Arts Integration: Math in the Music

By

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ABSTRACT

The purpose of the current study was to learn more about art integration in Ontario schools. This study is focusing on how can music education have a positive effect on a student’s math achievement? The sub questions are:

(1) How do teachers integrate music into math instruction? If at all?
(2) What are some connections between musical theory and primary math concepts?
(3) What evidence do teachers have that music education has had an effect on their student’s math comprehension?
(4) How can teachers be better supported to implement arts integration?

The findings strengthen previous studies relating to arts integration in schools and more specifically about using the arts to support “traditional subjects”, lack of school provided resources, and minimal support from administration. The results of this study show: (1) that only teachers who are actively seeking resources for arts integration find them readily available; (2) when the school and school board were providing resources they were only accessible to a handful of teachers; (3) teachers are using the arts infused model of arts integration.
Chapter 1: INTRODUCTION

Introduction

“Music is the pleasure the human soul experiences from counting without being aware that it is counting.”

- Gottfried Wilhelm von Leibniz
  (1646-1716)
  (As cited in Periton, 2013)

“Mathematics and music, the most sharply contrasted fields of scientific activity which can be found, and yet related, supporting each other, as if to show forth the secret connection which ties together all the activities of our mind, and which leads us to surmise that the manifestations of the artist’s genius are but the unconscious expressions of a mysteriously acting rationality.”

- Hermann von Helmholtz
  (As cited in Ray, 2008)

Two eighth notes are in a quarter note; this is basic musical theory. One eighth multiplied by two is a quarter; this is a simple mathematical equation. The wording and concepts are all too similar, yet a student may understand one more than the other. Musical theory is rooted in mathematical concepts. Music and math are intertwined, so why are these two subject matters not taught together more often? Arts integration is not new to educators and is being implemented in multiple classrooms around the world (Aschbacher, 1996; Colwell, 2008; Elliot, 1999; Seefeldt, 2005).

Math anxiety is a large concern for both students and educators (Ashcraft, 2002; Geist, 2010; Popham 2008). Formal learning of mathematics in school has constructed a learning experience for students' that has been teacher focused (Geist, 2010). The students are learning the teachers’ methods rather than constructing their own knowledge (Geist, 2010; Scarpello, 2007). Just like music, math requires creativity. Students have to be able to play with numbers in order to think of their own methods and formulas and construct their mathematical knowledge. The
way in which the formal learning of mathematics is being delivered in the classroom can also cause students to be unengaged. Arts integration can create meaningful learning experiences for students and build on their different learning styles and skills (May, 2013; Griffin, 2005). Currently there are teachers who focus more on the tools they use to teach rather than the art of teaching (Griffin, 2005). Arts integration, more specifically music-integration, can be used as an element of a math lesson that can enhance the learning in a classroom as well as assist in explaining math concepts in primary grades.

**Purpose of the Study**

Arts integration appears to be an intimidating task for many educators, especially ones without any arts background. The purpose of this study is to look at how educators are using music to teach the Ontario math curriculum. The study will look at how teachers are integrating music into their math lessons. It will examine the positive and negative effects on math instruction teachers observe while implementing arts integration. Finally, the study will investigate what challenges the teachers face while trying to implement an arts integration program and what supports the teachers feel they may or may not need.

This study looks to assist in adding information in the Canadian context. Even though arts integration is implemented in Ontario, the majority of the existing research is based in the United States. Arts integration has shown to be difficult to implement and existing research indicates that administration issues is the root of the problem (May, 2013; Appel, 2006). The school system and curriculum are different here in Canada and vary amongst provinces.

**Research Questions**

The use of music to teach mathematics has been previously researched for years and has been used to teach various core subjects including mathematics (May, 2013; Colwell, 2008). The
aim of this study is to look at how teachers are using arts integration in primary classrooms to support the learning of core subjects, if at all. This study will be implementing a collective case study method to address the research questions. This study will examine three cases in which data will be collected through interview questions. The main research question is: How can music education have a positive effect on a student’s math achievement?

The sub questions for the research are as follows:

1. How do teachers integrate music into math instruction? If at all?
2. What are some connections between musical theory and primary math concepts?
3. What evidence do teachers have that music education has had an effect on their student’s math comprehension?
4. How can teachers be better supported to implement arts integration?

Background of the Researcher

As a young musician, I thrived in anything surrounded by music. My musicianship truly began in grade three when learning to play the recorder, then grade six with the flute and vocals, and finally grade nine when I began to learn to play the steel pan outside of school. I have a strong musical background, which grew when I attended Cawthra Park Secondary School of the Arts. During my high school career, I unmasked my love and talent for mathematics. When it came time to begin looking at post secondary education I applied for early childhood education, mathematics and music at various schools in Ontario. I followed my love for education and graduated from Ryerson University with a Bachelors of Arts in Early Childhood Education. I continued to work on my music and perform throughout undergrad as well as taking music electives to further my education.
A high school peer in the dance program once told me that the music majors are good at math because of the connections of the concepts. This sparked my interest because most of my friends in the music program excelled at mathematics, but there were a few that had very high anxiety in regards to math. Anxiety-stricken peers excelled at rhythmic notation but could not grasp fractions. As a Masters of Teaching student, I have begun to look deeper into these three interconnecting concepts that I have immersed myself in since grade school.

During my undergrad years, I have learned many educational theories and have conducted a mixed method research study. This study will be looked at through a social constructivist interpretive framework. Using interviews to collect data allows for emerging themes to be pulled from the research, which will be co-constructed between the researcher and the interviewee.

**Overview**

This research is organized into five chapters. The first chapter contains an introduction and purpose of the study, the research questions, background information on how I became interested in this research, and an overview of the study. The second chapter is a literature review. The third chapter contains the methodology. This chapter covers the studies procedure, instruments of data collection, participants, data collection and analysis, ethical review procedures, and the limitations. The fourth chapter will present the findings of the study, which will address the research questions. The fifth and final chapter will discuss the implications of the findings and recommendations, the limitations of the study, and next steps for further investigation. References and appendixes will follow at the end.
Chapter 2: LITERATURE REVIEW

2.0 Introduction

The focus of this study is on how music education can have a positive effect on a student’s math achievement. The sub topics include how teachers are integrating music in mathematics, what are the connections between primary math topics, what evidence do teachers have that music education has an effect on their students learning, and how educators feel they could be better supported in terms of arts integration. The literature review will cover these areas: what is arts integration, multiple intelligences, benefits of music integration, math anxiety, creativity, and teachers fear.

2.1 What is Arts Integration?

Arts integration has no one definition or agreed upon implementation (Mishook & Kornhaber, 2006; Marshall, 2014). May (2013) defines arts integration as “an approach to teaching in which students construct and demonstrate understanding through an art form” (p.5). It has also been defined as “the transfer of knowledge across artistic and non-artistic disciplines, [and] the use of arts to enhance the study of academic disciplines” (Mishook & Kornhaber, 2006, p.4). Silverstein and Layne (2010) defines art integration as “an approach to teaching in which students construct and demonstrate understanding through an art form” (as cited in Marshall, 2014, p.105). Generally speaking, arts integration is the combination of the arts and core subjects such as mathematics, science, or literacy.

Marshall (2014) cites three different types of arts integration models. Art-infused model of integration is a model in which the focus is the academic content and the arts are just used as a tool for teaching. Another form of arts integration is concept-based, which is an extension of the arts-infused model but focuses more on “ideas, concepts, and issues” (p.106). The third
integration model is process-based arts integration, which strongly focuses on the understanding of concepts and the procedures.

There is also a four level model for integration that was created by an University of Washington professor, James Banks (as cited in Berke, 2000). The first level is the contributions approach, which is described as music being used as for purposes other than solely music (as cited in Berke, 2000). The second level is the additive approach; in this approach, the music is included in the core curriculum but is used to complement the curriculum rather than as an essential portion (as cited in Berke, 2000). The third level is the transformative approach in which students can look at one topic from several scopes (as cited in Berke, 2000). This approach requires collaboration amongst general classroom teachers and music teachers. Banks’ last level is the social action approach, which is the most integral. Both subjects are being studied and examined at one time. This approach requires critical thinking in which students have to compare and contrast the two subjects on what is similar and what is not.

Defining arts integration and how educators define arts integration will have an impact on how they view its use in the classroom. Different definitions will lead to different implementations and consequently supports will be have to be slightly varied. The research on the many definitions of arts integration connects to the research sub question, “How do teachers integrate music into math instruction? If at all?”

2.2 Multiple Intelligences

Howard Gardner’s (2006) multiple intelligences has a strong relation to arts integration. Teaching methods are not one size fits all. All student learn differently so one teaching method cannot be expected to reach the entire class. Veenema & Garnder (1996) state that a single concept can be represented in numerous ways in a persons mind. Gardner created the concept of
multiple intelligences because he believes “that human cognitive competence is better described in terms of a set of abilities, talents, or mental skills” (p.6). Gardner’s (1993) original set of seven intelligences were: musical, bodily kinesthetic, logical mathematical, linguistic, spatial, interpersonal, and intrapersonal. An eighth intelligence, naturalist, was added later.

Gardner’s view of intelligence encompasses views of art integration. The focus of arts integration, more specifically music and math integration, brings together two forms of intelligences: musical and logical mathematical. Although all areas of intelligences are important, not all are possessed at the same level for everyone. Bringing the two areas together has been shown to benefit both mathematical learning as well as musical theory (May, 2013).

2.3 Benefits of Music Integration

Research of arts integration has shown to increase student interest in learning and increase the learning of other subject areas, such as mathematics (Deasy, 2002; May, 2013; McDonald & Fisher, 2004; Parr, Radford, & Snyder, 1998). The arts have played a role in mathematical understanding and use, through meaningful experiences that helped students retain learned knowledge (Gardner, 2006; Hirsh, 2010; Jensen, 2005; May, 2013; Schattschneider, 2006; Wilson, 2009; Jensen, 2005). Meaningful learning experiences are beneficial because the knowledge gained will be remembered for longer. Musical concepts are rooted in mathematics in that “musical tasks offer the student the opportunity to develop concepts of number through beat, rhythm, tempo, time, and scale” (Hirsh, 2010, p. 155), as well as spatial-temporal reasoning, which are related to higher math achievement (Hirsh, 2010). Teaching part-whole relationships in math such as fractions, decimals and percentages can be directly connected to rhythm in music, an alternative representation (Jones & Pearson, 2013). These kinds of concepts or mathematical concepts in general are easier for students to make sense of when they are
looking at it through a different scope or domain (Hirsh, 2010). Instead of a student going to math class to be taught solely mathematical equations, students learn through other subjects, such as music, to give them a different perspective of the content (Hirsh, 2010).

The literature on the benefits of music integration directly connects to the main research question of how music education can have a positive effect on a student’s math achievement. This research shows the links between musical and mathematical concepts.

### 2.4 Math Anxiety

Math anxiety is the “tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations” (Richardson & Suinn, 1972, p. 551). Math anxiety is a large concern for both students and educators (Ashcraft, 2002; Geist, 2010; Popham 2008) because it has been shown to decrease a person’s exposure to mathematics, self-confidence, ability to understand content and enjoyment doing mathematics (Ashcraft, Kirk, & Hopko, 1998; Hembree, 1990; Jameson, 2013). Finlayson (2014) states that math anxiety has a connection with traditional teaching methods, including consistent use of textbooks, teacher directed lessons, limited assessment tools (i.e. testing), lack of class discussion, and the teacher taking on an authoritative role (Harper & Daane, 1998; Finlayson, 2014).

Students’ fears of math stem from the school system and are often influenced by teachers’ math anxiety (Finlayson, 2014; Harper & Daane, 1998). Many teachers are fearful of math because of their beliefs of their own math abilities (Burns, 1998; Stuart, 2000; Finlayson, 2014). This may be a result of their own school experiences. The research such as Finlayson (2014) and Harper and Daane’s (1998) suggests that this is a cycle. Finlayson’s (2014) study seems to replicate the same information of Harper and Daane’s (1998) study. Harper and Daane
(1998) looked at math anxiety levels on preservice teachers before and after being enrolled in a mathematics course. The participants had high levels of anxiety on the pretest due to certain aspects of math instruction like an emphasis on the “right answer, fear of making mistakes and timed tests” (p. 29). Students are being taught in the traditional manner, which has been shown to cause math anxiety (Finlayson, 2014; Harper & Daane, 1998; Hirsh, 2010). When they become teacher candidates or preservice teachers and are faced with the task of teaching mathematics they rely on their personal experiences with math instruction. For example, teachers with math anxiety teaching using the right and wrong answer approach (Finlayson, 2014), while they “rely on teaching algorithms while neglecting cognitive thought processes and mathematical reasoning” (Sloan, 2010, p.243), because their anxiety does not allow them to explore other options.

2.5 Creativity & Flexibility

Teachers and preservice teachers who have math anxiety have a concept of mathematics as rule bound facts (Harper & Daane, 1998). “Creativity invites experimentation, formulation of new hypotheses, and opens possibilities” (Hirsh, 2010, p. 154). The formal learning of mathematics has created a learning environment that does not promote creativity. These methods put students in a position where they feel they have to memorize the methods in which the teacher feeds them instead of playing with numbers and developing their own (Geist, 2010; Griffin, 2005; Scarpello, 2007). Creativity in math is not given the same amount of attention as it is in other areas like the arts. The systematic process students are learning is not similar to the process in which creative math students and mathematicians describe which includes brainstorming and creating (Sheffield, 2013; Gardner, 2006; Hirsh, 2010). Moving away from stagnant math teachings will allow students to explore using numbers and construct their own
learning. Research has shown that nurturing students’ creativity in math positively correlated with engagement and enjoyment (Sheffield, 2013; Johnsen and Sheffield, 2012). Arts integration, more specifically music integration, can be used as an element of math lesson which can enhance the learning in a classroom as well as assist in explaining math concepts in primary grades.

Flexibility is a quality that every teacher requires in order to make it through the day. This also relates to math instruction and student learning. In most classrooms students are being taught using a traditional procedural method to solve math equations. Some educators have begun to learn and teach multiple methods to solve various amounts of mathematical equations. This is an important quality because more experienced mathematicians use more strategies than their beginner peers (Dowker, 1992; Star & Rittle Johnson, 2008). If students are being taught rigidly it will impede on their problem solving and mathematical skills (National Research Council, 2000; Star & Rittle Johnson, 2008).

Star & Rittle Johnson (2008) conducted a study with grade six students in which students were given two forms of instruction that would lead students to use and be exposed to multiple methods of solving. The first form of instruction conducted of educators giving the students prompts in order to discover multiple strategies and in the second the teachers directly taught multiple strategies. The results provided evidence that being exposed to multiple strategies, no matter the form of instruction, improved the student’s flexibility in problem solving.

2.6 Teachers’ fears.

Music is another subject area that causes teachers anxiety, as Hash (2010) found that preservice teachers did not feel comfortable teaching music and felt that a specialist should teach the subject. Research has shown that having art specific courses, for example music, can assist in teachers and preservice teachers views on the subject and their capabilities. Berke and Colwell
(2004) found that preservice elementary teachers had negative and low confidence in their ability to teach music. The teachers were enrolled in a music course over a summer, which was intended to advance the development of music knowledge for the preservice teachers. The results of the study indicate that there was a positive change in all areas: musical ability, knowledge, music objectives and integration of music into the curriculum. Music has also been shown to be viewed as a subject of lower importance. Results of Hash’s (2010) study also “suggest that participants regard music as less important than other subjects and non-musical outcomes of music instruction as more important than musical outcomes” (p. 6).

2.7 How has Music Been Integrated in Math? What is Preventing Expansion?

Jones and Pearson (2013) touch on some ways in which arts integration has been used in the subject area of math. One lesson consisted of “the math value of musical notes” (p.19). The students were taught how to identify each note, their name, and their value using the visual representation of a music staff. The students then went into learning the fractional value of each note. This was extended into learning about the amount of notes that could fit into one bar or measure using mathematical equations with exponents (Refer to Appendix A). The students were also the given a familiar tune of *Twinkle Twinkle Little Star*, and asked to fill in missing notes, not based on melody, by rhythm. This required students to look at the fractional value of the provided notes and use addition and/or subtraction to find the answer (Jones & Pearson, 2013).

The roadblocks that are written about include teacher and administrative collaboration, teacher participation, and time constraints (May 2013). Arts teachers are doing doing most in term of advocating and planning arts integrated lessons (May 2013). This is a large roadblock because schools consist of minimal arts teachers and large amounts of generalist school teachers (May, 2013; McDonald & Fisher, 2004). Having one or two teachers try to plan integration
lessons for each grade, subject, and class, is unrealistic. Getting administration on board with the implementation of arts integration would allow for beginning steps such as professional development for all teachers. Berke (2000) has written several steps on how to takes steps toward successful integration. The suggestions include getting organized, informing the principal, starting small, being proactive, being flexible and evaluating (Berke, 2000).

There is a large amount of literature that focuses on if students will benefit from arts integration and theoretical lesson plans (Jones & Pearson, 2013; Mishook & Kornhaber, 2006; Marshall, 2014) but not specifically, how they are gaining this knowledge. Currently, studies that focus on how students benefit from arts integration examine hypothetical music integration lessons and not what is truly being done in schools. McDonald and Fisher (2004) touch on how arts integration requires teacher cooperation differently from how they have done before because they need to consider other skill sets. Cane (2009) says collaboration groups should be created thinking about what each participant can contribute and how well they work together. This is why this study is focuses on how music education can have a positive effect on a student’s math achievement in the Ontario context. The present study also examines how teachers are integrating music into math instruction, the connections between the concepts, evidence teachers have that it has had an effect on their students, and how they feel they can be better supported in implementing arts integration.
Chapter 3: METHODOLOGY

3.0 Introduction

This research study focused on how music can have a positive effect on students mathematical understanding. This qualitative research will also look at how educators in the elementary division use music to teach mathematics, what connections are being made among math and musical topics, what evidence do teachers have that music education has an effect on their students learning, and how educators feel they could be better supported in terms of arts integration.

This chapter will elaborate on the qualitative research approach taken and why it was chosen. I identify the instruments and methods taken to collect the data, the participants’ involved in the study and the parameters in which they were chosen. I then go on to the steps in which I took to seek and recruit participants. I describe where my data analysis techniques were learned and sampled from. This chapter looks at issues in regards to ethical considerations and limitations to the study. The chapter finishes with a brief overview of the chapter.

3.1 Research Approach and Procedures

This study has taken a qualitative research approach through a collective case study. Qualitative research was chosen because it allowed for the researcher to collect data using open-ended questions (Campbell, 2014), which could be answered to display the attitudes and practices of these educators. The data collected was coded in order to observe the developing themes. The present study included a literature review was done, semi-structured face-to-face interviews, as well as analysis and coding of interview responses.
3.2 Instruments of Data Collection

I conducted three semi-structured interviews with consenting participants. Semi-structured interviews are “often the sole data source for a qualitative research project and are usually scheduled in advance at a designated time and location outside of everyday events.” (Di-Cicco & Crabtree, 2006, p. 315). Each interview was conducted for 45 minutes to an hour and were done individually. This provided an opportunity for the researcher to co-construct meaning with the interviewee (Di-Cicco & Crabtree, 2006). Di-Cicco Bloom and Crabtree (2006) states that individual semi structured interviews based on preplanned open ended questions allow for deeper understanding of the personal and social issues and experiences around the topic (Di-Cicco Bloom & Crabtree, 2006). The interview (Appendix C) questions that were asked were based on the research questions. The questions were created to inquire about their teaching career, how they have implemented arts integration, the results they have observed, and the challenges in which they have faced. The interview questions allowed for teachers to share their personal experiences.

3.3 Participants

This section reviews the sampling criteria that I determined to be appropriate for this research. I have also covered how I will find and recruit these educators and participants, as well as introduce the participants.

3.3.1 Sampling Criteria

The educators needed to have a background educating elementary students anywhere between Kindergarten and grade six, or work with students in this age group in an arts based or music school. These teachers needed to have been implementing arts integration, specially music
and math, for a minimum of two school years. This is relevant to the study because the first year may will contain more trial and error lesson plans. In the following years the teachers will have more experience, and therefore can edit and build upon what they learned in the first year. This I also will require the teachers to have been teaching for a minimum of five years. The teachers need to have taught in a school board in Ontario, Canada for at least two of the five years. This is required in order for teachers to provide a prospective of teaching and student learning over a longer span of time and maybe even grade levels. The teachers who have taught using arts integration outside of Ontario can give a comparison in terms of experience between the two school boards.

**Sampling Procedures, Recruitment**

To recruit participants I researched music schools, public schools, catholic schools, and private schools in Ontario, more specifically the general Toronto area. I contacted the principals with an summary of my research study, participant criteria, and my contact information to pass on to any interested persons. This allows for teachers to not feel pressured and to consent to participate in the study. I also contacted people within my teaching community and OISE, colleagues and professors, for recommendations on participants.

### 3.4 Participant Biographies

The first participant (assigned the pseudonym “Michelle”) worked at an arts based elementary school in a school board in the General Toronto Area. She is currently in her 12th year of teaching and has taught in this school for 11 years of her teaching career. In her first year at a general school she taught half day kindergarten and half day core French. Her entire 11 years at the arts based school she has taught kindergarten. Michelle learned to play the cello in grades
five to eight. Afterwards she took a break from cello and began learning the guitar in her high school years. That was the last of her formal music training.

The second participant, “Sandy,” began her career in Early Childhood Education and moved on to receive her Bachelors of Education. At the time of the study, she had been working with children for 10 years and was currently teaching grade one. She began working in the public school system about 4 years ago. Most of her years of teaching, she was in kindergarten. Sandy also had a musical background. She took piano at the Royal Conservatory of Music, and sang in the choir at her church.

3.5 Data Collection and Analysis

I began by doing a literature review. The literature review covered what arts integration, multiple intelligence, benefits of music integration, math anxiety, mathematical creativity, teachers’ fears, and what is holding back the expansion of arts integration. This information and my research questions informed my interview questions which were used in the face-to-face interviews. These interviews were the main source of data and were used to find how they were using. The interviews were then transcribed and read over them four times. After reading and rereading, I began to start highlighting and underlining important information from each transcript separately. The information was then organized into 12 categories themes. The categories were then synthesized into 3 emerging themes.

3.6 Ethical Review Procedures

This study followed the ethical standards of the Masters of Teaching program at OISE. The interviews were held with educators and did not include any students or other children. All participants were provided with a consent letter, which introduced the researcher, described the study, the requirements of participating, and the confidentiality agreement (REFER TO
APPENDIX B). The participants were informed that they will be given a pseudonym and no information that could be used to identify them would be used in the study. The consent letter also informed the participants they may withdraw at any point. This study does not have any known risks.

3.7 Methodological Limitations and Strengths

This research study has some limitations due to the fact it is qualitative in nature, and the ethical standards provided through the Masters of Teaching program at OISE. The ethical consent provided for this research from the University of Toronto, has limitations such as methods for data collection and who I can collect data from. There is approval to speak with adults in a semi-structured interview style. This is a limitation because there no opportunity to observe the teachers while implementing arts integration. This also means there is no direct data from students. Observing students while in an arts integration program would be greatly beneficial for the research. Having more of an opportunity to interview students and observe them in the classroom would have provided more of a balanced view of the implementation of arts integration.

The timing for preparation and completion of the study is another large limitation. The amount of time to collect data for a longer period. Having more time to complete the study would have allowed for more than one interview allowing the teachers to provide a more in depth view of their experiences with arts integration. The time constraints not only limit the amount of interviews per participant but how many participants there are. This is a limitation because it creates a small sample size, which created a lack of generalizability.

Though there are limitations to the methodology, there are also strengths. Using interviews as a form of data versus others such as surveys or journal logs. Interviews allow for
the educators to provide their own perspective and lesson planning choices. Looking at mathematic instruction from an experiential perspective rather than testing can be greatly beneficial. How educators feel while teaching mathematics through a musical lens can provide first steps into how to better support them further. This will consequently be beneficial for students.

3.8 Conclusion: Brief Overview and Preview

This qualitative study will be using semi structured interviews to look how educators are using arts integration to teach math through music. The participants will primary/junior teachers in Ontario that have worked with this specific kind of arts integration. Before being interviewed all participants were provided with a consent form which laid out a summary of the purpose of the study, their role, and a confidentially agreement. After consenting to take part in the study the participants were then interviewed at a time and place convenient for them. The data collected through these interviews was coded and themes were created and then further consolidated. The time constraints and ethical approvals provided to us while conducting the research has placed some limitations on the study such as small sample size and no direct data from students. Some strengths to the study are interviews because this provides a deeper look into the teachers’ experiences versus surveys. The next chapter reports the findings from the collected data.
Chapter 4: FINDINGS & DISCUSSION

4.0 Introduction

Thus far, this study has presented a review of the research questions and sub-questions, a literature review and the methodology. In this chapter, the findings and themes from the two interviews are presented and discussed through the lens of past research. Two participants came from two different boards and one came from a specialized arts school. This gave the research two perspectives and experiences, but similar responses were evident nonetheless. This chapter will cover multiple themes. The themes include:

1. What is arts integration?
2. Readily available resources
3. Schools and school board resources.

The way in which someone defines arts integration is an insight into how they would introduce it into the classroom. The teachers both felt like resources were readily available for them because they knew where to look for them but felt not all teachers were receiving or finding the same resources or being supported. One major mathematical concept in the primary years that both teachers really used arts integration for was patterning. While teaching topics such as patterning through music, the students were not only learning through music, they were receiving a holistic learning experience.

4.1 What is Arts Integration?

Arts integration is a term that can have multiple definitions (Mishook & Kornhaber, 2006; Marshall, 2014). How one defines arts integration is effected by how they personally implement it. Michelle defined arts integration as “using music, drama, fine arts, dance to I guess support learning in the more traditional areas like math, language, even science”. Similarly
Sandy answered, “I would define arts integration as a method of connecting art forms to different subjects. For example for math, for writing, for spelling, for linguistics.”

The ways in which Michelle and Sandy defined arts integration is reminiscent of the art-infused model from Marshall’s (2014) types of arts integration in which the art form, in this case music, to support the learning of “traditional areas” like math, literacy, and some cases science. This theme of using music as a tool for teaching other subjects is a theme demonstrated through description of their activities throughout the interview. Michelle said, “5 little pumpkins sitting on a gate, the first one said oh my its getting late, and its that subtraction, like taking them away”. This song demonstrated they are just singing concepts in which could have been written or talked out, which is why it is considered the most basic level of arts integration. Another song Michelle sang that would fall display the use of the arts infused model is: “I'm so glad to see you. I almost couldn't wait. Could you pull up your hands and tuck your shoulders in and count to eight”. Michelle does later go on to talk about student input and body patterns:

And then we create a body pattern, like a pattern with actions. Then the kids um then, I say who has a pattern and then they'll give me two actions and then we'll do their pattern. And we do that almost every morning for almost the whole year so and then it gets harder so we can start doing [inaudible] so that will be an example of integrating math with the music that we've learned from Orff.

Sandy describes a lesson with rhythm sticks relating loud and soft sounds to different aspects of pattern. This particular lesson contains aspects of the concept based model, the second level of the arts integration method, which incorporated “ideas, concepts, and issues” (Marshall, 2014, p.106). In order for Sandy to have taught her lesson she would have had to discuss what
consisted of a loud sound and a soft sound which is a basic description of the musical concept of dynamics. This lesson lacked in the areas of musical ideas and issues.

The participants’ definitions also align with the definitions of Mishook and Kornhaber (2006) “the use of arts to enhance the study of academic disciplines” (p.4) and Silverstein Layne’s (2010) definition: “an approach to teaching in which students construct and demonstrate understanding through an art form” (as cited in Marshall, 2014, p.105). These definitions also consequently also align with Marshall’s (2014) arts infused model.

This information is important because the existing research is more about what teachers could use in the classroom rather than what teachers are actually doing in our classrooms today. Some lesson topics that are in existing research mathematics with music are related are fractions and note value (Jones and Pearson, 2013) which falls into the most complex model of Marshall’s (2014) arts integration models, process based arts integration. In order for teachers to implement more complex arts integration lessons in the classroom they will require more resources.

4.2 Readily Available Resources

The second theme that emerged was the concept of resources being readily available if you are actively looking for them. Michelle and Sandy both expressed that resources were readily available to them but because they had places to go to find resources. Michelle spoke about her school being lucky when touching on about musical resources:

I have for music, we were very lucky at [Sunbeam P.S.] we have an itinerant Orff teacher and she has given us resources and one of them is an Orff songs and activities curriculum resource guide, kindergarten to grade six and and that I use quite often… She has in my lets say 11 years I’ve taught here [I’ve been] lucky to have three three years with about once a week and Orff teacher they come in and they teach the teachers how to teach music.
Working at an arts based school provided Michelle with opportunities but she also states that “only about 4 teachers per year get the itinerate teacher so its not every staff member”. The arts based school only provided 4 teachers in the whole school with specialized resource teachers for the arts. Michelle also explained that every school in the school board has an opportunity to receive these supports but only if the principal seeks these opportunities out. Michelle also states that they are provided with an arts grant so not all schools have the financial resources to get the support needed.

Sandy similarly knew where to seek out resources and found that they are readily available even though her choice of resources were different from Michelle’s: “Websites, I use Cube a lot and even the simplest thing as Pinterest…. It’s everywhere now, I find”. While websites are a great tool that Michelle uses, she also mentions her grade team as a resource. Specifically, she talks about bouncing ideas off her grade team and sharing ideas because they all had an interest in using arts integration in the classroom.

Past research looks at teachers in American schools and therefore their school system (Hash, 2010; Berke and Colwell 2004; May, 2013; McDonald & Fisher, 2004). This research and results even though small gives an insight on what it is like in two major school boards in Ontario, one arts based and one that is not specialized. Therefore, the perspectives, finances and particular focuses will be different for each board and each school within those boards.

4.3 School and school board resources

The third theme relates to resources provided at the school and board level. Both participants spoke to a lack of support for the majority of teachers in the profession, especially
those with minimal musical background and low comfort level with arts integration. Michelle specifically speaks to how the itinerate teachers support improved her skills and wished that more teachers received these opportunities:

Not every school has the funding that we do because we're and arts based I think we get a little more support but I don’t know if every school is getting that same support. I think it would be beneficial for Orff itinerant teachers to go in and teach other teachers in other schools. If there were those opportunities for every primary teacher to have have someone teach them because I think a lot of people don’t have that musical background. You know very few so it -- I know for me it's been such an amazing opportunity to learn so that I can be a better teacher for sure. So I think it would be great for those resources to be able to reach all the schools”.

Michelle earlier spoke about how her school receives an arts grant because they are arts based but later discloses that only a few teachers receive itinerate teachers:

My very first year teaching here I had vocal and they also have recorder but I think we only get to choose one. One form, only vocal recorder or Orff. Only about four teachers per year get the itinerate teacher so its not every staff member.

Sandy even though is working at a non specialized public school that does not receive any specific grants for arts education had a similar perspective. Sandy states that her school does not provide any resources for the staff. Sandy touches on the fact that these topics are school dependent, due to different admin and colleague’s views and comfort level.

It depends on your school. It depends on your teammates. I feel like education as a whole is being open to new ways of thinking and new ways of having students just
excited about learning. [...] It may take a little more to plan outside but I feel like it’s a slow progression but I also think it depends on your team.

Michelle and Sandy both speak about the resources being school dependent. In Michelle’s school there are resources being provided but only to a few teachers. In Sandy’s case the school does not provide any resources that she knows of for arts integration.

4.4 Discussion

These findings have filled in gaps for the Ontario context, more specifically in the General Toronto Area, while also coinciding with previous research. These interviews led to the themes of use of basic arts integration models, resources only being able to find resources if you are actively looking for them, and how the school and school boards are not providing adequate resources.

The way in which the participants have defined arts integration gives incite into how they implement it into their classrooms. The participants mostly use music as a tool to give instruction for other subjects such as math and language versus the more complex levels where musical concepts are taught in conjunction with the mathematical concepts. Michelle was engaging in arts integration according to May’s (2013) definition. The students are constructing knowledge while they are participating the musical math lessons. The students providing input into the lesson relates to May’s (2013) definition of arts integration: “an approach to teaching in which students construct and demonstrate understanding through an art form” (p.5). The students are constructing knowledge by creating a pattern through the body movements and music.

According to Marshall’s models of arts integration both participants are using the arts infused model in which they are only using the art form, in this case music, as a tool to solely teach the
content in another subject. This may be due to lack of knowledge and supports in the area, which was a reoccurring theme in the research.

These teachers were actively researching for resources to use specifically for arts integration. Even though these teachers are seeking resources, what they are finding may not be adequate enough for their personal learning. The participants both have started with Berke’s (2000) steps to successful integration which include getting organized, informing the principal, starting small, being proactive, being flexible and evaluating. These teachers have taken the first step of beginning to get organized. This implies that the administration of schools in Ontario may not be providing teachers with a wide range or adequate resources.

Michelle talks about the Orff itinerant teacher being her main source of resources and arts integrated lessons. Even though Michelle teaches in an arts based school she is not doing the planning for her arts integrated lessons, which has been shown to be a result in past research (May 2013). Arts teachers are the ones doing most, if not all, of the planning for arts integrated lessons as well as supporting the push for cross curricular and/or arts integrates methods of teaching. It is also mentioned that only four teachers a year in the arts based school receive these supports which can suggest that the other teachers may not necessarily need the supports because of having an arts based background or these are generalist teachers who are just going on unsupported in their teaching. This could be supported by May (2013) and McDonald & Fisher (2004) who state that there is a large amount of generalist teachers in primary schools and very few arts teachers. This is whole other topic in which would require further research in the Ontario schools to find out what the next step may be to better support our teachers which will consequently support our young learners.
These findings in the Ontario context are important because currently many of the major school boards in Ontario have a math initiative in place due to slipping math scores (PCAP-2010, 2012; Hammer and Alphonso, 2014; Stokke, 2015). Math scores are important because math achievement in the early years is a higher predictor of overall success in the areas in academics, personal finances, and career (Charette and Meng 1998; García Coll et al., 2007; García Coll et al., 2010; Stokke, 2015). Past research has shown that there is a significant increase in student engagement and understanding (Deasy, 2002; May, 2013; McDonald & Fisher, 2004; Parr, Radford, & Snyder, 1998). This may be connected to the fact that students learn better when provided with multiple strategies and methods to learn mathematical problem solving skills (Star & Rittle Johnson, 2008). Using a form of arts integration can provide them with a different view and method to solve certain problems.

4.5 Conclusion

The results of this study show: teachers are using the arts infused model of arts integration, that only teachers who are actively seeking resources for arts integration find them readily available, when the school and school board were providing resources they were only accessible to a handful of teachers.

These participants were actively looking for resources because they had an interest in teaching using arts integration but did not find that resources were not readily available to all teachers in most schools. Even within the arts based school only a small amount of teachers was receiving the supports of a specialized itinerant teacher either because they do not need the support or there is not enough support for all. Sandy’s school was not providing any resources which lead to the discussion around the schools and their boards not providing sufficient support for educators.
The participants did however find resources because they were actively searching for them. This was due to their personal interests in arts integration. Teachers with a lack of knowledge or interest in the area will not be looking for resources therefore not implementing them. With the lack of resources and support teachers are conducting basic arts integration where music is just a tool to disseminate information of another subject area.

Sandy and Michelle’s definition of arts integration speaks to the kind of lessons they implement in the classroom. Both teachers’ definition of arts integration was lower level because they use the arts as a tool to teach the core subjects such as math, science, and language. This may a result of lack of resources and knowledge. The final chapter will discuss the implication of these findings on arts integration for teachers and practices of schools in Ontario, the profession of teaching as a whole and future research to supplement and build on this research.
Chapter 5: IMPLICATIONS

5.0 Introduction

The purpose of the current study was to learn more about art integration in Ontario schools. The findings strengthen previous studies relating to arts integration in schools and more specifically about using the arts to support “traditional subjects”, lack of school provided resources, and minimal support from administration. The current chapter summarizes the research findings, highlights the present study’s implications for various stakeholders, provides several recommendations, and suggests directions for future research.

5.1 Overview of Key Findings

The results of this study show: (1) that only teachers who are actively seeking resources for arts integration find them readily available; (2) when the school and school board were providing resources they were only accessible to a handful of teachers; (3) teachers are using the arts infused model of arts integration.

The participants were actively looking for resources because they had an interest in teaching using arts integration but did find that resources were not readily available to all teachers in most schools. Even within the arts based school only a small number of teachers was receiving the supports of a specialized itinerant teacher either because they do not need the support or there is not enough support for all. Sandy’s school was not providing any resources, which led to the discussion around the schools and their boards not providing sufficient support for educators.

The participants did, however, find resources because they were actively searching for them. This was due to their personal interests in arts integration. Teachers with a lack of
knowledge or interest in the area will not be looking for resources therefore not implementing them. With the lack of resources and support, which consequently can lead to lack of awareness, teachers are either not using arts integration in any form or they are conducting basic arts integration in its simplest form where music is just a tool to disseminate information of another subject area.

Sandy’s and Michelle’s definitions of arts integration speaks to the kind of lessons they implement in their classrooms. Both teachers’ definitions of arts integration were lower level (Marshall, 2014) because they use the arts as a tool to teach the core subjects such as math, science, and language. This may a result of lack of resources and knowledge. The final chapter will discuss the implication of these findings on arts integration for teachers and practices of schools in Ontario, the profession of teaching as a whole and future research to supplement and build on this research.

5.2 Implications

The present study has important implications for educational reform for pre-service and in-service teachers. The first implication is surrounding the idea of teacher education lacking in arts education. The second implication is that the Ontario curriculum document values the arts more than the administration and overarching board of education. Each of these implications is discussed below.

First, the research implies that teacher education is not providing enough foundation for incoming teachers to implement arts education and cross-curricular lessons. Both participants implied that teachers, either themselves or their peers, were not fully prepared to teach music and implement arts integration. This tone was observed throughout the interviews even though they both were implementing some form of arts integration. This connects to Hash’s (2010) research
on how teachers did not feel comfortable teaching music and felt it should be taught by a specialist. Teacher education is not producing confident arts teachers (Berke, 2004), and being enrolled in one extra summer course improved these pre service teachers positively in the areas of musical ability, knowledge, music objectives and integration of music into the curriculum. Hash (2010) also found that teachers felt that music was less important than other core subjects. The implication from this research connected with past literature implies that there may not be a large focus or time placed on the arts in teacher education which consequently effects the views on its importance for teachers coming out of these programs. One participant also alluded to the fact even though she is in an arts based school that administration did not support all teachers and the second participant implied that they did not support any teachers with arts integration.

The second implication is that the school administration does not always fully support teachers who are using arts integration in the classroom, even though there is a math focus amongst the major school boards in the GTA. The Ontario Arts curriculum document has a section on the important of the arts in the curriculum:

“Education in the arts is essential to students’ intellectual, social, physical, and emotional growth and well-being. Experiences in the arts – in dance, drama, music, and visual arts – play a valuable role in helping students to achieve their potential as learners and to participate fully in their community and in society as a whole.” (p. 3)

Participants in the present study apparently did not share the same sentiment with regard to the importance of the arts in the curriculum. With the lack of support and resources it was implied that arts integration and arts a whole was not of importance to the administration, or that the administration was not searching for alternative ways to deal with decreasing math scores in Ontario. This is reflective of May’s (2013) research article, which lists multiple roadblocks, such
as, teacher and administrative collaboration, teacher participation and time constraints (May 2013). May (2013) also writes about advocacy mostly coming from arts teachers, which is not enough. This is a very clear roadblock due to the fact that schools, even the arts based school Michelle teaches in, has large amounts of generalist teachers.

5.3 Recommendations

Based on the implications from the findings there are some recommendations that can be made in regards to arts integration in Ontario schools. One recommendation is for the teacher education programs to provide longer courses on the arts and cross-curricular learning in order to provide future teachers with a foundation. Due to the lack of and minimalism of arts courses in teacher education the second suggestion is for schools and school boards to provide professional development for practicing teachers who have not received this as a part of their teacher education.

The first suggestion is for teacher education programs to provide more classes on the arts and cross-curricular learning. The research suggests that pre service teachers are not confident in teaching music and believe that specialists should be teaching music (Berke and Colwell, 2004; Hash, 2010). Michelle spoke about how she did not feel confident about teaching music even though she has taught in an arts-based school. She only began to feel more comfortable as she began to work with and resource teachers who provided her with the skills and resources to implement arts integration into the classroom. Sandy felt comfortable teaching music and through music because she had was a musician growing up but felt that her colleagues were not confident enough to do so because a lack of knowledge and experience. This is reflected in past literature. Berke and Colwell (2004) had pre service teachers participate in a summer music course. The pre service teachers improved in the areas of musical ability, knowledge, music
objectives and integration of music into the curriculum. This shows that teacher education programs need to provide more class time for the arts based courses. This will provide more opportunities for pre service teachers to become more comfortable in the field and be provided with resources they can begin to use in the field once they begin their career.

Having more classes in music for pre service teachers can also provide them with an opportunity to learn about the importance of arts education and integration. Research has shown that teachers overall feel that music is a less important subject however the non musical elements of the art form are more important than the music itself (Hash, 2010). The findings and past literature supports the recommendation of providing more class time for pre service teachers to learn about the arts and how to use them for cross curricular learning. The emphasis placed on the arts in teacher education will in turn produce educators who will feel more confident using arts integration in their future classrooms.

The second suggestion for administration is to provide more professional development opportunities for practicing teachers. The literature review shows the positives of arts integration on students mathematical understanding and performance (Gardner, 2006; Hirsh, 2010; Jensen, 2005; May, 2013; Schattschneider, 2006; Wilson, 2009; Jensen, 2005). Past literature also shows that preservice teachers do not feel prepared to teach the arts (Berke and Colwell, 2004; Hash, 2010). The implication also suggests that practicing teachers in Ontario schools also feel unprepared and not supported. This leads to the recommendation that schools and school boards need to provide more professional development for practicing teachers. This will provide them with a starting point to begin arts integration in the classroom to support their current math programs and PD.
5.4 Further Research

The present study has served to expand upon the extant literature, it has also highlighted the need for further study. In future research, it is recommended that a greater emphasis be placed upon supplementary quantitative data. Therefore, a quantitative or mixed methods study on how using music to teach mathematics is affecting student’s mathematical performance and anxiety would be beneficial for advocacy of arts integration and policy makers. Furthermore, this study has a small sample size due to time constraints. Conducting more interviews of educators across different major boards in the GTA would give further insight on how arts integration is valued and being implemented in schools in order to further advocate and shape the craft of teaching using arts integration.

5.5 Conclusion

Arts integration is a form of math instruction that past literature has shown to assist in teaching mathematical concepts to struggling students. This research has presented findings from two teachers in major school boards in the GTA. The findings showed (1) that only teachers who are actively seeking resources for arts integration find them readily available, (2) when the school and school board were providing resources they were only accessible to a handful of teachers, (3) teachers are using the arts infused model of arts integration.

These interviews also implied that teacher education programs in Ontario are lacking. The first implication is surrounding the idea of teacher education lacking in arts education. The second implication is that the Ontario curriculum document values the arts more than the administration and overarching board of education. The findings and implications of this present study align with past literature. This study is important because it is the Ontario context and how our teachers are functioning in the classroom. Teacher education and professional development
is not doing enough to produce all around confident educators. A teachers’ confidence in any subject area effects how they teach. With math scores sloping it is time for educators and administration to look at alternative methods for instruction and providing our incoming teachers with a solid education and current teachers with PD, in this case arts integration, will only help create more confident educators for the students that depend on them.
References


http://doi.org/10.2307/136200
doi:10.1177/8755123308317954


Math in the Music


doi:10.1177/1048371312464374


The Ontario Curriculum: Grades 1-8, The Arts (2009)

http://www.edu.gov.on.ca/eng/curriculum/elementary/arts.html


doi:10.1016/j.learninstruc.2007.09.018


Appendix A: The math value of musical notes

<table>
<thead>
<tr>
<th>Name of Note</th>
<th>Whole</th>
<th>Half</th>
<th>Quarter</th>
<th>Eighth</th>
<th>Sixteenth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note Symbol</td>
<td>⌘</td>
<td>⌘</td>
<td>⌘</td>
<td>⌘</td>
<td>⌘</td>
</tr>
<tr>
<td>Fraction of Measure</td>
<td>(\frac{1}{1})</td>
<td>(\frac{1}{2})</td>
<td>(\frac{1}{4})</td>
<td>(\frac{1}{8})</td>
<td>(\frac{1}{16})</td>
</tr>
<tr>
<td>Number of notes that fit into one Measure</td>
<td>(1 = 2^1)</td>
<td>(2 = 2^1)</td>
<td>(4 = 2^2)</td>
<td>(8 = 2^3)</td>
<td>(16 = 2^4)</td>
</tr>
</tbody>
</table>

(Jones & Pearson, 2013)
Appendix B: Consent Form

Date:

Dear __________________________,

I am a graduate student at OISE, University of Toronto, and I am currently enrolled as a Master of Teaching student. I am studying arts integration but more specifically music and mathematics for the purposes of the Masters of Teaching research paper. I would like to know how can music education have a positive effect on a students’ math achievement. I think that your knowledge and experience will provide insights into this topic.

The course supervising this research paper is instructed by Dr. __________________, and my research supervisor is Dr. ____________________. The purpose of this requirement is to allow us to become familiar with a variety of ways to do research. My data collection consists of a ______ minute interview that will be tape-recorded. I would be grateful if you would allow me to interview you at a place and time convenient to you, outside of school time.

The contents of this interview will be used for my assignment, which will include a final paper, as well as informal presentations to my classmates and/or potentially at a conference or publication. I will not use your name or anything else that might identify you in my written work, oral presentations, or publications. This information remains confidential. The only people who will have access to my assignment work will be my research supervisor and my course instructor. You are free to change your mind at any time, and to withdraw even after you have consented to participate. You may decline to answer any specific questions. I will destroy the tape recording after the paper has been presented and/or published which may take up to five years after the data has been collected. There are no known risks or benefits to you for assisting in the project, and I will share with you a copy of my notes to ensure accuracy.

Please sign the attached form, if you agree to be interviewed. The second copy is for your records. Thank you very much for your help.

Yours sincerely,

Melissa Barrow

Phone Number: 416-473-7295
Email: melissa.barrow@utoronto.ca

Instructors Name: Ken McNeilly
Email: Kenneth.mcneilly@utoronto.ca

Consent Form

I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw at anytime without penalty.

I have read the letter provided to me by Dakota Baird and agree to participate in an interview for the purposes described.

Signature:

Name: (printed) __________________________________________

Date: __________________________________________
Appendix C: Interview Questions

**Background Info**

1. What grade and subject matter are you currently teaching?
2. How long have you been in the profession?
3. What kind of musical background do you have? If at all?
   b. Formal training or self taught?

**Arts Integration**

4. Across which subjects have you used arts integration?
5. Are there certain subjects you feel more comfortable with than others?
6. What strategies do you use to comprehensively instruct the students while making a connection between mathematics and music?
7. What connections between music and mathematics have you used in past lessons?
8. Can you describe a sample lesson you have used?
   a. What were the students to learn from this lesson?
9. In what ways did you assess your students learning?
   a. Did you assess improvement from just math lessons versus arts integrated math lessons?

**Challenges**

10. What challenges have you faced implementing arts integration?
   a. Administration?
   b. Students and student learning?
   c. Colleagues?
11. Do you believe teachers have the support needed to implement arts integration effectively?
   
a. What steps do you think need to be taken to improve supports?