marie to conduct this study during the selected ten

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days. Also, the researcher and teacher had a limited amount of time to prepare materials and had completed songs for only one chapter, which typically requires ten days for her to teach.

Given a longer treatment period, with limited time for student adjustment, different results may have been found. Marie and the researcher collaborated after the study had been completed to create additional music-based lessons for 8th grade chemistry. They created five songs that taught three chapters dealing with changes in states of matter and the periodic table. The music-based teaching process using these songs lasted for the rest of the semester and the teacher reported that overall grades continued to rise as the year came to an end. During a conversation with Marie, she attributed the continual rise of students' grades to the music and that the students had adjusted to the new style of learning and were succeeding. In response to the lack of results from the quantitative data, the research shows that motivating students will undoubtedly result in academic achievement in the long run and a detailed assessment of motivation is needed to get a complete picture of the results (Ames, 1990).

Question Two: Motivation

Question two required a qualitative methodology to collect and analyze student and teacher written and verbal data. The students were asked to respond in writing at the end of the ten days to the prompt: "How did the music motivate you in science during this chapter?" Following the written responses, Marie then selected ten students she thought were better at oral expression than written and conducted a focus group. Marie was also interviewed for crosscheck validity regarding the student responses, both written and oral. These data uncovered themes that illustrate that the music-based teaching motivated the students in five

distinct ways; to learn, participate, come to class, come to school, and talk to their parents. This section will discuss the meaning across the five themes.

Themes from the student responses identified in chapter four were strong and unexpectedly clear. The students' statements throughout the motivation prompts and focus group were powerful indicators that this treatment was an engaging and motivational way of learning. In addition, Marie's responses in the follow-up interview uncover information about individual students and how the music-based teaching affected them in significant ways.

It is a struggle for many teachers to provide a unique learning experience for their students. The structures set in place by the state and federal system, consisting of standardized tests and pacing guides, inhibits the ability of a teacher to deviate from the "normal" routines. However, it is clear from the data in this study that students crave differentiated learning and teaching styles in the classroom. Students have multiple learning methods and tools outside of the classroom because of their ubiquitous access to the computer and other media technologies available to American consumers. These tools allow the student to participate in dynamic experiences while learning content and skills. However, according to research, our schools rely heavily upon the traditional more direct methods of teaching and learning, which creates a disconnect for our students (Spires, Lee, & Turner, 2007).

The themes in this study uncover what results when a teacher connects classroom content to activities and literacies that students use outside of school. Using music to learn 8th

grade chemistry was a radical change for these students – a change that was accepted and appreciated. The adolescent years are covered in stage five of Erikson's (1950) Psychosocial Development Theory. In this stage, the teacher can play the role of the parent introducing innovative and risk-taking styles of learning. Marie, in this case, used the music-based teaching method, which was extremely new and different from what the students were used to. By the teacher's modeling risk-taking in teaching, the students learn that is acceptable to venture "outside the box" in their learning. It is clear from their writing and focus group discussions that the students appreciated and thrived in this unique and enjoyable learning environment. More than 70% of the students in the treatment group reported that they enjoyed the music-based teaching process. These data was unsolicited, meaning that the students were compelled to express their enjoyment in the motivation prompt and focus group even though they were never asked whether or not they liked the new method of teaching. The music provided a welcome change in the classroom and caused many students to remain motivated and engaged – especially since the change appealed to their interests outside of the classroom.

The music was unique because it was intrinsically motivating for many students. Music has a power over most people; and, when they hear a familiar song, it elicits strong feelings, emotions, and memories. Music also causes people to be active, whether singing along, tapping a foot, rapping fingers on a table, or dancing. James (1974) suggests that students have a need for physical activity. Students, especially adolescents, crave activity throughout their school day. They have abundant nervous energy that needs to be channeled

and expelled in order for them to focus in the classroom during traditional activities. The music-based teaching method provided a process for releasing some of that energy while learning science content. Students reported that a more active classroom engaged and motivated them because they were free to sing, move around, and dance.

The presence of student engagement in the learning process is a fundamental attribute of any successful classroom. It is evident that the music-based teaching resulted in increased student engagement as reported throughout the students' writing and their oral responses during the focus group. Students reported being truly excited about what was going on in science class, and this enthusiasm caused them to rush to class, arrive on time, sing in the hallways, talk about science outside the classroom, and anxiously wonder what was going to happen next in school. When students are motivated and engaged in their learning, they are more open to the idea of learning. According to the research, motivation is the key to getting students to be committed to learning, and when students are excited about coming to school because of what is going on in science class, they are more likely to succeed (Ames, 1990). They are attaching part of their identity to school and learning to appreciate that school can be a great place and that learning can be an enjoyable and dynamic event.

Not only does adolescence begin the downward spiral for many students' grades and attitudes toward school, but it also marks a period when the relationship between parent and child begins to deteriorate. A large number of students reported that participating in these music-based lessons motivated them to go home and talk to their parents about science. The music in science gave more than a third of the students in the treatment group a reason to talk

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to their parents about something positive and exciting that was happening at school. According to James (1974), American students have a need to be needed. She contends that many students today feel as if they are simply passive spectators of culture. However, the Internet and the recent surge of web 2.0 technologies are changing students' views of themselves as young people and they are becoming extremely engaged in creating the new culture online. Students being disconnected from traditional culture and participating in new culture online has diminished the connection of parents and students, especially in the middle grade years. It seems, based upon the findings of this study, that music-based teaching can play a part in repairing that disconnection.

These data are significant for a number of reasons. From the researcher's experience in the classroom, when parents are more aware of what is happening in the classroom, they are more supportive of those activities at home. Parents who are more supportive will end up playing a more active role in their child's school life by doing things like making sure that their child has homework completed for the following day and helping with assignments. Also, if students come home and express excitement about school, it may motivate the parents to be more involved in school activities as well as be willing to offer support for their teacher. The more active and supportive a parent is in the life of a student, the more successful that student will be in every facet of their education.

From a practitioner's perspective, the most encouraging result from the data is that this treatment seemed to lower the barrier to learning science content. Many students struggle to memorize massive amounts of information each semester in order to pass a test or quiz.

That information is then mentally stored in hopes of being retrieved later to answer questions on a state mandated test at the end of the year. With all this focus placed upon rote memorization, less time is spent on more cognitively advanced skills such as critical thinking and problem solving. Similar to the findings of the company *Flowcabulary*, the music-based teaching lowered the barrier to learning by making the content more digestible to the average learner. Dowling (1993) would argue that this result can be linked to students' utilizing their Western tonal schema when processing musical content. This experiential processing frees up time and mental energy for higher level thinking activities required in science labs and simulations. The students could use the music to absorb and retain information, and proceed confidently to the higher, more cognitive, thinking skills – resulting in more advanced thinkers. Not only does the music lower the barrier to learning, but also provides a motivational and engaging experience. The students participating in this learning process are eager to participate in a wide range of activities in the classroom that will prepare them for the 21st century.

Theoretical Framework: Filling the research gap

The theoretical framework in Figure 1 postulated that music-based teaching results in increased academic achievement and motivation. The small circle on the left labeled "music listening" summarizes the finding in the literature that suggests listening to music results in increased spatial-temporal reasoning skills. The largest circle in the diagram indicates the literature-based findings that music training, whether instrument or singing, results in all attributes in the smaller circles as well as increased creativity and self esteem.
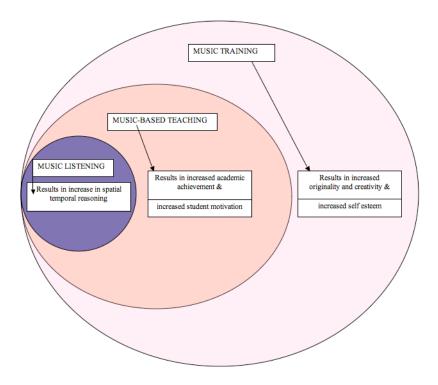
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Figure 1. Theoretical Framework

This study operated on the theory that implementing a music-based teaching process in an 8th grade science class would result in an increase in academic achievement and student motivation. The literature suggests that both academic achievement and motivation are increased as a result of students who receive music training – and not students who simply listen to music. The researcher was attempting to study a music participation model in the classroom called music-based teaching, which was more involved than just listening but less comprehensive than music training, and assess the impact it had on academic achievement and motivation.

The findings from this study illustrate that there was no significant increases in academic achievement as a result of using the music-based teaching method to teach 8th grade science content. Thus, in the framework, academic achievement should be moved into the area for the largest circle and continue to be the result of music training as seen in Figure 3.
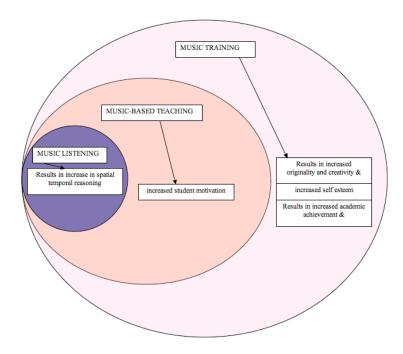
Figure 3. Theoretical Framework Post Study

However, this research did find that using music-based teaching resulted in increased student motivation in five distinct ways. Students were motivated to learn, participate, come to class, come to school, and talk with their parents. In short, this study fills a gap in the research finding that music-based teaching in an 8th grade science class increases student motivation in these ways. The findings in the study are significant because they create a

middle ground for the impact of music in the classroom. Previously, teachers could have their students listen to music and, according to the research, it would increase temporary cognitive skills. Also, teachers could identify students who had received training in music and expect them to have increased academic achievement, creativity, and self-esteem. However, this research creates a new and innovative middle ground called music-based teaching for effectively using music in the classroom to motivate students in many ways.

<center>The Rest of the Story: Unanticipated Results</center>

While reflecting across the themes that emerged from the student response data, Marie offered a more detailed explanation of four students. These students were extreme cases according to how they were affected by the music-based teaching process during the treatment. She thought it was important to provide a more detailed profile of these students, beyond their written or focus group responses.

> Steven is one of the students who was probably most profoundly affected out of all the students while using this curriculum. He is already pretty motivated to come to school and very excitable, but always had a really hard time learning content and succeeding on tests. Using the music-based teaching was his niche. He passed a test for the first time, in science, all year. He would go home and tell his dad and mom about the curriculum. It was some pretty significant changes for Steven. He was actually doing his homework. He was doing better in other classes as well because doing better in science boosted his confidence in himself. He started doing the

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homework in language arts and history, whereas before he would not do it so he had an excuse to fail. It's pretty amazing.

Donna was not an overly outgoing student. Even with the curriculum, she was not overly outgoing. But on a personal level, she really connected with using the songs and being able to learn the content that way. She did much better on tests, started doing her homework, and participating more in class because she was learning using the songs. Before, she would sit there quietly because she didn't know any of the answers. She did not learn well using traditional styles of teaching.

Cathy was one of those students who was very average. She did well, but never really stood out in any class. Using this music-based curriculum, she really started to enjoy science and became very inquisitive. This year she is actually my teacher's aid. She comes in every morning and helps me in the classroom setting up labs and things like that. It's because she really enjoyed the music, and that made her enjoy science. She is currently taking extra science courses and tells me that she wants to go to college for science. She told me that was because of her experience in 8th grade science and because of the music-based curriculum. That's huge. It helped her possibly determine what she wants to do for a career.

Donald was pretty close to failing science before we stared the music curriculum. Not because he did not come to class, but because he didn't do any work. With the music curriculum he was able to learn the content much easier and found it easier to do the assignments and participate in class. He managed to pull off a C for

the quarter. So, that was huge. At the beginning of the year he was in biology studying about cells, and he told me that he started singing the cell song that we did toward the end of the year. He told me that he remembered the song and was singing it during the test in 9th grade. Pretty cool.

Marie shared this additional information about these students because she found that using this curriculum has appealed to many different kinds of students. It motivated those "students that usually just come to class and do their thing" and also students like Steven who needed this new style of learning in order to succeed. It's important to find teaching methods that appeal to those students who are not engaged in class in order to provide them a valuable learning experience and show them that learning environments can be dynamic and interesting. Marie continues, stating that "there are gifted programs, and special education programs for students at the extreme ends of the spectrum, but there is not a lot geared toward those kids that just come to school and go through the motions and don't get as much out of it as they could." This music-based curriculum motivated students like Steven, Donna, Cathy, and Donald by providing a unique learning experience that encouraged them to be engaged in this new teaching method.

The following story was adapted from Marie's letter to the researcher, which was presented in a video developed for a research presentation (McCammon, 2008).

Marie obtained an undergraduate degree in biology from a reputable college and a Master of Arts in Teaching from a major state University. Her original plan after the undergraduate work was to become a physical therapist. She decided that the three-year

program was too long so she opted for a one-year program to get a master's degree in education. Marie is not one of those people who always knew she wanted to be a teacher.

Her first teaching job was at Crabtree High School, where she met the researcher. Marie taught 9th grade academic earth science and 11th grade physical science and, while she was teaching at Crabtree, she described herself as "less than extraordinary." She actually planned on teaching in North Carolina for two or three years just so she could return to the northeast and get a job there. So Marie looked at her job at Crabtree as a means to an end.

Marie often described her teaching style and personality at Crabtree as "ordinary". She never did anything to make herself stand out, and she did what she was supposed to do – nothing above and beyond. The most "extra stuff" she did at Crabtree was send an email to parents every Friday about what the class was going to do in the upcoming week.

Marie knew she did not want to stay at Crabtree, which led her to the newspaper, looking for jobs. She found an advertisement for a charter school called The Fuller Academy, and it said 'we pay more than Cook County'. That was all it had to say: her application was sent. Seven months later Marie had changed jobs and was a middle school 8th grade science teacher.

The Fuller Academy was a significant change for Marie. It is a small charter school in suburban North Carolina. The students wear uniforms; parents are responsible for getting their kids back and forth to school; the school has no cafeteria; K-5 teachers use direct instruction to teach; and it was middle school and not the high school atmosphere to which she was accustomed. As a new teacher at this small school, Marie's first reaction was to stick

to herself. She found her curriculum and started doing what she had done at Crabtree –
teaching just enough to do well and not be noticed. Marie blended in with the rest of the
school.

About half way through the school year, the researcher approached Marie and told her
that he had decided to write a music curriculum and test it in a classroom. She had never
worked closely with the researcher before. When they taught together, he taught economics
and she taught science, but she had listened to some of the songs he wrote for his classes and
knew the students enjoyed learning with them.

The researcher asked Marie if she would help him create a music-based curriculum for 8th
grade science, specifically chemistry, and then conduct a study on its effects in her
classroom. That seemed like a huge undertaking to Marie, and she considered the
ramifications. Saying "yes" meant that Marie would have to 1) try something new in her
classroom, 2) take a risk that it would not work, 3) spend time teaching the researcher the
curriculum so he could write the songs, 4) teach two different lessons, one with music and
one without, and 5) step outside her comfort zone in the classroom. This choice was outside
Marie's job description and that made her nervous. However, saying yes to conducting this
study also meant that she would 1) have a chance to help students who do not learn well with
traditional teaching methods, 2) have a chance to try something new that has never been done
before in teaching, and 3) have to step outside her comfort zone, which she realized was
really good for her to do.

In March, the researcher and Marie sat down, and she taught him the first two lessons of chemistry, dealing with the topic of matter. A few days later he had written the song and uploaded it to the Internet and Marie absolutely loved it. She had never been so excited to teach a lesson.

March came around, students came back from spring break, and it was time to start the songs. While using this teaching method, Marie saw many changes in the students. They were more excited to come to science class; they were better able to answer questions because they understood the material; and they had their homework complete because they understood the material. Many of them thought the music was not "cool" at first, but once they learned the song, they were singing it in the halls, singing it at home, and putting it on CD and listening to it in the car.

Marie used the songs to teach two of her classes, while the other two were the control group of the experiment. The other two classes did the regular, non-music curriculum. She basically used the songs and handouts instead of overhead notes and after a short period of adjustment to this new and innovative style of teaching, the students were loving it. They were singing it in the hallways, on their way in the room, and were telling Marie how they were even singing it at home for their parents and friends. They were extremely motivated about science; many for the first time ever.

The experiment lasted for two weeks and consisted of using these songs to teach the introduction to chemistry. Amidst the pre tests, posttests, written responses, and focus group discussions, Marie was noticing something profound taking place. The students were excited

about science, excited about learning, and Marie was truly excited about teaching - maybe for the first time ever. This new strategy had required Marie to step outside her comfort zone, and it was a radical success. Parents were emailing her explaining how their children could not stop talking, or in some cases singing, about science. Parents also wrote her and explained how amazing it was that their child finally passed a test and thanked her for appealing to their child's interest in such a positive way. Marie wanted more. She wanted more success with her students and more excitement. She reconnected with the researcher and asked how she could get more songs, more lyrics, and more opportunities for student learning.

The results of the quantitative data found that the experimental group had no significant increases in academic achievement compared to the control group. However, the experimental group had experienced extreme increases in motivation and excitement for learning science. From Marie's perspective, that was a great thing. Students who are more motivated will do better in the long run, so Marie was more than pleased with the results of the study. She wanted more. Marie wanted to use this music-based teaching method more with her classes. Marie and the researcher got back together and created two more chapters of music curriculum that she would use with all of her classes because the approach was working so well. That is when the real significant results began to occur. Marie was witnessing students' singing in the halls, parent emails and comments, and students' rushing to class to participate in science. This was just the beginning of what was to come.

Curriculum driving technology

Marie is now a firm believer that curriculum should drive technology changes in the classroom and not the other way around. She does not want to be handed technology and then be told "ok, go find a way to use it." Instead, she would like to look at what is already successful in her classroom and add technology to further enhance her students' experiences. Working with this music-based teaching gave her the opportunity to do that. Now that Marie had a curriculum development partner who could help her create extremely engaging lessons, she wanted to figure out how to enhance the experience using technology.

Over the next few months, and through the summer, Marie and the researcher worked to create a twelve-song album of standards-based science songs and handouts to teach difficult or boring topics throughout the 8th grade science curriculum. However, now Marie wanted her students to take a more active role in the songs by doing interpretive movements and dancing while filming science music videos. She also wanted to have a space online to host those videos so that the students could discuss them with each other and share them with their friends and family. Having these resources available would further strengthen the learning of the material and would also give Marie a chance to teach her students about appropriate and productive use of web 2.0 tools. These types of ideas were not on Marie's radar a year ago. She was just a science teacher.

The researcher, who works for a leading educational research institute, designed a process for doing what Marie wanted. The institute designed an environment where Marie

could film her students' interacting with the music curriculum and safely put it online so that they could watch it, share it, and comment on it.

Marie's web 2.0 environment consists of a Flip video camera, a video sharing site, and wordpress open source blogging software. She simply films something in the classroom using her Flip camera, uploads it, and then embeds it onto her blog. After she does this, her students can see it, share it, and make comments. This activity happens in a safe, moderated environment. Because Marie is the administrator of this environment, she is able to train other teachers how to use it and allow them access to set up an environment for their own classes. In just over three months she trained and set up video and blogging environments for 10 other teachers at Fuller Academy. Marie has become a technology leader at her school, has uploaded or approved hundreds of curriculum-based videos, and her students are learning about productive and appropriate web collaboration – a skill necessary for 21st century workplace.

It is incredible how Marie's view of teaching has changed in the past year and how her feelings about technology in the classroom have developed way beyond what she would have expected. She was "just a science teacher" a year ago. She has taken away so many lessons about curriculum development and technology from working with the researcher. Marie describes it best:

It is imperative that we develop curriculum that speaks to this new generation of students who are enthralled with being active in their learning, with communication and interaction on the web, and all types of online media. The music is a great way to

engage and motivate students while using the web to share and interact with content seems to compliment this music-based teaching process perfectly. Grassroots efforts seem like an extremely effective tool for making significant changes in classrooms. I introduced [the site] to my classroom and then to other teachers. Educators were using it and loving it, and policy was created from the ground up around its use in schools. Its an extremely effective tool and was implemented in a matter of days after it's creation. Finally, technology use in the classroom should be borne out of the desire to enhance that which is already working in the classroom. This music-based teaching experiment is a perfect example of it. The music was highly effective in motivating my students to participate in the learning of science. There were certain technologies that could enhance the experience for them. Those tools were developed and deployed, all in a very short period of time, in order to keep up with the pace of the 21st century. This pace is necessary.

Implications for practice

A major goal of this study was to implement this treatment in a real classroom so that the results could be both generalizable and scalable. Thus, the implications for further practice should include the means for disseminating the materials and process so that other teachers are able to use this music-based teaching method to teach 8th grade science. This goal has been accomplished.

The album of 8th grade science songs, handouts, and lyrics is available on the Internet at www.iamlodge.com. There is also a brief explanation of how to use the songs in the

classroom – informed by Marie's best practices. Any 8th grade science teacher can visit the web site and download the materials for free and use them in a classroom to increase student motivation for learning science.

In early April, 2008, two weeks after presenting this study at a national research conference, the researcher was searching the Internet for music resources of the classroom and found a link to a music video on TeacherTube. This music video was filmed by Ms. Perry from Lars County Middle School in rural North Carolina and included her students singing and dancing to a song written by the researcher. The description next to the video stated: "Using materials developed by Lodge McCammon (www.iamlodge.com), students were asked to create a music video about undersea life." The researcher had no previous contact of knowledge about this school or project.

Ms. Perry filmed similar music videos with three of her classes at Lars and the style of the videos suggested that she had seen The Fuller Academy's music videos on the web, as the students from Lars County Middle School were imitating movements first created by Marie's students. Marie showed Ms. Perry's videos to her classes, and they were thrilled. It would seem that imitation truly is the highest compliment.

This same day, Marie sent the researcher an email that included a link to Lars County's web site. The county had written a short article about their use of music in the classroom and explained the following:

[Title] "Music and Video Find a Place in the Classroom"

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Learn differently was the key today for students at Lars County Middle School, and for teachers all across Lars County Public Schools. Using resources developed by Lodge McCammon of the William and Ida Friday Institute for Educational Innovation, students in an 8th grade science class made music videos describing life in the ocean and features the song "200 Meters Down." Students were put into groups and asked to create a dance or act to go along with one verse of McCammon's song "200 Meters Down" to be recorded on video. These videos have been posted and are available for viewing on TeacherTube.

In ten days, the three videos filmed by Ms. Perry and the students from Lars County Middle school had received more than 3,000 views. These numbers are staggering as are the number of views that Marie reports receiving each month on her blogs and website. However, there is an important distinction between these two schools. The Fuller Academy is a suburban North Carolina school, is 90% Caucasian, and does not support a free or reduced lunch program. On the other hand, Lars County Middle School is at the opposite end of the demographic continuum with a student population of 85% African American and 63% receiving free lunch.

Music-based teaching is clearly generalizable across socioeconomic and demographic lines. It is also accessible by using Internet resources to deliver and disseminate the process and materials to teachers who want to motivate their students using new and innovative teaching and learning tools.

The final step with Lars County Middle School is to contact Ms. Perry and interview her about how implementing this music-based teaching method has affected her and the students. Her story would be fascinating if it parallels Marie's experiences with this innovative curriculum.

Implications for Future Research

This study has created a new area for research called music-based teaching. This process consists of teachers implementing music-centered lessons where songs are used to teach content and students interact with the music in the classroom in a number or ways. The music-based teaching method requires the teacher to do more than have her students listen to music, but does not require any musical skill, as the method is not dependant on music training.

Any new area of research requires additional studies in order to fortify the seminal work presented in this study, as well as break new ground. Research needs to be conducted to determine the impact of music-based teaching on academic achievement, motivation, creativity, and self esteem. However, several recommendations can be made in order to more successfully assess the impact on these variables. These recommendations will briefly be discussed in the following section.

Recommendations

It was reported by Marie that academic achievement was realized in the long run while using the music-based teaching method; therefore, additional research studies in this area should be longer than two weeks. Measuring student achievement for an entire semester

would be a more effective length of time, giving the students an opportunity to adjust to the new way of learning. Also, even though there were no significant differences between treatment and control test scores, a delayed measure of the same material may produce different results. In addition to this longer treatment, as suggested by Dede, it must be considered that unconventional methods of teaching require new and innovative methods of assessment. Research needs to be conducted to design creative alternative assessments that accurately test for all the academic benefits that may result from classroom interaction with music. For instance, the theoretical framework assumes that spatial temporal reasoning will result from students listening to music in the classroom. However, further research needs to be conducted on whether that is the case with music-based teaching, and how alternative assessments can be developed to account for that cognitive benefit and others that may result. Researchers continuing with music-based teaching studies are advised to treat achievement data carefully, as it may not present the entire picture. Because the quantitative means for measuring student achievement outcomes are problematic, it is necessary to employ a strong qualitative component to any additional studies.

The unintended results of this study, namely Marie's "aFullerning" as a teacher leader, make it imperative that future research consist of detailed interviews with the teacher, as well as data such as the motivation prompts and focus groups for the students. Interviews with the teacher will allow future findings to determine if Marie's experience can be replicated by simply implementing the music-based teaching method – while using technology to enhance the experience. Marie's experience is the most significant throughout

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this study, as it has the potential to have the largest impact on teaching and learning. If Marie's experience can be replicated, then this study creates a low barrier way to generate technology-savvy teacher leaders who are experts at motivating their students. Therefore, it is important for future research to determine how critical Marie's connection to the development of the materials and process was to her growth as a leader by removing the development of the materials from the process of the study.

This research created the groundwork for additional work in the area of music-based teaching. More studies need to be conducted that determine what other attributes music participation in classes shares with students who have had music instruction. The materials have been created and are available on the web. The main recommendation for future research is to use these resources to implement this music-based teaching method in 8th grade classes across the county, testing for changes in academic achievement, motivation, creativity, and self esteem.

Conclusion

American education is in desperate need of a makeover. Students suffer from a lack of enthusiasm, motivation, and engagement as the classroom becomes increasingly disconnected from life outside of school. Meanwhile teachers are left holding chalk and overhead projectors and are told to carry out education. Many of these teachers are uninspired cogs in a machine that asks for innovation and change but does not know how to support or assess it. Therefore, the education system requires two actions to take place. First, tools and methods must be developed in order to motivate and engage our students so that

they learn to appreciate the value of education. Without this value, students will trudge though their school years, possibly through college, and head home after graduation to play video games and chat online. The current system is creating a generation of aloof young people bored into cognitive submission by the dull and disconnected American school environment. Also, teachers must be given tools that empower and inspire them to take ownership of their classrooms and career. They must be offered opportunities to stand out as leaders and given the support and environment necessary to motivate and engage their students in real ways. This study successfully speaks to both of these issues.

The main research goal of this study was to find some common ground that music participation might share with the benefits of music instruction. The result was the creation of a new area of research called music-based teaching, which consists of using music as the tool for delivering content. The findings illustrated that music-based teaching increased student motivation for learning science content. The compelling responses given by the students throughout the motivation prompts and focus group suggest that they were engaged and motivated in many critical ways and that they found new value in what can happen in the classroom.

Marie's unintended results are equally powerful in this study. She began the treatment as a normal teacher; as a result of her participation in the development and implementation of this treatment, she has been forever changed. Marie has developed a deep-rooted passion for educating students and has been inspired to love the work she does. This attitude she takes with her each day in the classroom motivates her students to value their time with her and

take ownership of their education. American education could only hope that change like this would spread throughout a stagnant and bureaucratic system.

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APPENDICIES

Informed Consent

North Carolina State University
INFORMED CONSENT FORM for RESEARCH

<u>Title of Study</u> *Chemistry to Music: discovering how song can affect academic achievement and student motivation in an 8th grade science class.*

<u>Principal Investigator</u> *Lodge McCammon*   <u>Faculty Sponsor</u> *Dr. Carol Pope*

We are asking you to participate in a research study. The purpose of this study is to determine the effects of using original music to teach chemistry to 8th grade science students at Franklin Academy. The study will look at how academic achievement and student motivation are effected by the use of this new musical curriculum.

INFORMATION
If you agree to participate in this study, your student will be asked to:
1. **Take a preliminary test, based upon the North Carolina standard course of study questions, for a chapter dealing with 8th grade chemistry (this pre test will not count for course credit).**
2. **Listen to two songs about chemistry, over the course of about two or three weeks, and interact with those songs (some interactions may include memorizing lyrics, singing, lip-syncing, performing for others, or explaining the meaning behind the lyrics).**
3. **Complete all course materials, required by the teacher, that are associated with the song (worksheets, homework, and quizzes).**
4. **Take a test, based upon the North Carolina standard course of study questions for the same chapter dealing with 8th grade chemistry (This test will count for class credit).**
5. **Complete a written prompt dealing with student motivation (sample question: How did the music help your motivation or attitude toward learning chemistry/science?)**
6. **A small group of students will be asked to take part in a focus group after the treatment is over. In this focus group the students will be asked to elaborate on their answers about how the music affected their motivation. This focus group will be audio/video taped and participation will be entirely voluntary. After the study is concluded, the tapes will be returned to the teacher for classroom use.**

RISKS
Singing can be scary. In no way will the students be graded or assessed on their musical ability. Lip-syncing or "fake singing" is an acceptable alternative for those who don't wish to sing out loud.

BENEFITS
This curriculum offers up a new and dynamic way of teaching and learning. The intended benefits are as follows:
1. **Increase student achievement by increasing test scores on the teacher-generated chapter tests.**
2. **Increase student achievement by better preparing students for the portion of the end of course exam dealing with chemistry.**
3. **Increase student's motivation for learning science.**

CONFIDENTIALITY
The information in the study records will be kept strictly confidential. Data will be stored securely in a locked cabinet at The Friday Institute for Educational Innovation. Once the data is no longer needed it will be returned to the teacher at Franklin Academy. No reference will be made in oral or written reports which could link you or your student to the study.

CONTACT
If you have questions at any time about the study or the procedures, you may contact the researcher, Lodge McCammon, at 1890 Main Campus Drive, Raleigh, NC 27606, or 919.604.3337. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. David Kaber, Chair of the NCSU IRB for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (919/515-3086) or Mr. Matthew Ronning, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (919/513-2148)

PARTICIPATION
Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed at your request.

CONSENT
"I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may withdraw at any time."

Subject's (student) signature_____ **Date** _____

Parent/Guardian's signature_____ **Date** _____

Investigator's signature_____ **Date** _____

Appendix B

Music-Based Teaching Curriculum

"We are Matter" – Chapter 13, Sections 1&2 - Lyrics

Kelly wants to know what her mass would be on the moon
Her weight is right at 90 lbs now - without her shoes
All the different atoms 'round her head becoming molecules
They're only tiny elements that love to combine
But never, never get to choose
They never get to choose

      Matter is anything that takes up space
      That has a mass or a volume, like a guitar case
      So measure matter matter – yeah matter
      in a number of ways
      We are matter, yeah we take up space
      Whether kilograms or liters we displaced
      Oh Kelly, Kelly what units - will you indicate
      Cubic centimeters sound so great

Kelly plays a game where 2 elements can chemically bond
She dresses carbon and oxygen up in pretty clothing
In hopes - that they'll get along
The chemical reaction happens almost right away
Kelly's little atoms - now a compound and a molecule
Will never separate
Will never separate

Density's kinda rad, it measures mass over volume
Kelly's crazy friends – say she's denser than them
She used to think it was bad
Till she made the calculation
And found out
Most of her friends have empty heads…

Kelly gets depressed when 2 substances can't seem to bond
They're easily separated to original parts
And don't, don't really get along
In the heterogeneous mixtures - she can see what is wrong
But it's the other kind of mixtures that truly hurt her feelings
cause, cause they look so strong
but there is no chemical bond

[Chorus]
Oh, Kelly, Kelly what will you indicate
Oh, Kelly, Kelly what units will you indicate
Cubic centimeters sound so great

Curriculum handouts can be downloaded at http://www.iamlodge.com

If you follow the law…no mass will be destroyed
Things will just change…nothing added oh boy
Such are Physical changes like state or form
Or chemical ones we've never seen before
Like how rust comes from iron ore

      Don't change your chemical properties
      Though the world will conserve mass and energy properly
      Change your physical properties
      I know it takes a change in energy…
      A change requires energy

Ice in my left hand, yeah its got to melt,
Endothermic takes heat form something else
Now exothermic is like a tiny fire
Giving off heat, come on don't make me a liar
It's the water to ice that I admire

Get ya some kinetic…particles in constant motion
Talk about potential…releasing energy when bonds are broken…
Electromagnetic – invisible waves and sunlight that keep going…
Helps photosynthesis keep things growing

If you follow the law, no energy will be lost
Electrical electrons - just moving across
Got a steaming cup of coffee in my right hand
The temperature's hot…thermal energy adds
All the cups together…made from the can

Curriculum handouts can be downloaded at http://www.iamlodge.com