MATH IS MUSIC TO OUR EARS:
THE EFFECTS OF A MUSIC AND MOVEMENT INTEGRATED MATHEMATICS CURRICULUM ON SECOND GRADE STUDENTS' ENGAGEMENT WITH LEARNING

by

Amanda Boccardi

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Honors Bachelor of Science in Elementary Teacher Education with Distinction

Spring 2015

MATH IS MUSIC TO OUR EARS:

THE EFFECTS OF A MUSIC AND MOVEMENT INTEGRATED MATHEMATICS CURRICULUM ON SECOND GRADE STUDENTS' ENGAGEMENT WITH LEARNING

by

Amanda Boccardi

Approved: _____

Lynnette Young Overby, Ph.D.
Professor in charge of thesis on behalf of the Advisory Committee

Approved: _____

Elizabeth Pemberton, Ph.D.
Committee member from the School of Education

Approved: _____

Laura Eisenman, Ph.D.
Committee member from the Board of Senior Thesis Readers

Approved: _____

Michael Arnold, Ph.D.
Director, University Honors Program

ACKNOWLEDGMENTS

I would first like to thank Dr. Lynnette Overby, my thesis director and ArtsBridge Scholars Program director, for her endless support, guidance, and encouragement since the very start of the research process; without her, this project would not have been possible. Secondly, I would like to thank Dr. Elizabeth Pemberton, my second reader, and Dr. Laura Eisenman, my third reader, for providing constructive feedback throughout the entire writing process; their time and effort in doing so is extremely valued. I would also like to thank Karen Brady for kindly welcoming the curriculum "Math is Music to Our Ears" into her classroom as well as my fellow ArtsBridge scholars – namely Elizabeth Sablesak and Lucy Font – and ArtsBridge coordinators – Yael Haislip and Meghan Scully – for their constant support throughout the length of this project. Last but not least, I would like to thank my wonderful family and friends, whose continuous love and support have pushed me throughout this entire process to pursue my passions and reach for my potential.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The purpose of this research study was to investigate the effect of a music and movement integrated mathematics curriculum on second grade students' emotional, behavioral, and cognitive engagement with learning. A concurrent triangulation design was used to guide this inquiry. Four types of data were collected from the following sources: (a) journal reflections; (b) surveys; (c) videotaped student performances; and (d) written work samples. Participants were seventeen 2nd grade students from a public school in Newark, Delaware. Findings from in-depth data analyses suggest that participants perceived the integrated learning experience to be emotionally, behaviorally, and cognitively engaging.

Chapter 1

INTRODUCTION

High student disengagement and a decline of arts programs are two major problems facing K-12 schools in the United States today. In addition to these widespread issues, there is also a universal desire to equip students with the skills necessary for success in the complex 21st century world. This study addresses these issues by focusing on arts integration as one possible solution for K-12 classrooms. According to the Kennedy Center, "arts integration is an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objectives in both" (Silverstein & Lane, 2014, p. 1). In this study, arts integration was used to evaluate student engagement in an elementary mathematics classroom.

Arts integration pedagogy is grounded in the theories of Experiential Learning and Student Engagement, which both have influenced current teaching practices. As developed by David A. Kolb, Experiential Learning Theory defines learning as "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 41). Likewise, the Theory of Student Engagement developed based on this idea of experiential learning – that students learn when they are engaged in authentic experiences. Thus, engagement is naturally linked with achievement, as learning cannot exist without engagement with instruction (Fredricks, Blumenfeld, & Paris, 2004).

While it is well known that engagement is essential for learning, what does it truly mean for students to be *engaged*? Fredricks, Blumenfeld, and Paris (2004) offer a "multidimensional" perspective of engagement with three components: emotional, behavioral, and cognitive (p. 60). Emotional engagement refers to the extent to which a student's task involvement is characterized by positive emotion, as indicated by enjoyment and enthusiasm (O'Donnell, Reeve, & Smith, 2012). Behavioral engagement refers to the extent to which a student displays high attention, strong effort, and enduring persistence on a learning activity (O'Donnell et al., 2012). Lastly, cognitive engagement refers to the use of deep cognitive processes through which students use mental effort, synthesize concepts, and thus achieve greater understanding of ideas (O'Donnell et al., 2012). Defining student engagement as this "meta-construct" has allowed for teachers and researchers to form a richer characterization of the student learning experience. Thus, this multidimensional model for engagement was used as the structure that guided the analysis of student engagement in this study.

The purpose of this mixed methods study, therefore, was to use an arts integrated mathematics curriculum to investigate the effect, if any, that arts integration had on the emotional, behavioral, and cognitive engagement of second grade students. Entitled "Math is Music to Our Ears," the curriculum utilized two art subjects – music and movement – as tools to teach math concepts to second grade students. Through analyses of journals, surveys, videotaped student performances, and student work, this study found that "Math is Music to Our Ears" did engage students in terms of their emotional, behavioral, and cognitive engagement. This showed that an arts integrated

curriculum could, in fact, aid in increasing student engagement in elementary mathematics classrooms.

This thesis is organized into four sections: (a) a literature review, (b) the methodology for creating, implementing, collecting data, and analyzing data for a dance and math integrated curriculum, "Math that Moves You," (c) the results of the curriculum's effect on the engagement of second grade students, and (d) a discussion of the study's results and implications for future research.

Chapter 2

LITERATURE REVIEW

Introduction

This literature review explores theoretical frameworks that guide teaching practices and pedagogy for integrated mathematics curricula in the United States. Topics covered in this literature review are: (a) Experiential Learning Theory, (b) Theory of Student Engagement, (c) 21st Century Learning Skills, (d) STEAM, (e) arts integration, and (f) utilizing the arts to teach mathematics.

Arts integration pedagogy is grounded in the theories of Experiential Learning and Student Engagement, which both have influenced current teaching practices. Thus, many benefits have been found in utilizing this teaching approach in the classroom where the arts (e.g. dance, music, drama, the visual arts) are used as a tool to teach core content areas including mathematics, language arts, science, and social studies. More specifically, links have been made between arts-integrated mathematics teaching and positive student outcomes like achievement and positive changes in attitudes toward math. These benefits influenced the motivation for this study, through which the concept of arts integration was explored in a specific situation where second grade students learned mathematics through music and dance.

Experiential Learning Theory

Based on the work of Jean Piaget, Kurt Lewin, and John Dewey, the experiential learning theory was developed by David A. Kolb in the 1970s. According

to Kolb (1984), this theory defines learning as "the process whereby knowledge is created through the transformation of experience" (p. 41). The combination of grasping and transforming experiences results in knowledge (Kolb, 1984, p. 41). In other words, experiential learning is an active process involving transactions between a person and the environment, with prior experiences influencing the way a person thinks and constructs knowledge (Okan, 2012, p. 1080).

Kolb (1984) models this learning process as a cycle that consists of four main stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (p. 21). Personal experiences, the focal point for learning, give "life, texture, and subjective personal meaning to abstract concepts;" at the same time, they provide a "concrete, publicly-shared reference point for testing the implications and validity of ideas created during the learning process" (Kolb, 1984, p. 21). Therefore, this learning process can be viewed as a cycle, involving concrete experiences that guide the formation of abstract concepts, new thoughts for action, and thus the development of new experiences (Kolb & Kolb, 2009, p. 299).

Over the past several decades, new insights related to best practices in teaching have derived from the experiential learning theory. With a newfound view on learning, some educational theorists have begun to rethink how cognition should be conceptualized (Kolb & Kolb, 2009, p. 303). For example, rather than viewing it simply as the process of "thinking," Capra (1996) more broadly defines cognition to mean the process of "knowing" that involves "perception, emotion, and action – the entire process of life" (p. 175). The nature of experiential learning also lends itself to meta-cognitive thinking strategies. By consciously following a recursive cycle of experiencing, reflecting, thinking, and acting, individuals can increase their learning

power as they "learn how to learn." (Kolb & Kolb, 2009, p. 297). Additionally, the transfer of knowledge from previous learning experiences to new contexts results in the use of higher-level thinking strategies (Kolb & Kolb, 2009, p. 310).

Another implication of this learning theory highlights the responsibility of teachers to provide interactive environments that engage students in learning experiences, thereby fostering the construction of knowledge. "To teach is to engage students in learning… The aim of teaching is not only to transmit information but also to transform students from passive recipients of other people's knowledge into active constructors of their own and others' knowledge" (Christensen, Garvin, & Sweet, 1991, p. xiii, xv, xvi). Thus, if learning is to occur, it requires a space for it to take place; in experiential learning, this space exists in the experience of the learner and is formed both by objective factors such as the physical setting and time available for learning and by subjective factors such as learning preferences and expectations (Kolb & Kolb, 2009, p. 320).

Theory of Student Engagement

While the idea of student engagement has its roots in the experiential learning theory, Alexander Astin (1984) was among the first to focus his research on the link between engagement and academic achievement. According to Astin (1984), "A particular curriculum, to achieve the effects intended, must elicit sufficient student effort and investment of energy to bring about the desired learning and development" (p. 301). Research has since converged on the construct of engagement as playing a major role in high-quality learning and positive student outcomes (Fredricks & McColskey, 2012).

Since Astin's work, the idea of engagement has been conceptualized in numerous ways. More recently, *student engagement* is defined as a "meta-construct" that includes three dimensions: emotional engagement, behavioral engagement, and cognitive engagement (Fredricks, Blumenfeld, & Paris, 2004, p. 60). *Emotional engagement* refers to the extent to which a student's task involvement is characterized by positive emotion, as indicated by enjoyment and enthusiasm (O'Donnell et al., 2012, p. 335). The first indicator for emotional engagement, enjoyment, is defined as an affective state of pleasure, and the second indicator for emotional engagement, enthusiasm, is defined as intense enjoyment (O'Donnell et al., 2012, p. 335).

Behavioral engagement refers to the extent to which a student displays high attention, strong effort, and enduring persistence on a learning activity (O'Donnell et al., 2012, p. 335). The first indicator for behavioral engagement, attention, is defined as concentration and on-task focus; the second indicator for behavioral engagement, effort, is defined as the investment of physical and mental energy on a task; and the third indicator for behavioral engagement, persistence, is defined as the investment of effort over time (O'Donnell et al., 2012, p. 335).

Cognitive engagement refers to the use of deep cognitive processes through which students use mental effort, synthesize concepts, and thus achieve greater understanding of ideas (O'Donnell et al., 2012, p. 336). Thus, the students' ability to synthesize concepts, or create connections among ideas, serves as an indicator for deep cognitive processing, and thus, for cognitive engagement (Weinstein & Mayer, 1986, p. 315).

Focusing fully on the emotional quality, behavioral intensity, and cognitive investment of a student's involvement during a learning activity provides a richer

characterization of children than is possible in research on single components (Fredricks et al., 2004; Skinner, Furrer, Marchand, & Kindermann, 2008; Wellborn, 1991). For instance, emotionally, a student might enjoy an activity but fall off-task quickly or struggle to connect ideas; behaviorally, a student might be on task but dislike what he is doing or struggle to make connections; and cognitively, a student might be thinking deeply about concepts but may dislike what he is doing or lose focus quickly (Fredricks et al., 2004, p. 61). Thus, defining student engagement as the full range of positive emotions, on-task behavior, and invested cognition creates a meaning that is suitable for understanding learning and development (Reeve, 2006, p. 668).

Why is Student Engagement Important?

Student engagement is important for four main reasons: it makes learning possible, it predicts students' academic progress and achievement, it is malleable, and it provides teachers with moment-to-moment feedback about the progress of their students (O'Donnell et al., 2012, p. 337). First, learning is "practically impossible without attention, effort, positive emotion, and deep information processing and understanding" (O'Donnell et al., 2012, p. 337). To make student engagement possible, teachers must provide students with a learning environment that includes instructional activities aimed to motivate students (O'Donnell et al., 2012, p. 338). Learning environments that tap into student interests, preferences, goals, and other motivational resources affect engagement, or how actively involved students are in the classroom (O'Donnell et al., 2012, p. 338). Engagement then leads to various student outcomes, including learning, achievement, and skill development (O'Donnell et al.,

2012, p. 338). Thus, student engagement can be viewed as the outward manifestation of motivation on which learning is dependent (O'Donnell et al., 2012, p. 336).

Secondly, past research indicates that student engagement has numerous short-term and long-term effects on academic and personal success. In the short-term, engagement predicts students' learning, grades, and achievement test scores; over the long term, it predicts patterns of attendance, retention, graduation, and academic resilience (Finn & Rock, 1997; Balfanz, Herzog, & Mac Iver, 2007). A recent study conducted by the Education Week Research Center (2014) surveyed educators across the nation directly on this topic. Of the 497 participating educators, all 497 educators identified student engagement and motivation as the most important driver of student achievement, ranking higher than teacher quality, school climate, parental support, school safety, social and emotional learning, school discipline policies, and family background (p. 11).

Third, student engagement is presumed to be "malleable" and highly influenced by the learning environment (Bempechat & Shernoff, 2012, p. 318). Unlike with students' inward motivation or abilities, teachers can influence student engagement (O'Donnell et al., 2012, p. 337). For example, if teachers try to answer the question, "How can I motivate my students?" they may feel overwhelmed by this task; however, if teachers instead consider the question "How can I engage my students?" they may feel much less overwhelmed (Bempechat & Shernoff, 2012, p. 318). To create a learning environment that engages students, such strategies include (1) relating to students in caring ways, (2) supporting students' autonomy or self-determination; (3) providing clear structure, and (4) offering classroom activities that are interesting, optimally challenging, and provide opportunities to collaborate with

peers (O'Donnell et al., 2012, p. 337). Thus, teachers can control the caring, supportive, structured, and challenging instruction that they provide, which can increase engagement (O'Donnell et al., 2012, p. 337) and therefore counter downward student trajectories (Bempechat & Shernoff, 2012, p. 318).

Fourth, student engagement can be visible, especially in terms of behavior, allowing teachers to observe the motivation levels of their students (O'Donnell et al, 2012, p. 337). For example, teachers can monitor which students are on and off task, providing them with insight on how well the instructional activities promote engagement. Thus, the moment-to-moment feedback that engagement provides enables teachers to determine how well their efforts to engage students are working (O'Donnell et al., 2012, p. 337).

21st Century Skills and STEAM

With the turn of the millennium, rapid technological advances gave rise to the Digital Age, impacting society on a multitude of levels. Recognizing this impact, a group of educational leaders advocated for schools to take action in order to adequately prepare students for these societal changes. Thus, the Partnership for 21st Century Skills (P21) was founded in 2002 and positioned 21st century readiness at the center of K-12 education (Partnership, 2009, p. 1).

According to this national organization, students need more than just a mastery of core subjects in order to succeed in the complex life and work environments of the 21st century (Partnership, 2009, p.1). To be prepared for a successful future, students must also learn to make interdisciplinary connections across subjects and develop four main skills: (1) creativity and innovation; (2) critical thinking and problem solving; (3) communication; and (4) collaboration (Partnership, 2009, p. 2). Therefore, the

mastery of these four essential skills within the context of core knowledge instruction will help students to prosper in the 21st century.

Over the past several decades, in accordance with the initiative to teach 21st century skills, there has also been a major national push to strengthen K-12 education in the STEM fields – science, technology, engineering, and mathematics. Current job projections for the year 2018 indicate that 16 of the 20 occupations with the largest projected growth are STEM related (Lacey & Wright, 2009, p. 92). However, the demand for STEM-capable workers today is greater than the supply of applicants who have trained for those careers (Lacey & Wright, 2009, p. 83). Thus, advancing the STEM brand has become a "well-supported campaign to better link K-12 science teaching to today's industry while preparing tomorrow's high-tech work force" (Bequette & Bequette, 2012, p. 43).

Along with the push to strengthen the STEM subjects in K-12 education came the question of how to do so, especially in the elementary and middle school classrooms (Bequette & Bequette, 2012, p. 43). As a solution, the arts were introduced to the set, forming the "STEAM" initiative (Bequette & Bequette, 2012, p. 43). Bequette and Bequette (2012) argue that the arts can serve not only to present the STEM subjects to students in an engaging manner but also to help students see the natural interdisciplinary connections across the subjects, increase creativity, and develop cultural understandings (p. 47). Some skills that are used similarly by scientists, technicians, engineers, artists, and mathematicians include planning and designing, using spatial reasoning, collaborating, problem solving, communicating, and even constructing an aesthetically pleasing product (Bequette & Bequette, 2012, p. 43-44). The development of creativity occurs in these processes, a skill that the arts

particularly enhance. According to Csikszentmihalyi.(1996), creativity is "individual ingenuity" and "when we are involved in it, we feel that we are living more fully than during the rest of life" (p. 2). Thus, it is evident that the STEAM subjects foster the mastery of the four major 21st century skills, thereby readying students for future success in the workplace and life.

Arts Integration

The theoretical frameworks for experiential learning, student engagement, and 21st century readiness set the foundation for the development of the "Math is Music to Our Ears" curriculum that was implemented in this study. This curriculum used arts integration techniques to teach mathematics, music, and movement concepts. According to the Kennedy Center, *arts integration* is defined as an "approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objectives in both" (Silverstein & Layne, 2014, p. 1).

Why Music and Dance?

Inherent connections between music and dance have been observed throughout history; Paul Hodgins, for example, coined the term "choreomusicology" to highlight this interdependence (Mason, 2012, p. 6). According to Hodgins, choreomusical relationships fall into two categories: intrinsic and extrinsic (Mason, 2012. p. 18). Intrinsic relationships are rhythmic (pulse, accent, or meter), dynamic (volume), textual (arrangement of instruments or dancers), structural (phrasing or form), qualitative (timbre of sound or sharpness of movement), and mimetic (sound mimicking movement or movement mimicking sound) (Mason, 2012, p. 18).

Extrinsic relationships are archetypal (symbolic aspects), emotional (expression of feelings), and narrative (story-telling) (Mason, 2012, p. 19). Because of the innate intrinsic and extrinsic relationships between music and dance, integrating both art forms with mathematics for this study seemed feasible.

Past research also shows that integrating music and dance with core subjects – particularly with mathematics – engages students. In a three-year study of 7,000 Canadian students in Grades 1 through 6, Upitis (2011) found that the students who received arts integrated instruction scored 11 percentile points higher on mathematics exams than did the students who did not receive arts integrated math instruction (p. 3). In addition, these students and their teachers, parents, and administrators were interviewed about their experiences with the arts integration programs. In fact, one sixth-grade boy said, "Music brightens up the mind. When you learn something new, you feel good and that makes you feel good in other subjects like math" (Upitis, 2011, p. 4). By the end of the three-year period, over 90 percent of the teachers in the arts-integration group expressed a newfound appreciation for how students could learn about non-arts subjects through arts-infused instruction (Upitis, 2011, p. 4). Principals in this group also considered the arts as "very important" by the end of the study, a sentiment that some did not express at the beginning (p. 4).

Werner (2001) also investigated the effects of arts integration by comparing student attitudes toward math in the dance-integrated and traditional classroom settings (p. 1). Between 100 and 115 students in Grades 2-5 in each of the two classroom types completed pre- and post-surveys in the fall and spring related to their attitudes toward math (Werner, 2001, p. 3). On the fall pre-test survey, students from the dance integration classrooms scored the same as their non-dance counterparts on

their attitude toward math (Werner, 2001, p.5). However, after having one year of dance and math, the dance integration students scored much higher than the non-dance students (Werner, 2001, p.5). In general, the dance and math students either stayed the same or increased their scores on the survey, whereas the non-dance and math students stayed the same or decreased their scores (Werner, 2001, p. 5).

More recently, Ryan (2014) investigated the effect that instruction of mathematics through a dance integrated curriculum supplement has on second graders' academic achievement and attitudes. Data from twenty-two participating students, including pre- and post-tests, journal entries, and videotaped student performances, showed increases in math and dance content knowledge, increases in creativity and performance skills, and positive student attitudes toward both math and dance (p. 220). Thus, the findings of both Werner (2001) and Ryan (2014) illustrate both academic and personal benefits that elementary school students experience from dance and math integrated learning.

The Research Problem

High Student Disengagement in Today's Schools

According to the National Council of Teachers of Mathematics (2000), the vision for mathematics classrooms is for all students to have "access to high-quality, engaging mathematics instruction" and for students to "value mathematics and engage actively in learning it" (p. 2). However, student disengagement also remains a widespread issue.

To understand the scope of the problem in the United States today, a recent 2014 study surveyed educators across the nation directly on this topic. Two-hundred-

ninety-three (293) of 488 educators (60.0%) reported that the majority of students at their schools were disengaged and unmotivated (Education Week Research Center, 2014, p. 23). At the elementary level in particular, another study investigated a variety of teaching methods and their effects on student engagement in 22 classrooms from kindergarten through fourth grade (Godwin, Almeda, Petroccia, Baker, & Fisher, 2013, p. 2449). Consistent with prior research, this study found that elementary students spend 29% of their time off task, with distractions more likely to happen when children are working on their own or receiving whole-group instruction at their desks (Godwin et al., 2013, p. 2451).

Several related studies have linked disengagement to negative student outcomes as extreme as dropping out. In one longitudinal study, for example, student progress was studied for a five-year duration from eighth grade to twelfth grade (Finn & Rock, 1997, p. 224). The participating students were classified as either: (a) resilient, if high school was completed with grades being about half B's and C's or better; (b) nonresilient completers, if high school was completed with mostly C's or below; or (c) dropouts, if high school was not completed (Finn & Rock, 1997, p. 225). Of a sample containing 1,803 students from low-income homes, 332 students (18.4%) were classified as resilient; 1,301 students (72.2%) were classified as nonresilient completers; and 170 students (9.4%) were classified as dropouts (Finn & Rock, 1997, p. 225). One key finding was that nonresilient completers and dropouts (81.6% of the sample) were less engaged in school in terms of hard work, class attendance, homework completion, attentiveness, obedience, and preparedness than those who were resilient (Finn & Rock, 1997, p. 226). A similar longitudinal study conducted by Balfanz, Herzog, and Mac Iver (2007) yielded similar results.

For mathematics in particular, research indicates that during the years between elementary school and high school, many students disengage from math – to the detriment of their later schooling, and even their adult careers. A study that followed 273 students over the course of their first year of middle school, for example, found that by spring, the pupils described mathematics as less valuable than they had the previous fall, and reported that they were investing less effort and persistence in the subject than they had before (Pajares & Graham, 1999, p. 124). Researchers from the University of Sydney in Australia, set out to investigate what made middle-school students switch on or off to math (Martin, Anderson, Bobis, & Way, 2012, p. 1). The findings of Martin and his colleagues, based on data from 1,601 Australian middle school students from 200 classrooms in 33 schools, concluded that low levels in self-efficacy, personal enjoyment, and the value that students place on math as well as high levels of math anxiety contributed to student disengagement in the subject (Martin et al., 2012, p. 1). However, the authors suggested that teachers can help foster student enjoyment by creating a classroom environment that meets the interests of students (Martin et al., 2012, p. 14), a major contributor for engaging students in learning.

A Decline in Arts Programs

According to the U.S. Department of Education, during the decade of 2000 to 2010, there was a decline in the availability of music, visual arts, dance, and drama classes in elementary schools (Parsad & Spiegelman, 2012, p. 5), a decline that many attribute to budget cuts and an increased focus on reading and mathematics instruction (Sousa & Pilecki, 2013, p. 10). During this decade, elementary schools generally maintained their music programs; however, the amount of time devoted to music instruction dropped dramatically, typically from three to five periods per week to just

one or two (Sousa & Pilecki, 2013, p. 10). While the availability of music instruction in public schools remained steady in general, there were noticeable declines in the nation's poorest high schools; a decade ago, 100% of these high schools offered music programs, but today this number is down to 81% (Sousa & Pilecki, 2013, p. 11).

The availability of dance instruction in public schools between 2000 and 2010 faced drastic changes. In the 2009-10 school year, 3% of elementary schools offered instruction that was designated specifically for dance during the regular school hours, a decline from 20% last decade (Sousa & Pilecki, 2013, p. 40). As dance dropped dramatically during the decade as a stand-alone subject in elementary schools, it was steadily incorporated into other subject and curriculum areas including physical education and music (Parsard & Spiegelman, 2012, p. 50). However, even the integration of dance in physical education and music declined. In the 2009-2010 school year, 44% of elementary schools offered dance as part of the school's physical education program – a decrease from 48% last decade; for dance and music, this decline was from 48% to 37% (Parsard & Spiegelman, 2012, p. 50).

Arts Integration as a Solution

Student disengagement and the cutting of arts programs are two major issues facing K-12 schools today. Even more universal is the desire to equip students with the skills necessary for success in the complex 21st world. This study addresses these issues by focusing on arts integration as one possible solution. Using a music and movement integrated mathematics curriculum called "Math is Music to Our Ears," this study aims to identify the effects, if any, that arts integration has on the emotional, behavioral, and cognitive engagement of second grade students.

Conclusion

This literature review explored two of the theoretical frameworks that arts integration curricula in general and the "Math is Music to Our Ears" integrated curriculum are based on: (a) Experiential Learning Theory, and (b) Student Engagement Theory. It also outlined the 21st Century Learning Skills and STEAM initiatives, which were foundational for the development of the curriculum "Math is Music to Our Ears."

In addition, two problems facing today's schools, high student disengagement and a decline in arts programs, were addressed. Arts integration was identified as a possible solution to these two issues. In particular, integration of the arts and mathematics was also noted in detail, showing benefits of studies incorporating music and dance into mathematics teaching. These studies displayed an emphasis on student achievement and the development of positive attitudes toward mathematics as a result of such integrated instruction.

As these benefits were noted, the subthemes of student emotional, behavioral, and cognitive engagement with learning were not investigated systematically through one study; they were only touched upon in various studies and in different kinds of light. The following chapters explore a curriculum supplement, "Math is Music to Our Ears" that was studied to fill in this gap by evaluating student engagement in learning math – emotionally, behaviorally, and cognitively – through arts integration. The following chapter discusses the methodology utilized to study this curriculum supplement.

Chapter 3

METHODOLOGY

Introduction

Student engagement is a meta-construct that includes three dimensions: emotional, behavioral, and cognitive engagement (Fredricks et al., 2004). The purpose of this research study that used a curriculum entitled "Math is Music to Our Ears" was to show the effect, if any, that instruction of mathematics through a music and movement integrated curriculum has on second graders' engagement with learning. In this mixed methods study, qualitative and quantitative data were collected and analyzed. In addition, three case studies were conducted. The methodology for the collection and analyses of the qualitative and quantitative data are discussed below.

Research Questions

The main research question that guided the study of student experiences through integrated learning was: What were the effects of a music and movement integrated mathematics curriculum on second grade students' emotional, behavioral, and cognitive engagement with learning? To investigate this question, three focus questions were addressed, each pertaining to a facet of engagement:

(1) What were the effects of a music and movement integrated mathematics curriculum on emotional engagement, as indicated by enjoyment and enthusiasm?

(2) What were the effects of a music and movement integrated mathematics curriculum on behavioral engagement, as indicated by attention, effort, and persistence?

(3) What were the effects of a music and movement integrated mathematics curriculum on cognitive engagement, as indicated by deep cognitive processing?

Participants

A second grade class at a public school in Newark, Delaware was chosen for this study. This class consisted of 17 students, 10 females and 7 males; all students volunteered and signed assent forms to participate in the study. Parent consent forms were also obtained for all 17 students to participate, with 15 students having permission to be videotaped. The students' classroom teacher also volunteered to participate in the study through the ArtsBridge America program at the University of Delaware. None of the students had IEPs (Individualized Education Plans) or needed any other academic accommodations during the time that the curriculum was implemented. In addition, none of the students had previously experienced learning through arts integration at the time that this study was implemented.

Rationale for Mixed Methods Design

Creswell, Plano Clark, Gutmann, and Hanson (2003) define a mixed methods design as consisting of the "collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research" (p. 212). Several types of mixed methods designs

have been implemented in past research. In this study, Creswell's (2013) concurrent triangulation model was used as the framework for the research design.

Using the concurrent triangulation model, qualitative and quantitative data sources were collected concurrently, were analyzed separately, and then were utilized in combination to find patterns when comparing the data sets (Patton, 2002). Three types of qualitative data sources were collected: (a) journal responses, (b) survey responses, and (c) observations from video footage. Two types of quantitative data were collected: (a) scores based on student work samples and (b) student self-ratings on a survey. In determining whether to assign the qualitative and quantitative data equal or unequal priority, the researcher broke down the original research question into aspects to be assessed by the data sources. Thus, three facets of "student engagement" with learning through arts integration were developed: emotional engagement, behavioral engagement, and cognitive engagement. (See Appendix A for the Model of Student Engagement.) Journal responses and survey responses were designed primarily to assess the students' emotional engagement; video recordings of dance performances and journal entries were designed to assess the students' behavioral engagement; and student work samples and journal responses were designed to assess the students' cognitive engagement. Because each component of engagement is equally important, the qualitative and quantitative data sources were determined to have equal priority in their analyses.

Through Creswell's (2013) concurrent triangulation model, the collection of diverse data sources, referred to as *data triangulation*, served to strengthen the study, as the strength of one type of data source could compensate for the potential weaknesses of another (Patton, 2002, p. 247). This approach could thus help increase

reliability and validity among the sources and findings. According to Jick (1979), data triangulation "can also capture a more complete, holistic, and contextual portrayal of the unit(s) under study" (p. 603). Through the use of various data sources, different aspects of engagement could be assessed in more than one way.

Rationale for Case Study Analyses

In addition to using the mixed methods design to assess student engagement for the whole class, the qualitative and quantitative data were used for case study analyses of three individual students. In this study, a computerized generator randomly selected three individual students as the subjects of case study analyses. Case studies are a design of inquiry in which the researcher develops an in-depth analysis of specific cases (bounded by time and activity) using a variety of data collection procedures to gather information over a sustained period of time (Creswell, 2013, p. 14). According to Creswell (2013), researchers identify themes during the coding process of the data and interconnect themes across cases (p. 200).

Case studies are generally strong where statistical methods and formal models are weak. While one limitation of case studies is generalization, George and Bennett (2004) identify four main advantages that make the case study design valuable in testing hypotheses and in the development of theories (p. 19). These four advantages of case studies include their potential for achieving high conceptual validity, their strong procedures for fostering new hypotheses, their value in examining the role of causal mechanisms in the context of individual cases, and their capacity for addressing causal complexity. In terms of conceptual validity, where statistical studies run the risk of "conceptual stretching" by lumping together dissimilar cases to get a larger sample, case studies allow for conceptual refinements with a higher level of validity

over a smaller number of cases. In terms of deriving new hypotheses and identifying causal mechanisms in individual cases, in-depth observations and analyses can reveal if the hypothesized variables affect a certain outcome or if new variables may affect a certain outcome. Thus, case study analyses provide research with great insight into the causal complexity of why certain outcomes occur (George & Bennett, 2004, p. 19).

Curriculum Development

The "Math is Music to Our Ears" curriculum was written by the researcher based on the Common Core State Standards for second grade math and the National Core Arts Standards for music and dance. It included one introductory mini-lesson that presented two types of movement concepts: (a) general and self-space and (b) locomotor movements and non-locomotor movements. It also consisted of six integrated lessons: (1) Shape Dance, (2) Lunch Time Dance, (3) Money Rhythms, (4) Money Dance, (5) Fraction Notes, and (6) Math is Music to Our Ears. (See Appendix B for the learning plans of each lesson.) The first four integrated lessons were peer taught with another ArtsBridge scholar, Elizabeth Sablesak.

The design of this curriculum followed McTighe and Wiggins' (2005) backwards design model. This template for curriculum writing consisted of three stages. In Stage 1, standards and learning objectives from math, music, and movement were chosen. Math concepts included (a) time, (b) money, and (c) fractions. Music concepts included (a) rhythm and (b) note values. Movement concepts included (a) general and self-space, (b) loco-motor and non-locomotor movements, and (c) sharp and smooth force. The big idea bridging the concepts taught in these lessons was "patterns." In Stage 2, performance tasks were developed in alignment with the chosen standards in order to assess what the students would learn. In Stage 3, the six

integrated learning plans were created. The activities in the six integrated learning plans were not only developmentally appropriate because they aligned with the second grade standards, but they involved group activities that allowed students to learn by doing. Through this discovery-based learning, the students were centered as active constructors of knowledge while they were able to physically move around (a developmental need) and experience the content in a fun way (O'Donnell et al., 2012, p. 84).

Each lesson plan followed a similar structure. The students began each lesson with a whole group brainstorm of the concepts to be learned that day. A movement warm-up was next, followed by group activities that integrated math, music, and movement ideas. Following this were group performances that were videotaped. Each lesson ended with the students reflecting on their learning experiences through written journals. The videotaped group performances, written journals, and student work samples from integrated group activities served as formative assessments (tasks that help monitor students' learning during a small span of time) throughout the implementation of the curriculum.

Duration

The curriculum was taught during a three-week period. After introducing the students to the arts-integrated approach with a mini-lesson about movement concepts, the researcher collected consent forms by the last week of November 2013. The researcher went into the classroom one time during this week to teach the first of six integrated lessons. The second week consisted of teaching the next three lessons, and the third week consisted of teaching the last two lessons. Each lesson occurred from 12:20-1:10pm between November 22, 2013, and December 12, 2013. "Math is Music

to Our Ears" was the first time that the students were exposed to the mathematics concepts, since the students were scheduled to receive traditional instruction about time, money, and fractions during the months of March, April, and May. The researcher then returned to the class in May of 2014 to implement a post-survey.

Instruments

Four instruments were utilized in order to collect qualitative and quantitative data about the students' engagement with learning through the arts integrated approach. Three sources of qualitative data included (1) daily journal responses, (2) post-survey free responses, and (3) videotaped student performances. Two sources of quantitative data included: (1) student work samples from one lesson and (2) student self-ratings on the post-survey.

Data Collection Procedures

During the collection of all data sources, the students were reminded to provide their honest opinions and best efforts. Both qualitative and quantitative data sources were collected to answer the following research question: What were the effects of a music and movement integrated mathematics curriculum on second grade students' emotional, behavioral, and cognitive engagement with learning? To assess emotional engagement, daily journal responses, survey responses, and survey self-reports were collected. To assess behavioral engagement, videotaped dance performances and journal entries were collected. To assess cognitive engagement, student work samples, journal responses, and videotaped dance performances were collected.

Emotional Engagement

The first research question guiding the investigation of student emotional engagement during the implementation of the arts-integrated unit was: What were the effects of a music and movement integrated mathematics curriculum on emotional engagement? *Emotional engagement* refers to the extent to which a student's task involvement is characterized by positive emotion, as indicated by enjoyment and enthusiasm (O'Donnell et al., 2012, p. 335). The first indicator for emotional engagement, enjoyment, is defined as an affective state of pleasure, and the second indicator for emotional engagement, enthusiasm, is defined as intense enjoyment (O'Donnell et al., 2012, p. 335). Two qualitative data sources were used to assess the level of emotional engagement in terms of enjoyment and enthusiasm for the whole class: (1) selected daily journal responses and (2) survey responses. One quantitative data source, student self-ratings from the post-survey, was also used to assess the level of emotional engagement in terms of enthusiasm for the whole class.

Daily Journal Responses. At the end of each day of instruction, the participants reflected on their learning experiences in personal journals. The students were provided with ten minutes each to respond to two prompts, "What did you like or not like about today's lesson?" and "What did you learn today?" On the sixth and final day, the students were posed an additional third question, "What was your favorite or least favorite part of this entire experience?" (See Appendix C.) These prompts were written on the front chalkboard for visual reinforcement. The length and detail of each response was left up to the students, and they were reminded to answer honestly.

Survey Free Responses and Self-Ratings. In addition to daily journal entries, a post-survey was implemented five months after the last day of instruction in order to

evaluate the students' enjoyment and enthusiasm about their learning experiences during the implementation of the arts-integrated curriculum. The survey was completely anonymous in order to encourage honesty and to protect the identity of the students. The survey included four parts. Parts 1 and 2 consisted of a quantitative component in which the students rated themselves on a five-point scale in terms of how much they learned certain concepts (Part 1) and how much they enjoyed learning certain concepts (Part 2). Parts 3 and 4 consisted of a qualitative component in which the students were able to freely elaborate on how much they learned certain concepts (Part 3) and how much they enjoyed learning certain concepts (Part 4). Because Parts 1 and 3 asked the students to rate themselves and elaborate on how well they learned certain concepts, it was the intention of the researcher to use only Parts 2 and 4 during the analysis of emotional engagement on surveys in terms of enjoyment and enthusiasm. (See Appendix E for the survey and Appendix F for the selected questions.)

Behavioral Engagement

The second research question guiding the investigation of student behavioral engagement during the implementation of the arts-integrated unit was: What were the effects of a music and movement integrated mathematics curriculum on behavioral engagement? *Behavioral engagement* refers to the extent to which a student displays high attention, strong effort, and enduring persistence on a learning activity (O'Donnell et al., 2012, p. 335). The first indicator for behavioral engagement, attention, is defined as concentration and on-task focus; the second indicator for behavioral engagement, effort, is defined as the investment of physical and mental energy on a task; and the third indicator for behavioral engagement, persistence, is

defined as the investment of effort over time (O'Donnell et al., 2012, p. 335). Two qualitative data sources were used to assess the level of behavioral engagement in terms of attention, effort, and persistence for the whole class: (1) videotaped dance performances and (2) journal entries.

Videotaped Dance Performances. A permission form was signed by 15 out of the 17 of the students' parent or legal guardian, which granted permission for the students to be videotaped during the lessons. Of the six integrated lessons, five lessons consisted of dance performances that integrated the math, music, and dance concepts learned that day. The students performed these dances in groups. Given instructions for the task, the students were free to collaboratively develop the choreography. During this collaborative process, the researcher circulated around the room in order to assist the students in resolving questions or issues. The two participants, who did not consent to the videotaping procedure, were not videotaped. Consequently, their group mates for the day were not videotaped as well. Groups varied in size and were predetermined by the researcher in order to optimize instructional time and match students who worked well together. The researcher used previous observations as well as guidance from the general classroom teacher in order to determine the groups based on behavioral compatibility.

Journal Entries. In addition to the videotaped dance performance tasks, the daily journal entries were also used to assess the level of student effort on the task. As described above, at the end of the first five lessons, the students responded to two prompts and at the end of the sixth lesson, the students responded to three prompts. Because the length of these free responses were determined by the students, the daily

journal entries served to collect qualitative data on student effort, an indicator for behavioral engagement. (See Appendix C for selected journal questions.)

Cognitive Engagement

The third research question guiding the investigation of student cognitive engagement during the implementation of the arts-integrated unit was: What were the effects of a music and movement integrated mathematics curriculum on cognitive engagement? *Cognitive engagement* refers to the use of deep cognitive processes through which students use mental effort, synthesize concepts, and thus achieve greater understanding of ideas (O'Donnell et al., 2012, p. 336). Thus, the students' ability to synthesize concepts, or create connections among ideas, was used as an indicator for deep cognitive processing, and thus, for cognitive engagement (Weinstein & Mayer, 1986, p. 315). Three quantitative data sources were used to assess the level of cognitive engagement: (1) student work samples, (2) journal responses, and (3) videotaped dance performances.

Student Work Samples. Of the six integrated lessons, one lesson consisted of a culminating task that did not involve dance. This lesson was entitled Money Rhythms and focused on the integration of mathematics and music. The culminating task at the end of this lesson was a paired activity that consisted of creating rhythms with coins and music rests. (See Appendix I for this activity.) Each student in the class had a partner; however, due to the odd number of participants in this class, one student chose to work individually instead of in a group of three. During this task, the researcher circulated around the classroom to answer any questions only about the task itself (i.e. questions about how a quarter should be drawn or how to draw a quarter rest in music), allowing the students independence in how they wanted to respond. The

task was used to assess if the students were able to integrate mathematics and music concepts, which would show the students' level of cognitive processing.

Journal Responses. The daily journal responses also served to provide additional information about which specific topics cognitively engaged the students. One question in particular was aimed to collect this information: "What did you learn today?" The students were encouraged to answer freely and honestly. (See Appendix C for selected journal questions.)

Videotaped Dance Performances. As described above, the students performed five dances that integrate math, music, and dance. One selected dance, "Lunch Time Dance" from Lesson 2, was used to evaluate the students' knowledge of dance and math. (See Appendix J for this dance performance task and rubric.)

Case Studies

Since the post-surveys were anonymous, the data sources used for each of the three case studies were: (1) daily journal entries, (2) videotaped dance performances, and (3) student work samples. The students selected for these case studies, one male and two females, were selected using a computerized random generator in order to prevent researcher bias

Data Analysis Procedures

All students were assigned codes in order to ensure confidentiality. Qualitative data were scored based on rubrics in several categories depending on the data source (shown in Appendices D, G, and H). Using the same rubrics, a second rater then coded the data, and the scores were analyzed for inter-observer agreement.

Quantitative data were scored based upon a binary scoring system in which a response was either correct or incorrect.

Emotional Engagement

Daily Journal Responses. Selected journal responses were scored based upon rubrics related to the categories of Student Enjoyment and Student Enthusiasm. These selected responses could be found in Appendix C and their rubrics in Appendix D. The only responses that were utilized for this data set were from students who were present in class and had answers to all of the selected journal questions so that the data were not skewed.

After the researcher scored the journal responses, another individual also scored them for inter-rater reliability. The percentage of inter-observer agreement (IOA) was calculated by dividing the number of agreements (scores that were the same between the two observers) by the total number of scores assigned (agreements plus disagreements). This value was converted into a percentage (Thomas, Nelson, & Silverman, 2011, p. 203). If the IOA was below 80%, the two observers met and discussed 10 of their disagreements chosen at random until they agreed upon 8 of those scores. The researcher then modified the rubrics based on this discussion to clarify the description for each score. Once the IOA was 80% the qualitative results were considered trustworthy.

The IOA was utilized to determine the trustworthiness of the scores given on the rubrics of the journal responses. Because the instructor and the researcher were the same person, a second observer scored the qualitative data based on the rubrics, and then the IOA was calculated to determine whether or not the data were reliable.

Survey Responses. Selected survey responses were scored based upon rubrics related to the categories of Student Enjoyment and Student Enthusiasm. These selected responses could be found in Appendix F and their rubrics in Appendix G. The only free responses that were utilized for this data set were from students who had answered to all of the selected survey questions so that the data were not skewed.

Another individual scored the survey responses with the same rubrics, and an IOA percentage was calculated for the survey responses using the same procedures outlined above for the journal responses. If the IOA was below 80%, the two observers met and discussed 10 of their disagreements chosen at random until they agreed upon 8 of those scores. The researcher then modified the rubrics based on this discussion to clarify the description for each score. Once the IOA was 80% the qualitative results were considered trustworthy.

Student Self-Ratings on Survey. Along with the students' free responses on the journals and surveys, student self-ratings on the post-survey were also analyzed in order to further assess the students' emotional engagement. (See Appendix F for these selected questions.) On the same survey implemented through the methods discussed above, the students rated their enthusiasm on a five-point scale in how much they enjoyed learning (a) math, (b) music, (c) movement, and (d) math through music and math through movement. The only responses used for this data set were from students who were present and answered all four questions in this section of the survey. The number of responses for each level of enthusiasm on the five-point scale was totaled. A score of 5 out of 5 indicated high enthusiasm, a score of 4 out of 5 indicated fairly high enthusiasm, a score of 3 out of 5 indicated neutral enthusiasm, a score of 2 out of 5 indicated fairly low enthusiasm, and a score of 1 out of indicated low enthusiasm.

Behavioral Engagement

Videotaped Dance Performances. The videotaped dance performances from five integrated lessons (Shape Dance, Lunch Time Dance, Money Dance, Fraction Notes, and Math is Music to Our Ears) were scored based upon rubrics related to the categories of Student Attention, Student Effort, and Student Persistence. Though the students performed in groups, they were scored individually in these three categories. The rubrics for student attention, effort, and persistence can be found in Appendix H.

A second observer scored the videotaped student performances, and an inter-observer agreement was calculated. This value was converted into a percentage. If the IOA was below 80%, the two observers met and discussed 10 of their disagreements chosen at random until they agreed upon 8 of those scores. The researcher then modified the rubrics based on this discussion to clarify the description for each score. Once the IOA was 80% the qualitative results were considered trustworthy (Thomas, Nelson, & Silverman, 2011, p. 203).

Journal Entries. Journal entries were scored based upon a rubric in terms of Student Effort. The selected journal questions could be found in Appendix C and the rubric for Student Effort in Appendix D. The only entries that were utilized for this data set were from students who were present in class, regardless of whether or not the student responded to all journal questions.

Cognitive Engagement

Student Work Samples. Student work samples from the Money Rhythms lesson were used as quantitative data. These samples were utilized to provide information about the depth of cognitive processing that the students used. The only work samples that were used for this data set were from students who were present for

the activity. See Appendix I for the Money Rhythms Formative Assessment. The activity consisted of five items. Each work sample was scored using a binary system in which either the response was correct or incorrect. If the student left an answer blank, it was marked as wrong. Total scores per student were then calculated out of 5 based upon the total number correct. A score of 5 out of 5 indicated deep cognitive processing, a score of 4 out of 5 indicated fairly deep cognitive processing, a score of 3 out of 5 indicated adequately deep cognitive processing, a score of 2 out of 5 indicated fairly shallow cognitive processing, and a score of 0 or 1 out of 5 indicated shallow cognitive processing.

In order to test the internal consistency reliability of the formative assessment, the researcher conducted a Cronbach's (1951) alpha analysis of the assessment items utilizing the scores of all the students. According to Nunnally & Bernstein (1994), an alpha index of 0.70 or higher indicates modest reliability (p. 265).

Journal Responses. The daily journal entries were categorized based upon word or phrase indicators within each response to the question: "What did you learn today?" The four main categories included Math, Art (Music or Dance), Integration (Math or Art), and Unrelated.

Videotaped Dance Performances. One selected dance, "Lunch Time Dance" from Lesson 2, was used to evaluate the students' knowledge of dance and math. The criteria for dance knowledge included if the student (a) demonstrated a clear beginning, middle, and end; (b) utilized self-space in movements; and (c) formed beginning and ending shapes that were strong and still. The criteria for math knowledge that was demonstrated through dance included if the student appropriately represented time. (See Appendix J for this dance performance task and rubric.)

Case Studies

Using the scores resulting from the analysis procedures outlined above, three case studies were conducted. The students selected for these case studies, one male and two females, were chosen using a computerized random generator in order to prevent researcher bias. Data from these individuals were analyzed for any unique patterns in terms of emotional, behavioral, and cognitive engagement.

Conclusion

To summarize, the data collected from this study on the effect of a music and movement integrated mathematics curriculum on second grade students' engagement with learning were both qualitative and quantitative. Qualitative data consisted of journal responses, survey responses, and video footage. Quantitative data consisted of student work samples, student self-ratings on the post survey, topics for journal responses, and dance performance tasks. Multiple analyses were conducted in order to observe consistencies and inconsistencies among different types of sources in terms of emotional, behavioral, and cognitive engagement for the whole class. In addition, three case studies were conducted of three individual students in order to deepen the analysis of emotional, behavioral, and cognitive engagement. The methodology for the collection and analysis of these data sources were described above, and the results of the analyses will be discussed in the next chapter.

Chapter 4

RESULTS

Introduction

Student engagement is a meta-construct that includes three dimensions: emotional, behavioral, and cognitive engagement (Fredricks et al., 2004). The purpose of this research study that used a curriculum entitled "Math is Music to Our Ears" was to show the effect, if any, that instruction of mathematics through a music and movement integrated curriculum has on second graders' engagement with learning. Results from qualitative and quantitative data analyses are broken down into the three main categories of emotional engagement, behavioral engagement, and cognitive engagement.

The main research question that guided the study of student experiences through integrated learning was: What were the effects of a music and movement integrated mathematics curriculum on second grade students' emotional, behavioral, and cognitive engagement with learning? To investigate this question, three focus questions were addressed, each pertaining to a facet of engagement:

(1) What were the effects of a music and movement integrated mathematics curriculum on emotional engagement, as indicated by enjoyment and enthusiasm?

(2) What were the effects of a music and movement integrated mathematics curriculum on behavioral engagement, as indicated by attention, effort, and persistence?

(3) What were the effects of a music and movement integrated mathematics curriculum on cognitive engagement, as indicated by deep cognitive processing?

The first research question guiding the investigation of student engagement during the implementation of the arts-integrated unit was related to emotional engagement. *Emotional engagement* refers to the extent to which a student's task involvement is characterized by positive emotion, as indicated by enjoyment and enthusiasm (O'Donnell et al., 2012, p. 335). The first indicator for emotional engagement, enjoyment, is defined as an affective state of pleasure, and the second indicator for emotional engagement, enthusiasm, is defined as intense enjoyment (O'Donnell et al., 2012, p. 335).

The second research question guiding the investigation of student engagement during the implementation of the arts-integrated unit was related to behavioral engagement. *Behavioral engagement* refers to the extent to which a student displays high attention, strong effort, and enduring persistence on a learning activity (O'Donnell et al., 2012, p. 335). The first indicator for behavioral engagement, attention, is defined as concentration and on-task focus; the second indicator for behavioral engagement, effort, is defined as the investment of physical and mental energy on a task; and the third indicator for behavioral engagement, persistence, is defined as the investment of effort over time (O'Donnell et al., 2012, p. 335).

The third research question guiding the investigation of student engagement during the implementation of the arts-integrated unit was related to cognitive engagement. *Cognitive engagement* refers to the use of deep cognitive processes through which students use mental effort, synthesize concepts, and thus achieve greater understanding of ideas (O'Donnell et al., 2012, p. 336). Thus, the students'

ability to synthesize concepts, or create connections among ideas, was used as an indicator for deep cognitive processing, and thus, for cognitive engagement (Weinstein & Mayer, 1986, p. 315). Two quantitative data sources were used to assess the level of cognitive engagement: (1) student work samples from one lesson and (2) journal responses.

The results from the collection of qualitative and quantitative data are presented in this chapter. These results are broken down into the three main categories of emotional engagement, behavioral engagement, and cognitive engagement. The results for the data collection related to emotional engagement are presented in terms of rubric scores from selected journal and survey responses as well as student self-ratings on the survey. The results for the data collection related to behavioral engagement are presented in terms of rubric scores from video footage of student performances and from journal entries. The results from the data collection related to cognitive engagement are presented in terms of overall scores from an individual lesson assessment as well as from selected journal responses. In addition to the results presented in terms of emotional, behavioral, and cognitive engagement for the whole class, the results from case study analyses of three individual students are also described. Finally, limitations that affected the results of this study are also discussed at the end of the chapter.

Emotional Engagement

The first research question guiding the investigation of student emotional engagement during the implementation of the arts-integrated unit was: What were the effects of a music and movement integrated mathematics curriculum on student enjoyment and enthusiasm? The results for the data collection related to emotional

engagement are presented in terms of rubric scores from selected journal and survey responses as well as student self-ratings on the survey.

Selected Journal Responses

The selected journal responses were broken down into two categories: Student Enjoyment and Student Enthusiasm. The selected questions related to these categories can be found in Appendix C. Each student's response was scored based on a rubric for each category. Descriptors for each rubric score can be found in Appendix D. The selected journal questions were the same across both categories. The data set consists of 9 students who answered all six selected questions, thus consisting of 54 total responses.

For the "Student Enjoyment" category, 48 out of 54 of the responses (88.9%) received a score of 3, 4 out of 54 of the responses (7.4%) received a score of 2, 2 out of 54 of the responses (3.7%) received a score of 1, and no students received a score of a 0. The following table shows a breakdown of these overall scores in the category of "Student Enjoyment."

Table 1 Overall Student Enjoyment in Daily Journals

Score	Number of Responses	Approx. Percentage of Responses
3	48	88.9%
2	4	7.4%
1	2	3.7%
0	0	0%

Note: N = 54 responses

For this category, a sample student answer that received a score of 3 was "I liked when we made people clocks" (Student 1, Journal, 12/4/13). An answer that received a score of 2 was "I liked money. I dont like rythm" (Student 12, Journal, 12/5/13). An answer that received a score of 1 was "I didn't like the dance" (Student 14, Journal, 12/11/13). An answer that would have received a score of a 0 would have been a blank response or an answer unrelated to enjoyment.

For the "Student Enthusiasm" category, 8 out of 54 of the responses (14.8%) received a score of 3, 40 out of 54 of the responses (74.1%) received a score of 2.5, 4 out of 54 of the responses (7.4%) received a score of 2, 2 out of 54 (3.7%) of the responses received a score of a 1.5, and no students received a score of a 1 or 0. The following table shows a breakdown of these overall scores in the category of "Student Enthusiasm."

Table 2 Overall Student Enthusiasm in Daily Journals

Score	Number of Responses	Approx. Percentage of Responses
3	8	14.8%
2.5	40	74.1%
2	4	7.4%
1.5	2	3.7%
1	0	0%
0	0	0%

Note: N = 54 responses

For this category, a sample student answer that received a score of 3 was "My favorite part in math was showing time and how the day works. Math class is a very fun time. That is my favorite part of math" (Student 9, Journal, 12/4/13). An answer that received a score of a 2.5 was "I liked fractions" (Student 12, Journal, 12/11/13).

An answer that received a score of 2 was "I liked the dance that we did with the money. I did not like the clock with our bodys" (Student 12, Journal, 12/12/13). An answer that received a score of a 1.5 was "I didn't like the dans" (Student 11, Journal, 12/4/13). An answer that would have received a score of a 1 would have indicated extreme displeasure ("I hated learning about…") and an answer that would have received a score of a 0 would have been a blank response or an answer unrelated to enthusiasm.

The percentage of inter-observer agreement on the rubric scores for journal questions was 93.5%. This means that after another observer scored the students' performances based on the same rubrics, 93.5% of the responses were given exactly the same score (Thomas et al., 2011, p. 203), making these results trustworthy.

Patterns found in this data that relate to students' enjoyment and enthusiasm with learning during the implementation of the arts-integrated curriculum are that 96.3% of the total responses received scores of a 2 or higher, with 88.9% of the responses receiving a score above a 2 in both categories. Another pattern is that for student enthusiasm, no students scored a 1, which would indicate extreme displeasure.

Selected Survey Responses

The selected survey responses were broken down into two categories: Student Enjoyment and Student Enthusiasm. The selected questions related to these categories can be found in Appendix F. Each student's response was scored based on a rubric for each category. Descriptors for each rubric score can be found in Appendix G. The data set consists of 10 students who answered all eight free-response survey questions.

For the "Student Enjoyment" category, 59 out of 80 of the responses (73.8%) received a score of 3, 20 out of 80 of the responses (25.0%) received a score of 2, 1

out of 80 (1.1%) of the responses received a score of a 1, and no responses received a score of a 0. The following table shows a breakdown of these overall scores in the category of "Student Enjoyment."

Table 3 Overall Student Enjoyment in Post-Surveys

Score	Number of Responses	Approx. Percentage of Responses
3	59	73.8%
2	20	25.0%
1	1	1.1%
0	0	0%

Note: N = 80 responses

For this category, a sample student answer that received a score of 3 was "I can add that I learned a lot because I like how we learned" (Survey 2, Question 13, 5/29/14). An answer that received a score of a 2 was "It was easy to learn" (Survey 17, Question 14, 5/29/14). The answer that received a score of a 1 was "I didn't like math in these lessons because it was too easy for me" (Survey 4, Question 17, 5/29/14). An answer that would have received a score of a 0 would have been one that was blank or was unrelated to student enjoyment.

For the "Student Enthusiasm" category, 25 out of 80 of the responses (31.1%) received a score of 3, 36 out of 80 of the responses (45.0%) received a score of 2.5, 18 out of 80 of the responses (22.5%) received a 2, 1 out of 80 of the responses (1.1%) received a score of a 1.5, and no students received a score of a 1 or 0. The following table shows a breakdown of these overall scores in the category of "Student Enthusiasm."

Table 4 Overall Student Enthusiasm in Post-Surveys

Score	Number of Responses	Approx. Percentage of Responses
3	25	31.1%
2.5	36	45.0%
2	18	22.5%
1.5	1	1.1%
1	0	0%
0	0	0%

Note: N = 80 responses

For this category, a sample student answer that received a score of 3 was "I liked to learn the math because I thought that it was more fun than just doing our regular pages in our math book" (Survey 1, Question 17, 5/28/14). An answer that received a score of 2.5 was "I did like learning music because I didn't know much about music at all" (Survey 4, Question 18, 5/29/14). An answer that received a score of 2 was "I can add that I learned it very well" (Survey 8, Question 15, 5/29/14). The only response that received a score of 1.5 was "I didn't like math in these lessons because it was too easy for me" (Survey 4, Question 17, 5/29/14). An answer that would have received a score of 1 would have indicated extreme displeasure ("I hated learning about…") and an answer that would have received a score of 0 would have been a blank response or an answer unrelated to enthusiasm.

In addition, Items 13-16 were intended for the students to write about what they learned related to math, music, movement, and the entire learning experience, but 22 out of the 40 total responses in this section (55.0%) received a score of 3 and 18 out of 40 responses (45.0%) received a score of 2, with no responses receiving a score of 1 or 0 in the category of student enjoyment. For student enthusiasm on items 13-16, 12 out of 40 responses (30.0%) received a score of 3, 12 out of 40 responses (30.0%)

received a score of 2.5, 16 out of 40 responses (40.0%) received a score of 2, and no responses received a score of 1 or 0.

The percentage of inter-observer agreement on the rubric scores for survey questions was 90.0%. This means that after another observer scored the students' performances based on the same rubrics, 90.0% of the scores given were exactly the same (Thomas et al., 2011, p. 203), making these results reliable.

Patterns found in the survey data related to students' enjoyment and enthusiasm with learning are that over 98.0% of the responses (98.8% for student enjoyment and 98.6% for student enthusiasm) received a score of a 2 or higher, with at least 70% of the responses (73.8% for enjoyment and 76.1% for enthusiasm) being above a 2. For items 13-16, which were not originally intended to indicate student enjoyment and enthusiasm, 55.0% of the responses scored a 3 in enjoyment, and 60.0% of the responses scored a 2.5 or 3 in student enthusiasm.

Self-Ratings from Post-Surveys

In addition to the results of the selected journal and survey responses, student self-ratings from the survey served as additional evidence of student enjoyment and enthusiasm. In questions 9 through 12 (see Appendix E), the students were asked to rate themselves in terms of how intense their enjoyment was with learning math, music, movement, and through arts integration. The data set consisted of 17 students, as they all responded to each question in this section of the survey. A total of 68 responses was documented in terms of a five-point scale. A score of 5 indicated that the students "liked [it] a lot"; a score of 4 indicated that the student "liked [it]"; a score of 3, indicated that the students felt indifferently; a score of 2 indicated that the students "did not like [it]"; and a score of 1 indicated that the students "did not like [it]

at all." 51 out of 68 responses (75.0%) were scored as a 5, 11 out of 68 responses (16.2%) were scored as a 4, 6 out of 68 responses (8.8%) were scored as a 3, and none of the responses were scored as a 2 or 1. The results from these student self-ratings are represented in the chart below.

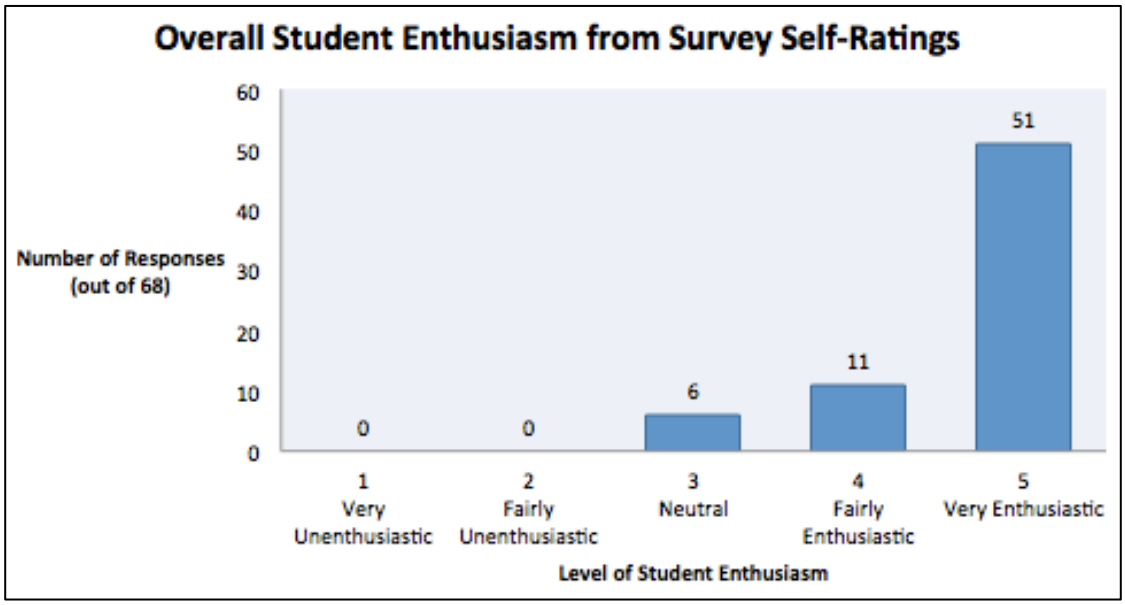


Figure 1 Overall Student Enthusiasm from Survey Self-Ratings

One pattern found in analyzing data from the student self-ratings was that 62 out of 68 of the responses (91.2%) received a score of a 4 or 5, indicating a general state of pleasure, or student enjoyment. This meant that 6 out of 68 of the responses (8.8%) did not receive a score of a 4 or 5, but none of the responses received a score of a 1 or 2, which would have indicated a general state of displeasure.

Behavioral Engagement

The second research question guiding the investigation of student behavioral engagement during the implementation of the arts-integrated unit was: What were the effects of a music and movement integrated mathematics curriculum on student attention, effort, and persistence? The results for the data collection related to behavioral engagement are presented in terms of rubric scores from video footage of student performances and from journal entries.

Student Performances

The video footage data consists of five performances, with two performances consisting of 13 total students on videotape, two performances consisting of 11 total students on videotape, and 1 performance consisting of 10 total students on videotape. Although the students performed in groups, each student was scored separately on three rubrics: one for attention, one for effort, and one for persistence. (See Appendix H for Rubrics.) The following table represents overall score averages in the categories of "Student Attention," "Student Effort," and "Student Persistence" for all five performances.

Table 5 Overall Student Performance Scores

	Average (%)	Shape Dance (%)	Lunch Time Dance (%)	Money Dance (%)	Fraction Dance (%)	Going to the Store Dance (%)
Attention						
3	94.8	100.0	92.3	100.0	81.8	100.0
2	3.6	0.0	0.0	0.0	18.2	0.0
1	1.5	0.0	7.7	0.0	0.0	0.0
0	0.0	0.0	0.0	0.0	0.0	0.0
Effort						
3	55.9	80.0	30.7	76.9	45.5	46.2
2	36.2	20.0	61.5	23.1	45.5	30.8
1	8.0	0.0	7.7	0.0	9.1	23.1
0	0.0	0.0	0.0	0.0	0.0	0.0
Persistence						
3	78.5	80.0	84.6	100.0	81.8	46.2
2	13.8	20.0	7.7	0.0	18.2	23.1
1	7.7	0.0	7.7	0.0	0.0	30.8
0	0.0	0.0	0.0	0.0	0.0	0.0

Note: N = 10 total students for Shape Dance; N = 13 total students for Lunch Time Dance, Money Dance, & Going to the Store Dance; and N = 11 total students for Fraction Dance

In the category of "Student Attention," 94.8% of the students received a score of 3; 3.6% of the students received a score of 2; and 1.5% of the students received a score of 1. In the category of "Student Effort," 55.9% of the students received a score of 3; 36.2% of the students received a score of 2; and 8.0% of the students received a score of 1. In the category of "Student Persistence," 78.5% of the students received a score of 3; 13.8% of the students received a score of 2; and 7.7% received a score of 1.

Students first participated in the "Shape Dance Lesson," during which they created and performed a "Shape Dance." For this performance, the students worked in small groups of four or five to first decide on six shapes together. Forming these shapes with their bodies, the students were to hold them for four beats while music

played, switching every four beats as directed by the instructor. A total of 10 students were videotaped for this performance, and the following chart represents the average scores in the three categories of "Student Attention," "Student Effort," and "Student Persistence."

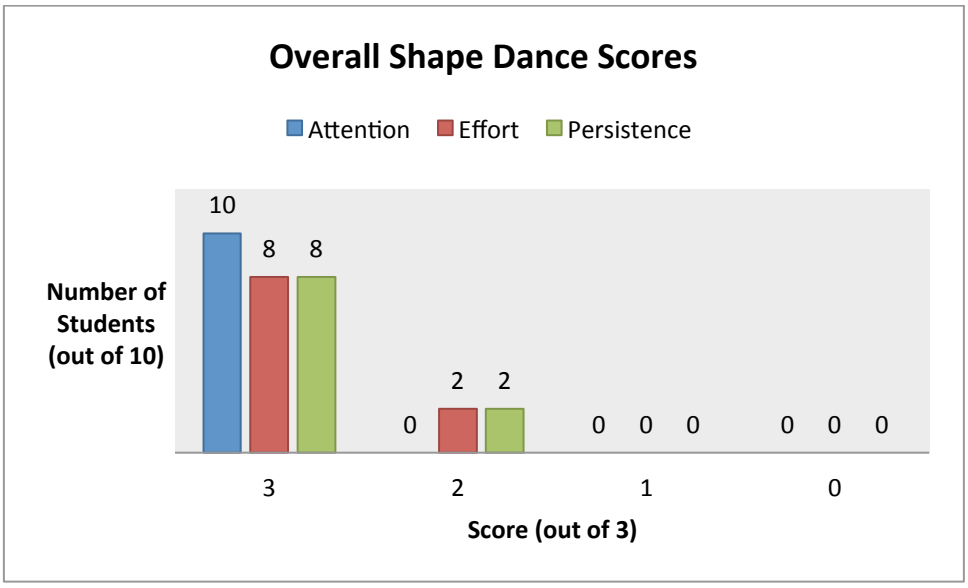


Figure 2 Overall Shape Dance Scores

As shown in Table 5 and in Figure 2, for this performance 10 out of 10 students (100.0%) received a score of 3 for attention, indicating that these students were on-task or focused for the entire performance. In the category of "Student Effort," 8 out of 10 students (80.0%) received a score of 3, indicating that these students totally exerted physical energy, as characterized by strong movements and an apparent desire to succeed (regardless of whether or not he or she followed directions);

and 2 out of 10 students (20.0%) received a score of 2, indicating these students exerted some physical energy, as characterized by fairly strong movements and a somewhat apparent desire to succeed (regardless of whether or not he or she followed directions). In the category of "Student Persistence," 8 out of 10 students (80.0%) received a score of 3, indicating that these students demonstrated consistent effort throughout the dance; and 2 out of 10 students (20.0%) received a score of 2, indicating these students demonstrated inconsistent effort throughout the dance).

The second performance that the students participated in was in the "Lunch Time Dance Lesson," during which they created and performed a "Lunch Time Dance." For this performance, the students worked in small groups of four or five to create movements in self-space of what they liked to do in the one-hour period of lunch and recess. The students were to start with a shape that represented the time that lunch started, switch movements every fifteen minutes as indicated by the instructor, and finally end in the shape representing the time that lunch ended. A total of 13 students was videotaped for this performance. Figure 3 represents the average scores in the three categories of "Student Attention," "Student Effort," and "Student Persistence."

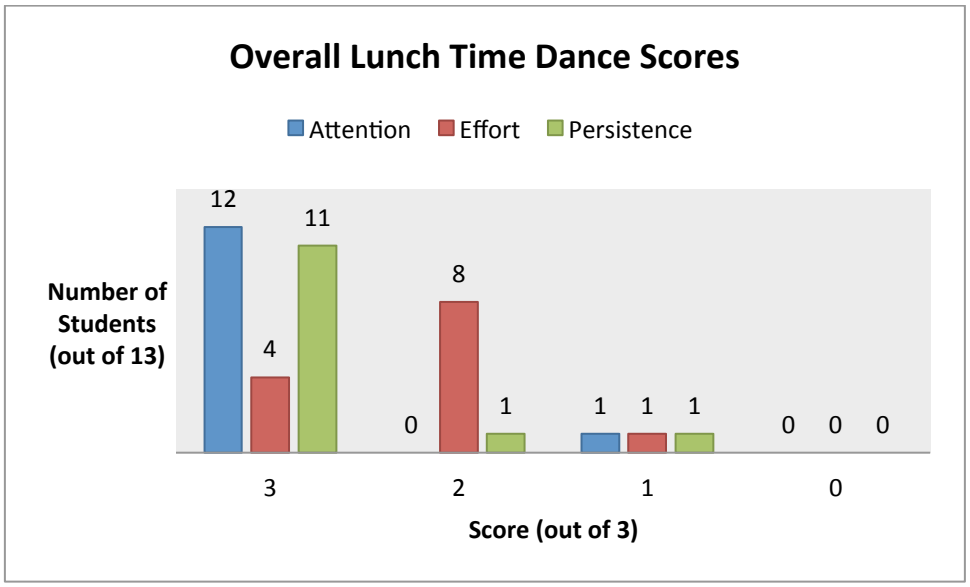


Figure 3 Overall Lunch Time Dance Scores

As shown in Table 5 and in Figure 3, for this performance 12 out of 13 students (92.3%) received a score of 3 for attention, indicating that these students were on-task or focused for the entire performance; and 1 out of 13 students (7.7 %) received a score of 1 for attention, indicating that this student was mostly off-task, as characterized by movement and/or focus for less than half of the performance. In the category of "Student Effort," 4 out of 13 students (30.7%) received a score of 3, indicating that these students totally exerted physical energy, as characterized by strong movements and an apparent desire to succeed (regardless of whether or not he or she followed directions); and 8 out of 13 students (61.5%) received a score of 2, indicating these students exerted some physical energy, as characterized by fairly strong movements and a somewhat apparent desire to succeed (regardless of whether or not he or she followed directions). One out of 13 (7.7%) students received a score

of 1, indicating that this student exerted little physical energy, as characterized by weak movements and an apparent careless attitude (regardless of whether or not he or she followed directions). In the category of "Student Persistence," 11 out of 13 students (84.6%) received a score of 3, indicating that these students demonstrated consistent effort throughout the dance; 1 out of 13 students (7.7%) received a score of 2, indicating that this student demonstrated inconsistent effort throughout the dance); and 1 out of 13 students (7.7%) received a score of 1, indicating that this student danced some of the time with inconsistent effort.

In the third student performance, the "Money Dance Lesson," students created and performed a "Money Dance." For this performance, the students worked in pairs to dance representations of a combination of coins. A given movement represented each coin: a skip represented a quarter, a jump represented a dime, a hop represented a nickel, and a spin represented a penny. A total of 13 students were videotaped for this performance, and the following chart represents the average scores in the three categories of "Student Attention," "Student Effort," and "Student Persistence."

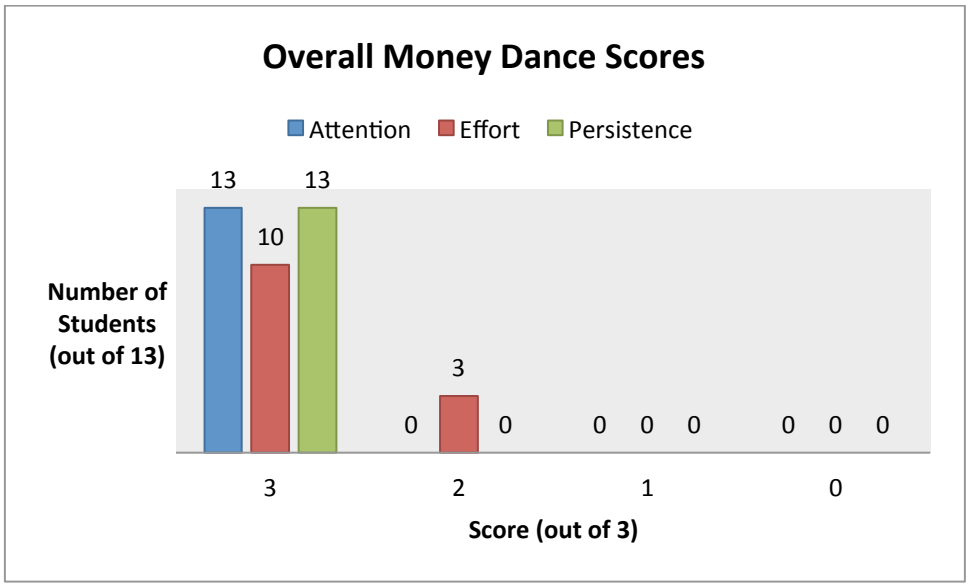


Figure 4 Overall Money Dance Scores

As shown in Table 5 and in Figure 4, for this performance 13 out of 13 students (100.0%) received a score of 3 for attention, indicating that these students were on-task or focused for the entire performance. In the category of "Student Effort," 10 out of 13 students (76.9%) received a score of 3, indicating that these students totally exerted physical energy, as characterized by strong movements and an apparent desire to succeed (regardless of whether or not he or she followed directions); and 3 out of 13 students (23.1%) received a score of 2, indicating these students exerted some physical energy, as characterized by fairly strong movements and a somewhat apparent desire to succeed (regardless of whether or not he or she followed directions). In the category of "Student Persistence," 13 out of 13 students (100.0%) received a score of 3, indicating that these students demonstrated consistent effort throughout the dance.

The fourth student performance was in the "Fraction Notes Lesson," during which they created and performed a "Fraction Dance." For this performance, the students worked in pairs to first create their own rhythms on worksheets using the music note symbols for whole notes, half notes, and quarter notes and what they learned about fractions. After they practiced speaking their rhythms, they were to create Fraction Dances using arm movements from the movement warm up that represented each note value. To represent a whole note, the students were to move their arms at their sides smoothly to connect above head to form a circle during the span of four beats. To represent a half note, the students were to move their arms at their sides smoothly to stretch out wide during the span of two beats. Half note = du-u while the arms smoothly stretched out wide. To represent a quarter note, the students were to move their arms sharply during the span of one beat. A total of 11 students were videotaped for this performance, and the following chart represents the average scores in the three categories of "Student Attention," "Student Effort," and "Student Persistence."

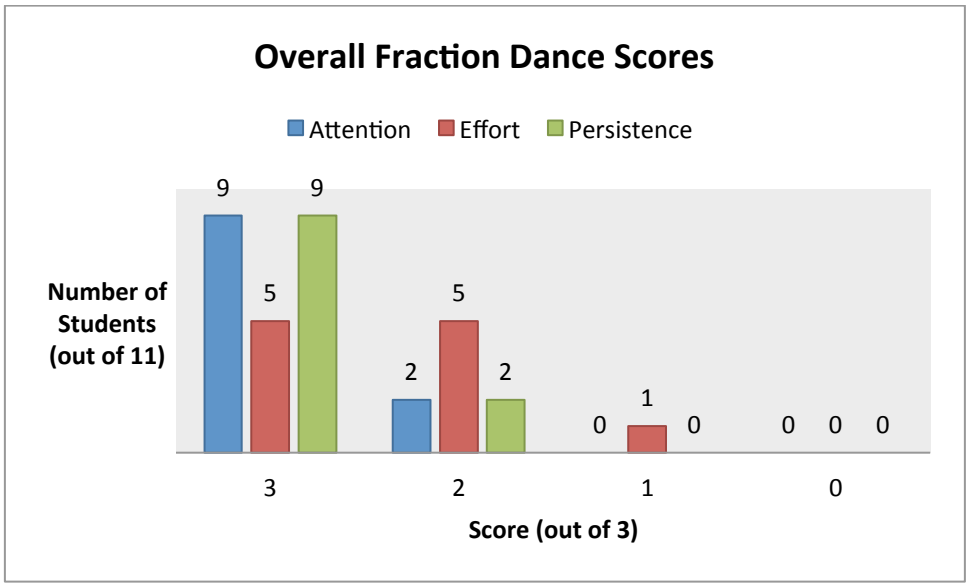


Figure 5 Overall Fraction Dance Scores

As shown in Table 5 and in Figure 5, for this performance 9 out of 11 students (81.8%) received a score of 3 for attention, indicating that these students were on-task or focused for the entire performance; and 2 out of 11 students (18.2 %) received a score of 2 for attention, indicating that these students were mostly on-task, as characterized by movement and/or focus throughout most of the performance. In the category of "Student Effort," 5 out of 11 students (45.5%) received a score of 3 indicating that these students totally exerted physical energy, as characterized by strong movements and an apparent desire to succeed (regardless of whether or not he or she followed directions); and 5 out of 11 students (45.5%) received a score of 2, indicating these students exerted some physical energy, as characterized by fairly strong movements and a somewhat apparent desire to succeed (regardless of whether or not he or she followed directions). One out of 11 students (9.1%) received a score

of 1, indicating that this student exerted little physical energy, as characterized by weak movements and an apparent careless attitude (regardless of whether or not he or she followed directions). In the category of "Student Persistence," 9 out of 11 students (81.8%) received a score of 3, indicating that these students demonstrated consistent effort throughout the dance; and 2 out of 11 students (18.2%) received a score of 2, indicating that this student demonstrated inconsistent effort throughout the dance).

The fifth student performance was in the "Math is Music to Our Ears Lesson," during which they created and performed a "Going to the Store Dance," which incorporated concepts and skills from the previous five lessons. For this performance, the students, given items with a certain price, worked in pairs to create a song and dance demonstrating the process of exchanging money at a store. The students were to begin in a shape representing the time that the "customer" left to go to the store. Then, the "cashier" danced the cost of the item, with each move representing a different coin. The "customer" gave the cashier money by speaking a rhythm representing this amount before the cashier returned the change using movements. After this exchange, the students were to end in a shape representing the time that the "customer" left the store. A total of 13 students were videotaped for this performance, and the following chart represents the average scores in the three categories of "Student Attention," "Student Effort," and "Student Persistence."

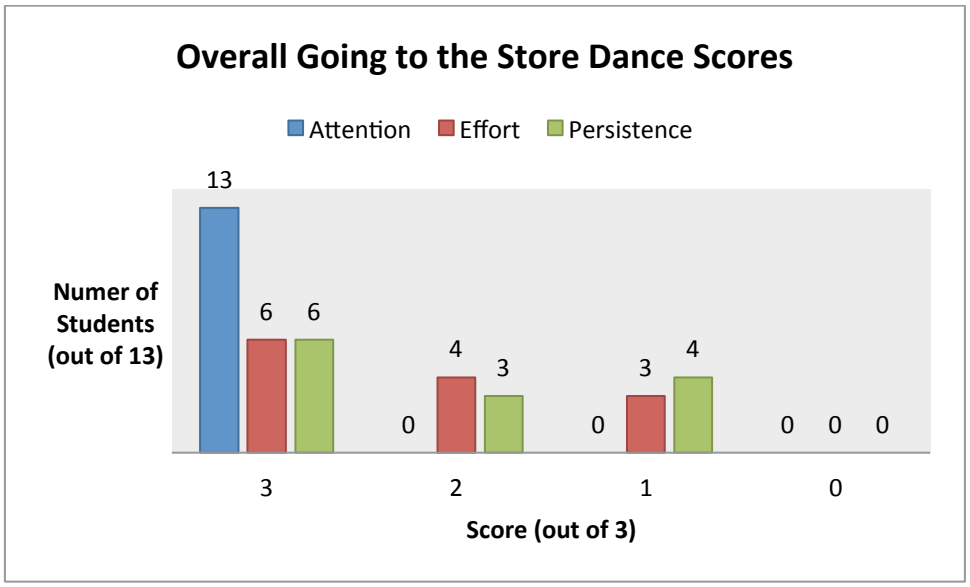


Figure 6 Overall Going to the Dance Scores

As shown in Table 5 and in Figure 6, for this performance 13 out of 13 students (100.0%) received a score of 3 for attention, indicating that these students were on-task or focused for the entire performance. In the category of "Student Effort," 6 out of 13 students (46.2%) received a score of 3, indicating that these students totally exerted physical energy, as characterized by strong movements and an apparent desire to succeed (regardless of whether or not he or she followed directions); 4 out of 13 students (30.8%) received a score of 2, indicating these students exerted some physical energy, as characterized by fairly strong movements and a somewhat apparent desire to succeed (regardless of whether or not he or she followed directions); and 3 out of 13 (23.1%) students received a score of 1, indicating that this student exerted little physical energy, as characterized by weak movements and an apparent careless attitude (regardless of whether or not he or she followed directions). In the

category of "Student Persistence," 6 out of 13 students (46.2%) received a score of 3, indicating that these students demonstrated consistent effort throughout the dance; 3 out of 13 students (23.1%) received a score of 2, indicating that this student demonstrated inconsistent effort throughout the dance); and 4 out of 13 students (30.8%) received a score of 1, indicating that this student danced some of the time with inconsistent effort.

The original percentage of inter-observer agreement on the rubric scores for student performances was 67.9%. This means that after another observer scored the students' performances based on the same rubrics, 67.9% of the scores given were exactly the same (Thomas et al., 2011, p. 203). Since these results were not trustworthy, 28 disagreements were chosen at random and were discussed with the outside observer until 26 were agreed upon. The rubrics were modified to reflect this discussion, and the percentage of inter-observer agreement was 80% making the data from these rubrics trustworthy.

Several patterns emerged during the data analysis. One finding from the video footage data reflected the students' attention, effort, and persistence. Overall, 98.1% of students scored a 2 or 3 in the category of student attention; 92.1% of the students scored a 2 or 3 in the category of student effort; and 92.3% of the students scored a 2 or 3 in the category of student persistence.

Another pattern emerged in the category of student attention, in that 100% of the students scored a 2 or 3 in "Shape Dance"; 92.3% of the students scored a 2 or 3 in "Lunch Time Dance"; 100% of the students scored a 2 or 3 in "Money Dance"; 100% of the students scored a 2 or 3 in "Fraction Dance"; and 100% of the students scored a 2 or 3 in "Going to the Store Dance."

An additional pattern emerged in the category of student effort, in that 100% of the students scored a 2 or 3 in "Shape Dance"; 92.2% of the students scored a 2 or 3 in "Lunch Time Dance"; 100% of the students scored a 2 or 3 in "Money Dance"; 91.0% of the students scored a 2 or 3 in "Fraction Dance"; and 77% of the students scored a 2 or 3 in "Going to the Store Dance."

Finally, a pattern emerged in the category of student persistence, in that 100% of the students scored a 2 o r 3 in "Shape Dance"; 92.3% of the students scored a 2 or 3 in "Lunch Time Dance"; 100% of the students scored a 2 or 3 in "Money Dance"; 100% of the students scored a 2 or 3 in "Fraction Dance"; and 69.3% of the students scored a 2 or 3 in "Going to the Store Dance."

Overall Student Effort on Journal Entries

In addition to the results from the student performance data, the daily journal entries were again scored in terms of overall student effort on each entry. After the first five arts-integrated lessons, the students were to respond to the same two journal prompts: "What did you like or not like about today's lesson?" and "What did you learn today?" On the sixth and final lesson, an additional third prompt was posed: "What was your favorite or least favorite part of this entire experience?" The data set consisted of 17 students, with one entry per lesson, giving a subtotal of 102 entries. However, 4 absences occurred and were accounted for, giving a total of 98 entries. Each entry was scored in terms of the rubric provided in Appendix D in terms of "Student Effort." The results from this analysis are represented in the table below.

Overall, out of 98 entries, 15 entries (15.3%) received a score of 3, indicating exceptional effort, which was characterized by entries that answered both questions (or all three questions in Lesson 6) with detail. 61 out of 98 entries (62.2%) received a

score of 2, indicating good effort, which was characterized by entries that answered two questions without detail. 21 out of 98 entries (21.4%) received a score of 1, indicating some effort, which was characterized by entries that answered one question. Finally, 1 out of 98 entries (1.0%) received a score of a 0, indicating no effort, which was characterized by entries that did not answer any questions. The table below represents the scores for each entry in terms of "Student Effort."

Table 6 Student Effort on Journal Entries

Score	Number of Entries	Percentage of Entries
3	15	15.3%
2	61	62.2%
1	21	21.4%
0	1	1.0%

Note: N = 98 entries

An example of an entry that received a score of a 3 on Student Effort was "I liked the part when we did the making shapes inside the string also preforming the shape paderns. What I learned is about a Reythem staff" (Student 4, Journal, 11/22/13). An example of an entry that received a score of a 2 on Student Effort was "I liked when we did the music. I learned music notes" (Student 1, Journal, 12/5/13). An example of an entry that received a score of a 1 on Student Effort was "I like when we were doing clocks it was fun" (Student 2, Journal, 12/4/13). Lastly, an entry that received a score of a 0 on Student Effort was a completely blank entry (Student 5, Journal, 12/11/13).

The percentage of inter-observer agreement on the rubric scores for student effort on journals was 80.4%. This means that after another observer scored the

students' performances based on the same rubrics, 80.4% of the scores given were exactly the same (Thomas et al., 2011, p. 203), making these results reliable.

One pattern from this data set was that 77.2% of all 98 entries scored a 2 or 3, indicating that the overall effort on the journals was either good or exceptional for 77.2% of the entries. In addition, 99.0% of the entries scored a 1 or higher, indicating that 99.0% of the entries reflected at least some effort.

Cognitive Engagement

The third research question guiding the investigation of student cognitive engagement during the implementation of the arts-integrated unit was: What were the effects of a music and movement integrated mathematics curriculum on the students' depth of cognitive processing? The results from this data collection are presented in terms of overall scores from an individual lesson assessment as well as in terms of the academic topics of selected journal responses.

Student Work Samples

Student work samples from the Money Rhythms lesson were used as quantitative data. (See Appendix I for the Money Rhythms Formative Assessment.) The purpose of the culminating activity in Money Rhythms was to assess the students' ability to synthesize math and music concepts, or make connections among the subjects. Synthesis entails the use of deep cognitive processing, so the students' ability to successfully answer each item provided information about the their depth of cognitive processing (O'Donnell et al., 2012, p. 336).

Through this partner activity, the students were assessed on their ability to connect the value of quarters and dollars with the rhythmic values of notes and rests in

music. Each question was scored using a binary system in which the drawn response was either right or wrong. Items 1-4 consisted of combining quarters and quarter rests into "Money Rhythms"; Item 5 consisted of representing one Money Rhythm only in terms of music symbols. In Item 1, the students were to make a Money Rhythm costing 25 cents; correct answers consisted of one quarter and three quarter rests, in any given order. In Item 2, the students were to make a Money Rhythm costing 50 cents; correct answers consisted of two quarters and two quarter rests, in any given order. In Item 3, the students were to make a Money Rhythm costing 75 cents; correct answers consisted of three quarters and one quarter rest, in any given order. In Item 4, the students were to make a Money Rhythm costing 100 cents or one dollar; correct answers consisted of four quarters or a one-dollar bill with no rests. Finally, in Item 5, the students were to choose a Money Rhythm and substitute any quarter with a quarter note symbol or any dollar with a whole note symbol in order to create a full rhythm with only music symbols.

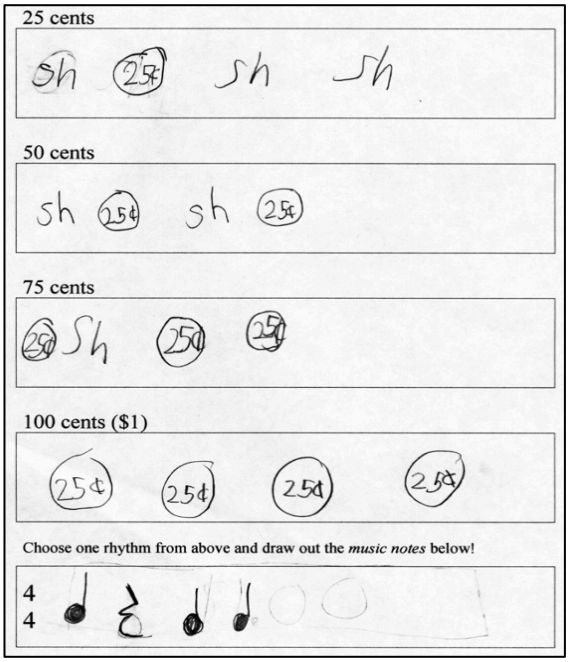


Figure 7 Students 15 & 16, Work Sample, 12/5/13

Note: "Sh" was accepted as a proper representation of a "rest."

If an answer was left blank, it was marked as wrong. Total scores per student were calculated out of 5 based upon the total number correct, indicating how well the students were able to synthesize the math and music concepts. Figure 1, shown above, is an example of student work that scored a 5 out of 5.

The data set consisted of 17 students, who were all present for the activity. The students worked in pairs, and one student (Student 5) chose to work independently instead of with in a group of three. The following table represents a breakdown of the scores for each student in the class.

Table 7 Student Work Sample Scores

Student	**Score (5 points)**
1	4
2	4
3	5
4	5
5	1
6	5
7	5
8	5
9	5
10	5
11	5
12	5
13	5
14	4
15	5
16	5
17	4
Mean	4.294
SD	1.007

Based on these scores, each student was given a level for their depth of cognitive processing. A score of 5 out of 5 indicates a deep level of cognitive processing; a score of 4 out of 5 indicates a fairly deep level of cognitive processing; a score of 4 out of 5 indicates an adequate level of cognitive processing; a score of 2 out of 5 indicates a fairly shallow level of cognitive processing; and a score of a 0 or a 1 indicates a shallow level of cognitive processing. Using this scale, 12 out of 17 students (70.6%) demonstrated a deep level of cognitive processing; 4 out of 5 students (23.5%) demonstrated a fairly deep level of cognitive processing; 1 out of 17

students (5.9%) demonstrated a shallow level of cognitive processing; and no students demonstrated an adequate or fairly shallow level of cognitive processing. The following table represents these scores accordingly.

Table 8 Overall Levels of Cognitive Processing

Number of Correct Responses	Level of Cognitive Processing	Number of Students	Approx. Percentage of Class
5	Deep	12	70.6%
4	Fairly Deep	4	23.5%
3	Adequate	0	0%
2	Fairly Shallow	0	0%
0-1	Shallow	1	5.9%

Note: N = 17 students

In order to test the internal consistency reliability of the formative assessment, the researcher conducted a Cronbach's Alpha analysis of the assessment's items utilizing the scores of all the students. According to Nunnally & Bernstein (1994), an alpha index of 0.70 or higher indicates modest reliability (p. 265). The analysis derived a coefficient of 0.738, which deemed the items to be reliable and consistent within the assessment.

One pattern found in analyzing the data from the student work samples that reflects students' level of cognitive processing was that 94.1% of the students received scores of a 4 or 5, indicating deep and fairly deep cognitive processing. Another finding was that for the one student who scored a 1 in the "shallow" range, this was the only student who worked independently on the assessment, as was his choice.

Academic Topics for Selected Journal Responses

Along with student work samples, journal responses to the general question, "What did you learn today?" were used to evaluate the students' cognitive engagement. Student responses were arranged into four main categories: Integration, Art, Math, and Unrelated. A total of 9 students consistently answered this question on all six days, allowing for 54 total responses to be categorized. The following table shows a breakdown of the responses in the four main categories:

Table 9 Breakdown of Topics for Journal Responses: What did you learn today?

	Math	**Art (Music or Dance)**	**Integration (Math and Art)**	**Unrelated**
Number of Responses	28	8	16	2
Percentage of Responses	51.9%	14.8%	29.6%	3.7%

Note: N = 54 responses

Responses were classified based on word or phrase indicators within each response. The word or phrase indicators for the four categories – Math, Art (Music or Dance), Integration (Math and Art), and Unrelated – are displayed in the Table 10 below followed by the number of students who said each phrase.

Table 10 Coding for Journal Responses: What did you learn today?

	Math	Art (Music or Dance)	Integration (Math and Music or Dance)	Unrelated
Indicators (Words & Phrases)	*"time" (4)* *"analog clock" (1)* *"clock" (2)* *"counter-clockwise" (1)* *"money" (7)* *"count money" (2)* *"how to count money and how much it costs" (1)* *"what money is worth" (1)* *"fractions" (9)*	*"self-space" (1)* *"music notes" (3)* *"beats" (1)* *"music" (1)* *"how to talk in music" (1)* *"new way to act" (1)*	*"shapes with 4 people in string" (1)* *"music to do math" (1)* *"make any shapes in movements" (1)* *"anything can be a shape" (1)* *"patterns" (1)* *"make patterns out of anything" (1)* *"be time" (1)* *"use money to sing" (1)* *"make math out of music" (1)* *"sometimes money can be music notes" (1)* *"different music patterns" (1)* *"use money to dance" (1)* *"cent dances" (1)* *"use fractions to make music" (1)* *"fractions with our bodies" (1)* *"use money in music" (1)*	*"what people like" (1)* *"how to fold paper" (1)*

Out of 54 total responses, 28 responses (51.9%) were claims that the students learned mathematics that day. An example of a response in the Math Category was "I learn time today" (Student 7, Journal, 12/4/13). 8 out of 54 responses (14.8%) were claims that the students learned an art concept – music or movement – that day. An example of a response in the Art (Music or Dance) Category was "One thing I learned was how to talk in music" (Student 9, Journal, 12/12/13). 16 out of 54 responses (29.6%) were claims that the students learned math and art concepts at the same time, indicating an integration of the two subjects. An example of a response in the Integration Category was "I learned that we can use fractions to make music" (Student 3, Journal, 12/11/13). Finally, 2 out of 54 responses (3.7%) were claims that the students learned something unrelated to mathematics, music, or dance. A response in the Unrelated Category was "I learnd how to fold paper" (Student 17, Journal, 11/22/13).

One pattern from this data is that 52 out of 54 responses (96.3%) reflected student claims that they learned something related to mathematics, music, and movement. Another pattern from this data includes that, while the question was vague, about 30% of the responses reflected deep cognitive processing, as indicated by the Integration Category.

Dance and Math Knowledge from Videotaped Performances

In addition to the student work samples and journal responses, the students' dance performance in the lesson "Lunch Time Dance" was used to evaluate the students' level of cognitive engagement. For this performance, the students worked in small groups of four or five to create movements in self-space of what they liked to do in the one-hour period of lunch and recess. The students were to start with a shape

that represented the time that lunch started, switch movements every fifteen minutes as indicated by the instructor, and finally end in the shape representing the time that lunch ended.

Thirteen students were videotaped for this performance and were scored in terms of dance knowledge and mathematics knowledge. The criteria for dance knowledge included if the student (a) demonstrated a clear beginning, middle, and end; (b) utilized self-space in movements; and (c) formed beginning and ending shapes that were strong and still. The criteria for math knowledge that was demonstrated through dance included if the student appropriately represented time. Each student was rated on a scale of 0 to 3, 0 meaning never, 1 meaning rarely, 2 meaning mostly, and 3 meaning always in each criteria for dance and math knowledge. (See Appendix J for the Lunch Time Dance Rubric.) The following table represents the students' scores in these categories.

Table 11 Whole Class Dance and Math Knowledge from Dance Performances

Score	**Dance Criteria**			**Math Criteria**
	Clear Beginning, Middle, and End	**Utilized Self-Space in Movements**	**Beginning and End Shapes are Strong and Still**	**Appropriately Represented Time**
3	69.2%	73.1%	57.7%	46.2%
2	30.8%	19.2%	26.9%	3.8%
1	0%	7.7%	7.7%	3.8%
0	0%	0.0%	7.7%	46.2%

Note: N = 13 students who were videotaped performing Lunch Time Dance

In terms of having a clear beginning, middle, and end in their dances, 9 out of 69.2% of the students scored a 3; 30.8% of the students scored a 2; and no students scored a 1 or a 0. In terms of utilizing self-space in their movements, 73.1% of the students scored a 3; 19.2% of the students scored a 2; 7.7% of the students scored a 1; and no students scored a 0. In terms of having strong and still beginning and end shapes, 57.7% of the students scored a 3, 26.9% of the students scored a 2; 7.7% of the students scored a 1; 7.7% of the students scored a 0. Finally, in the criteria for demonstrating mathematics knowledge through dance in terms of appropriately representing time, 46.2% of the students scored a 3; 3.8% of the students scored a 2; 3.8% of the students scored a 1; and 46.2% of the students scored a 0.

The original percentage of inter-observer agreement on the rubric scores for student performances was 64.1%. This means that after another observer scored the students' performances based on the same rubrics, 64.1% of the scores given were exactly the same (Thomas et al., 2011, p. 203). Since these results were not trustworthy, 25 disagreements were chosen at random and were discussed with the outside observer until 20 were agreed upon. The rubrics were modified to reflect this discussion, and the percentage of inter-observer agreement was 81.9% making the data from these rubrics trustworthy.

One pattern shown in this data set includes that 100% of the students demonstrated a clear beginning, middle, and end in their dances all or most of the time (receiving the score of a 3 or a 2). Another pattern is that 92.3% of the students utilized self-space in their movements all or most of the time (receiving a score of a 3 or a 2). In addition, 84.6% of the students had strong and still beginning and end shapes all or most of the time (receiving a score of a 3 or a 2). Finally, half of the

students demonstrated knowledge of math through dance by appropriately representing time with their bodies.

Case Studies: Students A, B, and C

In addition to the results presented above in terms of whole class emotional, behavioral, and cognitive engagement, three specific cases were analyzed. The students selected for these case studies were chosen using a computerized random generator. One male, Student A, and two females, Students B and C, were selected, and samples of their work are presented below. Results from rubric scores for journal free responses are presented in terms of student enjoyment and student enthusiasm, which were indicators of emotional engagement. The journal entries were also scored in terms of student effort, indicating behavioral engagement, and were categorized by academic topic, indicating the subject for cognitive engagement. Results from rubric scores for the videotaped dance performance tasks are presented in terms of student attention, student effort, and student persistence, which were indicators for behavioral engagement. Lastly, results from the student work samples in Lesson 3 are also provided in terms of the depth of cognitive processing, which was an indicator for cognitive engagement.

Student A

Daily Journal Entries. After each lesson, the students wrote journal entries about their experiences learning through arts integration that day. The two prompts guiding these daily journal responses were: "What did you like or not like about today's lesson?" "What did you learn today?" and for Lesson 6 only "What was your favorite or least favorite part of this entire experience?" Student A's journal responses

were analyzed in terms of enjoyment, enthusiasm, effort, and academic topic, as represented by the table below. (See Appendix D for journal rubrics.)

Table 12 Scores from Daily Journals for Student A

	Lesson 1 (11/22/13)	**Lesson 2 (12/4/13)**	**Lesson 3 (12/5/13)**	**Lesson 4 (12/6/13)**	**Lesson 5 (12/11/13)**	**Lesson 6 (12/12/13)**
Enjoyment	3	1	3	3	3	3
Enthusiasm	2.5	1.5	2.5	2.5	2.5	2.5
Effort	2	2	2	2	2	2
Academic Topic	Integration	Math	Math	Math	Math	Math

Note: All scores range from 0 (student does not exhibit engagement indicator) to 3 (student strongly exhibits engagement indicator).

At the end of the first lesson, Student A wrote, "I liked the dans that we did. I lared you can make pater out of a nay thing" (Student 11, Journal, 11/22/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a 2.5 for enthusiasm because it indicated fairly intense enjoyment. In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, his response to the question, "What did you learn today?" was related to an integration of the math, music, and movement concept of patterns.

At the end of the second lesson, Student A wrote, "I didn't like the dans. I larnd time" (Student 11, Journal, 12/4/13). This response received a score of a 1 for enjoyment because it indicated a general state of displeasure and a 1.5 for enthusiasm because it indicated fairly intense displeasure. In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In

addition, his response to the question, "What did you learn today?" was related to math concept.

At the conclusion of the third lesson, Student A wrote, "I lined bets. I liked when we saw the mone" (Student 11, Journal, 12/5/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a 2.5 for enthusiasm because it indicated fairly intense enjoyment. In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, his response to the question, "What did you learn today?" was related to math concept.

At the end of the fourth lesson, Student A wrote, "I liked the mune dans [money dance]. I lend what mune is wharth" (Student 11, Journal, 12/6/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a 2.5 for enthusiasm because it indicated fairly intense enjoyment. In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, his response to the question, "What did you learn today?" was related to math concept.

At the end of the fifth lesson, Student A wrote, "I liked the do dans. I lirned frackshins" (Student 11, Journal, 12/11/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a 2.5 for enthusiasm because it indicated fairly intense enjoyment. In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, his response to the question, "What did you learn today?" was related to math concept.

Finally, at the end of the sixth lesson, Student A wrote, "I liked the dans. I lined mone. I liked the best is dans" (Student 11, Journal, 12/12/13). This response

received a score of a 3 for enjoyment because it indicated a general state of pleasure and a 2.5 for enthusiasm because it indicated fairly intense enjoyment. In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, his response to the question, "What did you learn today?" was related to math concept.

Videotaped Dance Performances. In each lesson with a dance performance task, Student A was videotaped and observed. Her performance in each dance was scored in terms of three indicators for behavioral engagement: attention, effort, and persistence. The table below represents Student A's scores for student attention, effort, and persistence in these dances. (See Appendix H for the dance performance rubrics.)

Table 13 Behavioral Engagement of Student A during Dance Performances

	Lesson 1: Shape Dance	**Lesson 2: Lunch Time Dance**	**Lesson 4: Money Dance**	**Lesson 5: Fraction Dance**	**Lesson 6: Going to the Store Dance**
Attention	3	3	3	2	3
Effort	2	3	2	2	2
Persistence	2	3	3	3	3

Note: All scores range from 0 (student does not exhibit behavioral engagement indicator) to 3 (student strongly exhibits behavioral engagement indicator).

Student A was present and videotaped for all lessons. For his dance performance in Lesson 1, he received a 3 for attention (indicating that he was completely on task), a 2 for effort (indicating that he exerted some physical energy or displayed a somewhat apparent desire to succeed), and a 2 for persistence (indicating that he maintained effort for some of the time). In Lesson 2, he received a 3 in all

categories, indicating that he was completely on task (attention), exerted physical energy or displayed an apparent desire to succeed (effort), and maintained effort over time (persistence). In Lesson 3, while Student A received a 3 for attention and persistence, he received a 2 for effort. For Lesson 4, he received a 2 for attention and effort and a 3 for persistence. In Lesson 5, he received a 2 for attention and effort and a 3 for persistence. Finally, in Lesson 6, he received a 3 for attention, a 2 for effort, and a 3 for persistence.

Student Work Sample. In Lesson 3, Student A participated in a culminating activity called "Money Rhythms." This formative assessment consisted of five items, scored as either right or wrong, and was used to assess the student's ability to synthesize math and music concepts, a deep cognitive strategy. Figure 3, below, shows this student's work on the Money Rhythms activity.

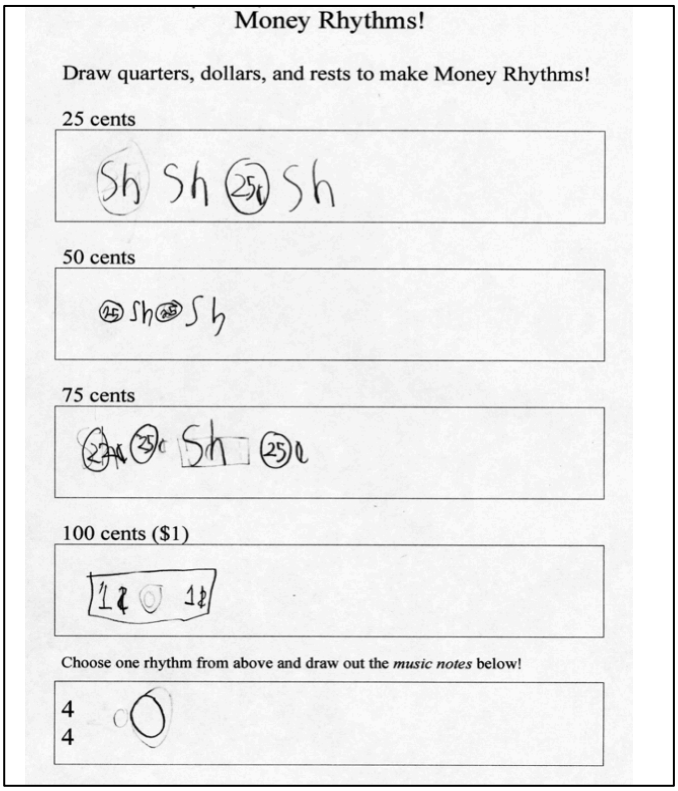


Figure 8 Students 11 & 13, Work Sample, 12/5/13

Note: "Sh" was accepted as a proper representation of a "rest."

In Item 1, Student A drew two "sh's" followed by one quarter and one "sh," which correctly represented a Money Rhythm costing 25 cents. In Item 2, he drew one quarter and one "sh" followed by another quarter and another "sh," which correctly represented a Money Rhythm costing 50 cents. In Item 3, Student A drew two quarters followed by one "sh" and one quarter, which correctly represented a Money Rhythm costing 75 cents. In Item 4, he drew a one-dollar bill, which accurately represented a Money Rhythm costing 100 cents or one dollar. Finally, in Item 5, he drew a whole note, which accurately represented his Money Rhythm of 100

cents but in terms of a music symbol. Thus, Student A received a score of a 5 out of 5, indicating his ability to synthesize math and music concepts correctly, which thus reflected very deep cognitive processing.

Patterns. One pattern found in analyzing Student A's engagement was that out of 6 journal entries, 5 entries (83.3%) received the score of a 3 for enjoyment, indicating a general state of pleasure. Another pattern is that out of 6 journal entries 5 entries (83.3%) received the score of a 2.5 for enthusiasm, indicating fairly intense enjoyment. In terms of effort on journals, 6 out of 6 journal entries (100%) received the score of a 2, indicating good effort. 5 out of 6 journal entries (83.3%) consisted of claims that he learned math concepts and 1 out of 6 journal entries (16.7%) consisted of a claim that he learned an integration of concepts. In terms of behavioral engagement, another pattern is that Student A received either a score of a 2 or a 3 for 5 out of 5 (100%) dance performances in all categories of student attention, effort and persistence. In addition, Student A received a 5 out of 5 on his formative assessment, indicating very deep cognitive processing.

Student B

Daily Journal Entries. After each lesson, the students wrote journal entries about their experiences learning through arts integration that day. The two prompts guiding these daily journal responses were: "What did you like or not like about today's lesson?" "What did you learn today?" and for Lesson 6 only "What was your favorite or least favorite part of this entire experience?" Student B's journal responses were analyzed in terms of enjoyment, enthusiasm, effort, and academic topic, as represented by the table below. (See Appendix D for journal rubrics.)

Table 14 Scores from Daily Journals for Student B

	Lesson 1 (11/22/13)	**Lesson 2 (12/4/13)**	**Lesson 3 (12/5/13)**	**Lesson 4 (12/6/13)**	**Lesson 5 (12/11/13)**	**Lesson 6 (12/12/13)**
Enjoyment	Abs.	2	3	3	2	3
Enthusiasm	Abs.	2	3	2.5	2	3
Effort	Abs.	1	2	2	3	3
Academic Topic	Abs.	n/a	Music	Math	Math	Math

Note: All scores range from 0 (student does not exhibit engagement indicator) to 3 (student strongly exhibits engagement indicator). Abs. indicates that this student was absent for Lesson 1.

Student B was absent for the first lesson. At the end of the second lesson, she wrote, "I didn't like when we went up in front of the class. Becuse it was inbarising. I loved makeing dance and seeing people's dances" (Student 6, Journal, 12/4/13). This response received a score of a neutral 2 for enjoyment and enthusiasm because it indicated both pleasure and displeasure. In terms of effort, this response received a score of a 1 because it did not answer the question, "What did you learn today?"

At the end of the third lesson, Student B wrote, "One thing I like was everthing but most of all just sitting learning whith you guys so I learned diffrent muisic notes" (Student 6, Journal, 12/5/13). This response received a score of a 3 for enjoyment and enthusiasm because it indicated a general state of pleasure (enjoyment) and intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, her response to the question, "What did you learn today?" was related to a music concept.

After the fourth lesson, Student B wrote, "One thing I learned was how to count money. I liked was makeing dances" (Student 6, Journal, 12/5/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a 2.5 for enthusiasm because it indicated fairly intense enjoyment. In

terms of effort, this response received a score of a 2 because it answered all questions but with little detail. In addition, her response to the question, "What did you learn today?" was related to a math concept.

At the conclusion of the fifth lesson, Student B wrote, "I learned fraction's. I liked makeing songs. I didn't like the math fraction's" (Student 6, Journal, 12/11/13). This response received a score of a neutral 2 for enjoyment and enthusiasm because it indicated both pleasure and displeasure. In terms of effort, this response received a score of a 3 because it answered all questions and provided detail. In addition, her response to the question, "What did you learn today?" was related to a math concept.

Finally, at the end of the sixth lesson, Student B wrote, "Dear Miss Amanda, First I like to make sure I spelled your name right. One thing I learned was: more about time. Second I learned you were Just kidding about your last day right. I liked makeing dances. I do not have anything to right for something I do not like. My favorite part of every thing was hanging with you guys. PS you are coming Monday of next month right please right back by" (Student 6, Journal, 12/12/13). This response received a score of a 3 for enjoyment and enthusiasm because it indicated a general state of pleasure (enjoyment) and intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions with detail. In addition, her response to the question, "What did you learn today?" was related to a math concept.

Videotaped Dance Performances. In each lesson with a dance performance task, Student B was videotaped and observed. Her performance in each dance was scored in terms of three indicators for behavioral engagement: attention, effort, and persistence. The table below represents Student B's scores for student attention,

effort, and persistence in these dances. (See Appendix H for the dance performance rubrics.)

Table 15 Behavioral Engagement of Student B during Dance Performances

	Lesson 1: Shape Dance	**Lesson 2: Lunch Time Dance**	**Lesson 4: Money Dance**	**Lesson 5: Fraction Dance**	**Lesson 6: Going to the Store Dance**
Attention	Abs.	3	3	3	3
Effort	Abs.	3	3	3	3
Persistence	Abs.	3	3	3	3

Note: All scores range from 0 (student does not exhibit behavioral engagement indicator) to 3 (student strongly exhibits behavioral engagement indicator). Abs. indicates that this student was absent for Lesson 1.

Student B was present for Lessons 2, 4, 5, and 6. In all of these dance performances, she received a 3 in the categories of attention, effort, and persistence, indicating that she was on-task (attention), exerted physical energy or displayed an apparent desire to succeed (effort), and maintained effort over time (persistence).

Student Work Sample. In Lesson 3, Student B participated in a culminating activity called "Money Rhythms." This formative assessment consisted of five items, scored as either right or wrong, and was used to assess the student's ability to synthesize math and music concepts, a deep cognitive strategy. Figure 3, below, shows this student's work on the Money Rhythms activity.

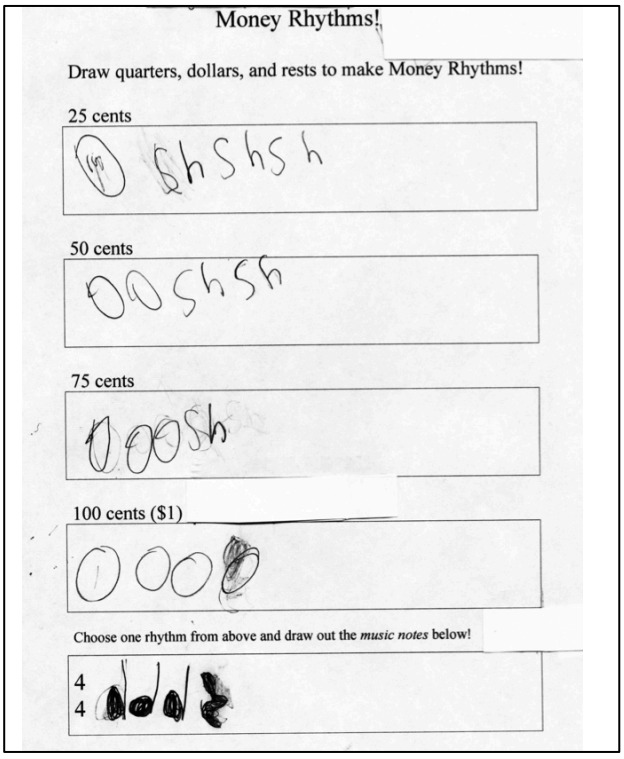


Figure 9 Students 6 & 8, Work Sample, 12/5/13

Note: "Sh" was accepted as a proper representation of a "rest."

In Item 1, Student B drew one quarter followed by three "sh's," which correctly represented a Money Rhythm costing 25 cents. In Item 2, she drew two quarters followed by two "sh's," which correctly represented a Money Rhythm costing 50 cents. In Item 3, Student B drew three quarters followed by one "sh," which correctly represented a Money Rhythm costing 75 cents. In Item 4, she drew four quarters, which accurately represented a Money Rhythm costing 100 cents. Finally, in Item 5, she drew three quarter notes and one quarter rest, which accurately represented her Money Rhythm of 75 cents but with music symbols. Thus, Student B received a

score of a 5 out of 5, indicating her ability to synthesize math and music concepts correctly, which thus reflected very deep cognitive processing.

Patterns. One pattern found in analyzing Student B's engagement was that out of 5 journal entries, 5 entries (100%) received the score of a 2 or a 3 for both enjoyment and enthusiasm. In terms of effort on journals, 4 out of 5 journal entries (80.%) received the score of a 2 or 3, indicating good or exceptional effort. 3 out of 5 journal entries (60.0%) consisted of claims that she learned math concepts and 1 out of 5 journal entries (20.0%) consisted of a claim that she learned a music concept. In terms of behavioral engagement, another pattern is that Student B received a score of a 3 for 4 out of 4 (100%) dance performances in all categories of student attention, effort and persistence. In addition, Student B received a 5 out of 5 on her formative assessment, indicating very deep cognitive processing.

Student C

Daily Journal Entries. After each lesson, the students wrote journal entries about their experiences learning through arts integration that day. The two prompts guiding these daily journal responses were: "What did you like or not like about today's lesson?" "What did you learn today?" and for Lesson 6 only "What was your favorite or least favorite part of this entire experience?" Student C's journal responses were analyzed in terms of enjoyment, enthusiasm, and effort, and academic topic, as represented by the table below. (See Appendix D for journal rubrics.)

Table 16 Scores from Daily Journals for Student C

	Lesson 1 (11/22/13)	**Lesson 2 (12/4/13)**	**Lesson 3 (12/5/13)**	**Lesson 4 (12/6/13)**	**Lesson 5 (12/11/13)**	**Lesson 6 (12/12/13)**
Enjoyment	3	3	3	3	3	3
Enthusiasm	2.5	3	3	2.5	2.5	2.5
Effort	3	3	3	3	3	3
Academic Topic	Integration	Math	Integration	Math	Math	Music

Note: All scores range from 0 (student does not exhibit emotional engagement indicator) to 3 (student strongly exhibits emotional engagement indicator).

At the end of the first lesson, Student C wrote, "Today my favorite part in math class was when we used string to make shapes. The thing I learned in math is anything can be a shape" (Student 9, Journal, 11/22/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a score of a 2.5 for enthusiasm because it indicated fairly intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions but with detail. In addition, her response to the question, "What did you learn today?" was an integration of the math, music, and dance concept of patterns.

After the second lesson, Student C wrote, "My favorite part in math was showing time and how the day works. Math class is a very fun time. That is my favorite part of math. One thing I learned in math is time learning time is fun" (Student 9, Journal, 12/4/13). This response received a score of a 3 for enjoyment and enthusiasm because it indicated a general state of pleasure (enjoyment) and intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions but with detail. In addition, her response to the question, "What did you learn today?" was related to a math concept.

At the end of the third lesson, Student C wrote, “Today I learned that sometimes money can be music notes. One thing I liked today was when we did the notes they showed us. That was my favorite part” (Student 9, Journal, 12/5/13). This response received a score of a 3 for enjoyment and enthusiasm because it indicated a general state of pleasure (enjoyment) and intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions but with detail. In addition, her response to the question, “What did you learn today?” was an integration of math and music concepts.

After the fourth lesson, Student C wrote, “One thing I liked was when we did the money movements. One thing I learned was how to count money and how much it costs. That was my faveorite part and what I learned” (Student 9, Journal, 12/6/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and s score of a 2.5 because it indicated fairly intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions but with detail. In addition, her response to the question, “What did you learn today?” was related to a math concept.

After the fifth lesson, Student C wrote, “One thing I liked was when we made a song. One thing I learned was fractions” (Student 9, Journal, 12/11/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a score of a 2.5 for enthusiasm because it indicated fairly intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions but with detail. In addition, her response to the question, “What did you learn today?” was related to a math concept.

Finally, at the end of the sixth and last lesson, Student C wrote, "One thing I liked was when we got to do the dance of money. One thing I learned was how to talk in music. My favorite part from everything was when we got to get vidieo taped" (Student 9, Journal, 12/12/13). This response received a score of a 3 for enjoyment because it indicated a general state of pleasure and a score of a 2.5 for enthusiasm because it indicated fairly intense enjoyment (enthusiasm). In terms of effort, this response received a score of a 3 because it answered all questions but with detail. In addition, her response to the question, "What did you learn today?" was related to a music concept.

Videotaped Dance Performances. In each lesson with a dance performance task, Student C was videotaped and observed. Her performance in each dance was scored in terms of three indicators for behavioral engagement: attention, effort, and persistence. The table below represents Student C's scores for student attention, effort, and persistence in these dances. (See Appendix H for the dance performance rubrics.)

Table 17 Behavioral Engagement of Student C during Dance Performances

	Lesson 1: Shape Dance	**Lesson 2: Lunch Time Dance**	**Lesson 4: Money Dance**	**Lesson 5: Fraction Dance**	**Lesson 6: Going to the Store Dance**
Attention	3	N/A	3	3	3
Effort	3	N/A	3	2	3
Persistence	3	N/A	3	3	2

Note: All scores range from 0 (student does not exhibit behavioral engagement indicator) to 3 (student strongly exhibits behavioral engagement indicator). N/A indicates that this student was not videotaped on Lesson 2.

Student C was present for all lessons but was not videotaped in Lesson 2 due to another member of her group not having permission for this. For her dance performances in Lesson 1 and Lesson 4, she received a 3 in the categories of attention, effort, and persistence, indicating that she was on-task (attention), exerted physical energy or displayed an apparent desire to succeed (effort), and maintained effort over time (persistence). In Lesson 5, Student C received a 3 for attention (indicated by high concentration and on-task focus), a 2 for effort (indicated by the exertion of some physical energy and an apparent desire to succeed), and a 3 for persistence (indicated by effort that was maintained over time). In Lesson 6, Student C received a 3 for attention, a 3 for effort, and a 2 for persistence (indicated by effort that was somewhat maintained over time).

Student Work Sample. In Lesson 3, Student C participated in a culminating activity called "Money Rhythms." This formative assessment consisted of five items, scored as either right or wrong, and was used to assess the student's ability to synthesize math and music concepts, a deep cognitive strategy. Figure 3, below, shows this student's work on the Money Rhythms activity.

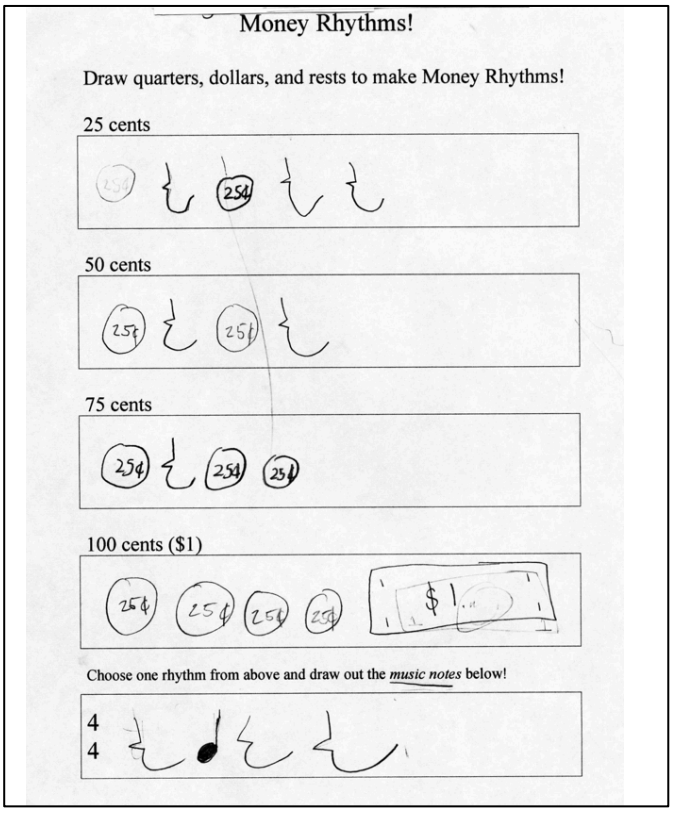


Figure 10 Students 7 & 9, Work Sample, 12/5/13

In Item 1, Student C drew one quarter rest and one quarter followed by two more quarter rests, which correctly represented a Money Rhythm costing 25 cents. In Item 2, she drew one quarter and one rest followed by another quarter and another rest, which correctly represented a Money Rhythm costing 50 cents. In Item 3, Student B drew one quarter and one rest followed by two quarters, which correctly represented a Money Rhythm costing 75 cents. In Item 4, she drew four quarters and one dollar, which each represented a Money Rhythm costing 100 cents. Finally, in Item 5, she drew three quarter notes and one quarter rest, which accurately represented her Money

Rhythm of 25 cents but with music symbols. Thus, Student C received a score of a 5 out of 5, indicating her ability to synthesize math and music concepts correctly, which thus reflected very deep cognitive processing.

Patterns. One pattern found in analyzing Student C's engagement was that out of 6 journal entries, 6 entries (100%) received a score of a 2 or a 3 for both enjoyment and enthusiasm. In terms of effort on journals, 6 out of 6 journal entries (100%) received a score of a 3, indicating exceptional effort. 5 out of 6 journal entries (83.3%) consisted of claims that she learned math concepts, with 2 out of these 5 (40%) journal entries consisting of an integration of math and art concepts. In terms of behavioral engagement, another pattern is that Student C received either a score of a 2 or 3 for 5 out of 5 (100%) dance performances in student attention, effort, and persistence. In addition, Student C received a 5 out of 5 on her formative assessment, indicating very deep cognitive processing.

Patterns Across Case Studies

In terms of emotional engagement enjoyment and enthusiasm (emotional engagement) conveyed in journals, one pattern is that, on average, 94.4% of the journal entries of all three students received a score of a 2 or a 3. In terms of effort on journals (behavioral engagement), on average, 93.3% of the journal entries of all three students received a score of a 2 or a 3. Another pattern is that 70.0% of the journal entries, on average, reflected claimed that the students learned math concepts (excluding the category of "Integration"). In terms of attention, effort, and persistence (behavioral engagement), 100% of the dance performances, on average, received a score of a 2 or 3 in each category. In terms of depth of processing (cognitive

engagement), all three students displayed very deep cognitive processing on their formative assessments in Lesson 3.

Limitations of the Study

Lack of randomization of the sample population was a limitation to this study. Since the second grade class was pre-determined by the school before the study took place, the group could not be randomized. In addition, the sample size, which consisted of 17 students, was too small to give a statistical analysis of the quantitative data collected. Another limitation for the quantitative data was that there were no control group scores from a class of students learning math the traditional way to which the participants' scores could be compared.

One limitation for the qualitative data was that not all students were present during class or answered all journal and survey questions due to time constraints. For the journals, a consistent group of only 9 students could be analyzed. For the surveys, a consistent group of only 10 out of 17 surveys could be utilized. Another limitation for the qualitative data was that not all students were videotaped due to lack of parental permission for 2 out of 17 classmates. Since the students performed in groups, the performances of one or two groups each day could not be scored because they were not recorded. This created an inconsistent number of total students that were recorded each day (13 students for two dances, 11 students for 2 dances, 10 students for 1 dance) as well as an inconsistent appearance of each student on tape. These limitations further reduced the size of the data sample.

Another limitation to the study was the overall time constraint because the curriculum was only taught over a three-week period, with 1-3, one-hour and fifteen-minute classes per week. If the length of time in the classroom were longer, such as

an entire marking period or even the entire school year, this would provide students with more time to experience integrated curriculum and thus more data to show the effect of the curriculum on the students' engagement with learning.

Conclusion

Throughout the implementation of this study, a variety of data sources were used. These assessments were in the forms of journal responses, survey responses, observations of video footage, and student work samples. The assessments were developed to coincide with the lessons, so the results indicated information about the participating students' enjoyment, enthusiasm, attention, effort, persistence, and depth of cognitive processing. The results included students' rubric scores on journal and survey responses related to indicators for emotional engagement (enjoyment, enthusiasm), rubric scores for video footage and journal entries related to indicators for behavioral engagement (attention, effort, persistence), and results from student work samples from one individual lesson and journal responses related to indicators for cognitive engagement (deep and fairly deep cognitive processing). In addition, three case studies were conducted in order to deepen the analysis of the effects of an arts-integrated curriculum on second grade students' emotional, behavioral, and cognitive engagement.

Despite the limitations of this study, several patterns can be derived from the results that were valid and reliable. First, patterns found in regards to students' enjoyment and enthusiasm in journal responses included that 88.3% of the responses received scores higher than a 2. Second, patterns found in regards to students' enjoyment and enthusiasm in the selected post-survey free responses included that 73.8% of the responses received a 3 in for student enjoyment and 76.1% of the

responses received a 2.5 or 3 for the student enthusiasm. An additional pattern found in the survey data was that for items 13-16, which were not originally intended to indicate student enjoyment and enthusiasm, 55% of the responses scored a 3 in enjoyment and 60% of the responses scored a 2.5 or 3 in student enthusiasm.

Next, patterns found with regard to students' attention, effort, and persistence included that overall, 98.1% of the scores received a 2 or 3 in the category of student attention, 92.1% of the scores received a 2 or 3 in the category of student effort, and 92.3% of the scores received a 2 or 3 in the category of student persistence.

Related to the students' depth of cognitive processing, one pattern found in the data from the student work samples included that 94.1% of the students received scores of a 4 or 5, indicating fairly deep or deep cognitive processing. Another finding was that for the one student who scored a 1 in the "shallow" range, this was the only student who worked independently on the assessment, by choice.

Additional patterns related to student enthusiasm were found in the data from the post-survey student self-ratings. One pattern was that 91.2% of the responses received a score of a 4 or 5, indicating a general state of pleasure, or student enjoyment. The remaining 8.8% of the responses received a neutral score of 3.

The next chapter includes a discussion of this study. The patterns in the results presented in this chapter are discussed in conjunction with the research questions and related to prior research and findings, providing implications for arts-integrated education and suggestions for future research.

Chapter 5

DISCUSSION

Summary of Results

Results in Relation to the Research Questions

The main research question that guided the study of student experiences through integrated learning was: What were the effects of a music and movement integrated mathematics curriculum on second grade students' emotional, behavioral, and cognitive engagement with learning? To investigate this question, three focus questions were addressed: (1) What were the effects of a music and movement integrated mathematics curriculum on emotional engagement, as indicated by enjoyment and enthusiasm? (2) What were the effects of a music and movement integrated mathematics curriculum on behavioral engagement, as indicated by attention, effort, and persistence? (3) What were the effects of a music and movement integrated mathematics curriculum on cognitive engagement, as indicated by deep cognitive processing?

To address these three questions, multiple sources were analyzed in each category of emotional, behavioral, and cognitive engagement and pointed to positive effects of arts integration in all three categories. High levels of student enjoyment and enthusiasm, as observed in journal and survey responses, pointed to high emotional engagement. High levels of student attention, effort, and persistence, as shown in videotaped student performances and journal entries, indicated high behavioral

engagement. High success with synthesizing ideas across math and the arts, a deep cognitive process, signified high cognitive engagement. Thus, it is clear that this arts integrated curriculum positively engaged students in all three dimensions, providing students with a deeply enriching learning experience.

Results in Relation to the Literature

Engagement. In the literature review, several research studies related to student engagement were discussed. Consistent with the findings of Godwin and her colleagues (2013), this study found that students retained focus throughout the arts integration curriculum, which consisted of active group and dance activities and very little whole group instruction and independent activities. According to Martin and his colleagues (2012), students who disengage in math also experience low levels in self-efficacy and personal enjoyment, a view that math is not important, and high levels of math anxiety. In this study, the students showed deep personal enjoyment with integrated learning, an indication of high emotional engagement. Because students typically tend to disengage in math between elementary school and high school (Pajares & Graham, 1999), arts integration serves as one way to help students remain excited, interested, and personally invested in their learning.

Arts Integration. As discussed in the literature review, utilizing music and movement integrated instruction to teach mathematics reaps many benefits. For example, Upitis (2011) found that students in music and mathematics integrated classrooms achieved better math test scores than did students in traditional mathematics classrooms. Similarly, despite the fact that student achievement in mathematics was not, the current study did find that the students benefited cognitively throughout the implementation of the "Math is Music to Our Ears" curriculum in

terms of their engagement. Furthermore, consistent with the findings of Werner (2001) and Ryan (2014) related to positive attitudes and high achievement in dance and math integrated classrooms for elementary school students, the participants demonstrated deep understandings of dance and math in their integrated dance performances as well as positive feelings toward both subjects in journals and surveys.

Theoretical Frameworks. Four main frameworks, as explored in the literature review, guided the development of this study: (a) Experiential Learning Theory, (b) Theory of Student Engagement, (c) 21st Century Learning Skills, (d) STEAM. Inspired by Kolb's (1984) Experiential Learning Theory, the lessons in "Math is Music to Our Ears" were designed to involve students with content through hands-on, interactive, and engaging activities. However, according to Fredricks and her colleagues (2004), engagement is a multidimensional construct, and in order to understand student engagement in full, each dimension – emotional, behavioral, and cognitive – must be explored. Thus, the results from this study, which indicate high levels of student engagement in *all three* dimensions, support the use of arts integration as a way to provide students with holistic learning experiences.

In addition, to be prepared for success in the 21st century, students must develop four main skills: (1) creativity and innovation; (2) critical thinking and problem solving; (3) communication; and (4) collaboration (Partnership, 2009, p. 2). The activities throughout the course of "Math is Music to Our Ears" allowed for the students to *create* music and dance performances, *critically think* about how to math and the arts intersect, *communicate* their ideas in groups, and *collaborate* on artistic decisions. In doing so, the students were using skills that are needed to be successful

in all of the STEAM fields – science, technology, engineering, art, and mathematics (Bequette & Bequette, 2012).

Implications for Future Research

The results from this study can extend into future research on arts integration in a variety of ways. In future replications of this study, for example, it will be important to compare student engagement levels in two types of settings. A researcher can teach both an experimental group and a control group the same mathematics lessons but utilize a music and movement integrated curriculum with the experimental group only. Then, the levels of student engagement – emotionally, behaviorally, and cognitively – can be compared between to the two types of classroom settings. An alternative analysis of student engagement can also include cross-analyses of the three dimensions of engagement in order to better understand the level of interdependence between them.

Additionally, a future replicated study using "Math is Music to Our Ears" could consist of several adjustments. First, the researcher could implement a pre-survey in addition to the post-survey to gauge student enjoyment, enthusiasm, and interest in math, music, and movement. The results from the pre-survey could then be compared with the post-survey in order to see if there was a change in the students' feelings toward the subjects, providing a deeper understanding of the students' emotional engagement. Also related to emotional engagement, the questions for the daily journal entries could be more specific – asking the students what they liked most or least about a particular activity, for example. In terms of behavioral engagement, a researcher could videotape the students throughout the entire curriculum in order to observe how on task they are in every activity as well as provide students. Finally, in

terms of cognitive engagement, the researcher can implement the Money Rhythms assessment prior to instruction as a pre-test for that lesson. Overall, the researcher can implement pre- and post-tests for the entire "Math is Music to Our Ears" curriculum to assess the students' knowledge in math, music, and dance.

An experimental design would allow the researcher to compare the achievement levels in the experimental and control groups in addition to comparing engagement levels. Another study could conceptualize and assess cognitive engagement conceptualized in other ways. For instance, videotaping the creative process of student groups developing integrated dances may reveal critical thinking skills. Recording student questions or conducting focus groups with students on what they learned each day may also provide the researcher with deeper insight on the students' cognitive engagement.

In order to sustain this project, schools can create professional development workshops as well as provide materials and resources for teachers on how to integrate music and dance in their classrooms. This way, students can experience the positive results that this study has shown. In addition, following up with the classrooms in which this study and similar studies take place to provide continued support, materials, and resources would also help to sustain this project, study, and resulting future studies.

Conclusion

Based on this study of the "Math is Music to Our Ears" curriculum, it is evident that through arts integrated instruction, students engaged with learning emotionally, behaviorally, and cognitively. As Christensen, Garvin, and Sweet (1991) state, "To teach is to engage students in learning… The aim of teaching is not

only to transmit information but also to transform students from passive recipients of other people's knowledge into active constructors of their own and others' knowledge." Thus, by creating this environment that engages students in body, mind, and mood, students can achieve academic success in a unique and fun way.

REFERENCES

Astin, A. W. (1984). Student involvement: A developmental theory for higher education. *Journal of College Student Development, 25*, 297–308. Retrieved from http://kvccdocs.com/KVCC/2013-Spring/FY125-OLA/content/L-17/Student%20Involvement%20Article.pdf

Balfanz, R., Herzog, L., & Mac Iver, D. J. (2007). Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: Early identification and effective interventions. *Educational Psychologist, 42*(4), 223-235. Retrieved from http://new.every1graduates.org/wp-content/uploads/2012/03/preventing_student_disengagement.pdf

Bempechat, J., & Shernoff, D. J. (2012). Parental influences on achievement motivation and student engagement. In. S. I. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 315-342). New York, NY: Springer Science and Business Media, LLC. Retrieved from http://www.researchgate.net/profile/David_Shernoff/publication/236685628_Parental_influences_on_achievement_motivation_and_student_engagement/links/02e7e5191020ec2cd1000000.pdf

Bequette, J., & Bequette, M. B. (2012). A place for art and design education in the STEM conversation. *Art Education 65*(2), 40-47. Retrieved from http://www3.kutztown.edu/arteducation/PDF/APlaceFor.pdf

Capra, F. (1996). *The web of life.* New York, NY: Anchor.

Christensen, C. R., Garvin, D. A., & Sweet, A. (1991). *Education for judgment: The artistry of discussion leadership.* Cambridge, MA: Harvard Business School.

Creswell, J. W., Plano Clark, V. L., Gutmann, M., & Hanson, W. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 209-240). Thousand Oaks, CA: Sage Publications, Inc.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334. Retrieved from http://kttm.hoasen.edu.vn/sites/default/files/2011/12/22/cronbach_1951_coefficient_alpha.pdf

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and intervention.* New York, NY: HarperCollins Publishers.

Education Week Research Center. (2014). *Findings from a national survey: Engaging students for success.* Bethesda, MD: Editorial Projects in Education Inc. Retrieved from http://www.edweek.org/media/ewrc_engagingstudents_2014.pdf.

Finn, J. D., & Rock, D. A. (1997). Academic success among students at risk for school failure. *Journal of Applied Psychology, 82*(2), 221-234. Retrieved from http://www.viriya.net/jabref/Academic_success_among_students_at_risk_for_school_failure.pdf

Fredricks, J. A., & McColskey, W. (2012). The measurement of student engagement: A comparative analysis of various methods and student self-report instruments. In S. I. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of Research on Student Engagement* (pp. 763-782). New York, NY: Springer Science and Business Media, LLC.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. (2004). School engagement: Potential of the concept: State of the evidence. *Review of Educational Research, 74*, 59–119. Retrieved from http://ceep.indiana.edu/hssse/Fredricks.pdf

George, A. L, & Bennett, A. (2004). *Case studies and theory development in the social sciences.* Cambridge, MA: Belfer Center for Science and International Affairs.

Godwin, K. E., Almeda, M. A., Petroccia, M., Baker, R., & Fisher, A. B. (2013). Classroom activities and off-task behavior in elementary school children, , in Proceedings of the 35th Annual Meeting of the Cognitive Science Society (Berlin), 2428–2433. Retrieved from http://www.columbia.edu/~rsb2162/Godwinetal_v12.pdf

Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly, 24*(4), 602-611. Retrieved from http://faculty.washington.edu/swhiting/pols502/Jick.pdf

Kolb, A. Y., & Kolb, D. A. (2009). The learning way: Meta-cognitive aspects of experiential learning. *Simulation & Gaming 50*(3), 297-327. Retrieved from http://gru.edu/qep/documents/articles/the-learning-way.pdf

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development* (1st ed.). Englewood Cliffs, NJ: Prentice Hall.

Lacey, T. A., & Wright, B. (2009). Occupational employment projections to 2018. *Monthly Labor Review*, *132*(11), 82-123. Retrieved from http://www.bls.gov/opub/mlr/2009/11/art5full.pdf

Martin, A., Anderson, J., Bobis, J., & Way, J. (2012). Switching on and switching off in mathematics: An ecological study of future intent and disengagement among middle school students. *Journal of Educational Psychology, 104*(1), 1-18. Retrieved from http://psycnet.apa.org/journals/edu/104/1/1.pdf

Mason, P. H. (2012). Music, dance, and the total art work: Choreomusicology in theory and practice. *Research in Dance Education, 13*(1), 5-24. Retrieved from http://www.tandfonline.com.udel.idm.oclc.org/doi/pdf/10.1080/14647893.2011.651116

McTighe, J. & Wiggins, G. (2005). *Understanding by design*. Alexandria: Association for Supervision and Curriculum Development.

National Coalition for Core Arts Standards (2014) National Core Arts Standards. *National Core Arts Standards.* Dover, DE: State Education Agency Directors of Arts Education.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: National Council of Teachers of Mathematics.

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics.* Washington, DC: Authors.

Nunnally, J. C., and I. H. Bernstein. (1994). Psychometric Theory. 3rd ed. New York: McGraw–Hill.

O'Donnell, A., Reeve, J., & Smith, J. K. (2012). *Educational psychology: Reflection for action* (3rd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Okan, Z. (2012). Edutainment and learning. In. N. M. Seel (Ed.), *Encyclopedia of the Sciences of Learning* (pp. 1080-1082). New York, NY: Springer Science+Business Media, LLC.

Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance of entering middle school students. *Contemporary Educational Psychology, 24*(2), 124-139. Retrieved from http://ac.els-cdn.com/S0361476X98909912/1-s2.0-S0361476X98909912-main.pdf?_tid=7c1be74c-04f3-11e5-ae26-00000aacb35e&acdnat=1432788131_cdeff06eeffed55dd63563a5f8732230

Parsad, B., & Spiegelman, M. (2012). *Arts education in public elementary and secondary schools: 1999-2000 and 2009-10* (NCES 2012-014). Washington, DC: National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubs2012/2012014rev.pdf

Partnership for 21st Century Skills. (2009). P21 framework definitions. Retrieved from http://www.p21.org/storage/documents/P21_Framework_Definitions.pdf.

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Ryan, J. (2014). Math that moves you: A study of the effects of a dance integrated mathematics curriculum supplement on the knowledge and attitudes of second grade students. In L. Y. Overby, & B. Lepczyk, *Dance: Current selected research (Vol. 8).* (pp. 219-258). Brooklyn, NY: AMS Press, Inc.

Silverstein, L. B., & Layne, S. (2014). What is Arts Integration?: Explore the Kennedy Center's comprehensive definition. *The Kennedy Center: ARTSEDGE - the National Arts and Education Network.* Retrieved from http://www.kennedy-center.org/education/partners/defining_arts_integration.pdf

Skinner, E., Furrer, C., Marchand, G., & Kindermann, T. (2008). Engagement and Disaffection in the Classroom: Part of a Larger Motivational Dynamic? *Journal of Educational Psychology, 100*(4), pp. 765–781. Retrieved from http://web.pdx.edu/~thomas/Skinner%20Furrer%20Marchand%20Kindermann%202008%20jep.pdf

Sousa, D. A., & Pilecki, T. (2013). *From STEM to STEAM: Using brain-compatible strategies to integrate the arts.* Thousand Oaks, CA: Corwin.

Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2011). *Research methods in physical activity* (6th ed.). Champaign, IL: Human Kinetics Publishers.

Upitis, R. (2011). Engaging students through the arts. *The Literacy and Numeracy Secretariat,* [Monograph 33]. Toronto, ON: Government of Ontario. Retrieved from https://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/WW_Engaging_Arts.pdf

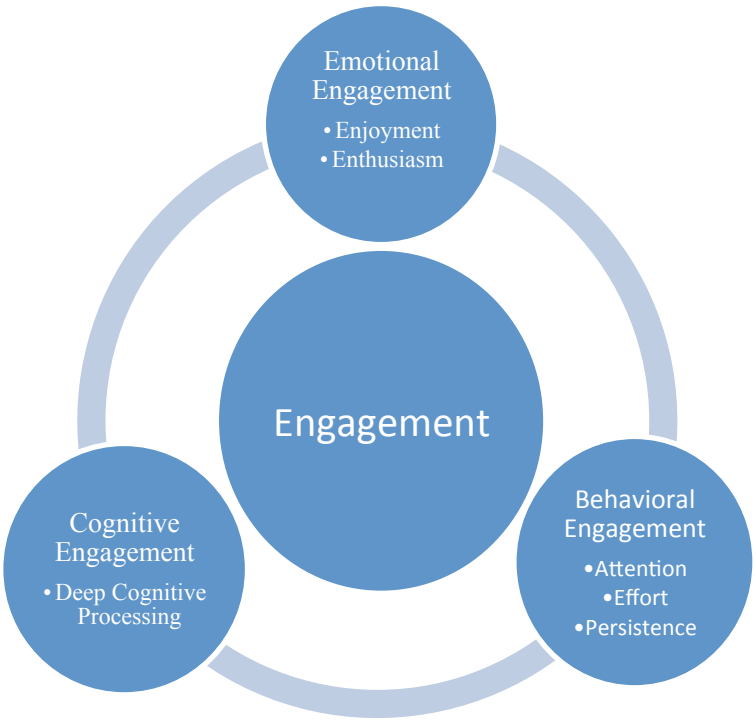
Weinstein, C., & Mayer, R. (1986). The teaching of learning strategies. In M. C. Wittrock (Ed.), *Handbook of research on teaching and learning* (pp. 315-327). New York, NY: Macmillan.

Wellborn, J. G. (1991). *Engaged and disaffected action: The conceptualization and measurement of motivation in the academic domain.* Unpublished doctoral dissertation, University of Rochester, Rochester, NY.

Werner, L. (2001, October). *Changing student attitudes toward math: Using dance to teach math.* Retrieved from https://conservancy.umn.edu/bitstream/handle/11299/143714/mathattitude.pdf?sequence=1

Appendix A

MODEL FOR STUDENT ENGAGEMENT



Adapted from Fredricks et al.'s (2004) multidimensional model for student engagement

Appendix B

LESSON PLANS

Math is Music to Our Ears: Lesson 1

Lesson Title: Shape Dance

Length: 50 minutes

Age Group: Grade 2

Materials Needed: drum, yarn, big clock, big circle visual, big common time and measure visual, circle handouts, easel & marker, music, journals

Standards:

Math	Music	Movement
CCSS.Math.Content.2.MD.C.7 Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m. **CCSS.Math.Content.2.G.A.3** Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.	**2.1** Imitate rhythmic and melodic patterns on pitched and unpitched instruments. **2.2** Perform on pitched and unpitched instruments in rhythm while applying a steady beat. **2.3** Perform rhythm accompaniments by ear.	**1.1** Perform axial movements (e.g., bend, stretch, twist, turn, swing, collapse). **1.3** Demonstrate eight basic loco-motor movements (e.g., walk, run, hop, jump, leap, gallop, slide, skip) traveling forward backward, sideward, diagonally, turning.

Learning Objectives:

Cognitive	Affective	Psychomotor/ Artistic
(1) Determine the shape of a clock. (2) Partition a circle. (3) Keep the beat in common time.	Students will be engaged by using their voices and bodies appropriately to represent	Students will speak rhythms and perform loco-motor and non-locomotor

(4) Perform loco-motor and non-locomotor movements.	shapes.	tasks to learn about shapes.

Assessment Criteria for this lesson:

Cognitive	Affective	Psychomotor/ Artistic
Can students determine the shape of a clock, partition a circle, keep the beat in common time, and perform loco-motor and non-locomotor movements?.	Will students be engaged by using their voices and bodies appropriately to represent shapes?	Can students speak rhythms and perform loco-motor and non-locomotor tasks to learn about shapes?

Introduce Lesson's Target Learning:

How will you introduce your lesson's concept?

- I will introduce this lesson by describing that the whole purpose of the unit is to observe patterns in math, music and movement. This class, students will be guided to understand shapes by learning about sounds and movements.

Why are you studying this?

- To help students understand the connections between music, dance, and math.

Integrated Activities

Whole group discussion

- What do you already know about clocks, rhythm, and movement? What do you want to learn about clocks, rhythm, and movement?
- Write ideas on front board. (3 separate webs)

I like people who…

- The entire class will form a circle
    - Let's think about space.
        - Inside = stand in the middle
        - Outside = stand outside the circle
        - Circle = the students
- Person in the middle says, "I like people who… (are wearing green)." Everyone wearing green would switch places, the person left in the middle is the next leader.

Movement Warm Up

- Self-space
    - Find your self-space -- How high is your space? Low? Wide?
    - Non-locomotor movements and shapes
- General space
    - Loco-motor movement
    - "No touching the walls, furniture, or each other."
    - Use drum.

    - Find three other people near you to make a group of four. If the number of students is not divisible by 4, make some groups of 5.

Shape Movements
- Using string, the groups of students will form the shapes that the teacher calls out
    - square, rectangle, circle
- Collect string

Alternating Sounds
- Using their bodies, the students will form a sound instead of making a shape or saying, "1, 2, 3, 4" to the beat.
    - clap, snap, click, hiss

Whole Group
- Students will sit on the floor facing the instructor.
- Hold up big analog clock.
    - "Today, you formed some shapes with your bodies and did a wonderful job. Who can raise his or her hand and tell me what shape this is?" Circle. If an analog clock is hanging up in the classroom, point it out.
- Pass out circle handouts.
- Hold up big laminated circle the size of the big clock.
    - Model folding it into two halves. Then into four fourths.
        - Students will fold their circles
- Draw on the easel a circle and "1/4, 2/4, 3/4, 4/4" in each quadrant of the circle. This represents how the students said, "1, 2, 3, 4" around their circles earlier. This circle was folded into 4 pieces.
- Hold up a picture of a staff with the "common time" symbol. Emphasize the word "time."
    - In music, this is called "common time."
    - Explain what a measure is.
    - Have the students count the pattern of "1, 2, 3, 4" while pointing to the circle
    - Each beat is one out of four. Just like how on the circle, each piece is one out of four pieces.

Culminating Activity:
Create a Shape Dance
- In small groups of 4 or 5 students, groups will together decide on six shapes.

Perform a Shape Dance
- Students will practice making the shapes together. They will hold them for four beats while music plays. Instructor will say "switch" when 4 beats are up.
- Half the room will perform for the other half. Audience will comment on the shapes they saw. The roles switch.

Assessment
The following assessments will be used to measure students' ability to tell time and understand tempo and movement.

Whole Group Reflection

- Whole group discussion on what we learned today. Will add to the webs of clocks, rhythm and movement. What are some of the shapes we learned?

Written reflections

- One thing that the students liked or did not like about the lesson.
- One thing they learned about the lesson.

Adapted from Lesson Plan Template by Eric Johnson 2002

Math is Music to Our Ears: Lesson 2

Lesson Title: Lunch Time Dance

Length: 50 minutes

Age Group: Grade 2

Materials Needed: drum, big clock, big circle visual, big common time and measure visual, circle handouts, easel & marker, music, journals

Standards:

Math	Music	Movement
CCSS.Math.Content.2.MD.C.7 Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m. **CCSS.Math.Content.2.G.A.3** Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.	**2.1** Imitate rhythmic and melodic patterns on pitched and unpitched instruments. **2.3** Perform rhythm accompaniments by ear.	**1.1** Perform axial movements (e.g., bend, stretch, twist, turn, swing, collapse). **1.3** Demonstrate eight basic loco-motor movements (e.g., walk, run, hop, jump, leap, gallop, slide, skip) traveling forward backward, sideward, diagonally, turning.

Learning Objectives:

Cognitive	Affective	Psychomotor/ Artistic
(1) Understand clockwise and counterclockwise on a clock and in dance. (2) Use "fraction language" when referring to a clock (whole hour, half hour, quarter of an hour).	Students will be engaged by using their bodies appropriately to represent how clocks work.	Students will perform loco-motor and non-locomotor movements, turns, shapes, and levels to demonstrate how clocks work

Assessment Criteria for this lesson:

Cognitive	Affective	Psychomotor/ Artistic
Can students understand that a clock moves clockwise, and we can turn in dance clockwise?	Will students be engaged and using their bodies appropriately to demonstrate how clocks	Can students perform loco-motor and non-locomotor movements, turns, shapes, and

Can students refer to time in terms of fraction terms like "whole hour," "half hour," and "quarter of an hour?"	work?	levels to demonstrate how clocks work?

Introduce Lesson's Target Learning

How will you introduce your lesson's concept?

- I will introduce this lesson by describing that the whole purpose of the unit is to observe patterns in math, music, and movement. This class, students will be guided to understand time by learning about different movements.

Why are you studying this?

- To help students understand the connections between the movement and math.

Integrated Activities

Whole group discussion

- What do you already know about direction of the hands of a clock and directions in dance?

Movement Warm Up

- Self-space
  - Find your self-space – How high is your space? Low? Wide?
  - Non-locomotor movements and shapes
- General space
  - Loco-motor movement
  - "No touching the walls, furniture, or each other."
  - Use drum

Clockwise and Counterclockwise

- Groups of 4
- Clockwise = right arm in middle, walk in circle.
- Counterclockwise = left arm in middle, walk in circle.
- Count the "1, 2, 3, 4" together for 8 beats while moving in one directions. Switch directions after 8 beats. Instructor will yell switch.

Instructional Input – Whole Group

- Hold up big analog clock. These parts are called hands. Does anyone know which direction they move in – clockwise or counterclockwise?
  - Hour hand – Starting at the 12, when the minute hand moves around the circle one full time, the hour hand moves to the next number.
  - Minute hand – Starting at the 12, when the second hand moves around the circle one full time, the minute hand moves to the next number.
- Big circle visual from Learning Plan #1
  - Fold the circle in half. When the minute hand moves around one full circle, one hour goes by. When the minute hand moves halfway around the circle, a "half hour" goes by.

        - Call up students to move the minute hand halfway around the circle, starting from different numbers.
    - Fold the circle in four pieces. When the minute hand moves around one full circle, one hour goes by. When the minute hand moves halfway around the circle, a half hour goes by. When the minute hand moves around one fourth of the circle, a fourth of an hour goes by, or a "quarter" of an hour. Sometimes we say, a "quarter past" or a "quarter before" the hour.
        - Call up students to move the minute hand a quarter around the circle. Only put the minute hand on 12, 3, 6, or 9 to make it more visual.

Body Clocks

- In partners, one student will be the hour hand (standing up) and the other will be the minute hand (kneeling). Instructor will yell out times and the partners must make the given time together. If time allows, students will switch roles.

Culminating Activity

Create a Lunch Time Dance

- When you get hungry in the middle of the day, what time is it? Lunch time!
- What else happens with lunch time in school? Recess!
- When do you have lunch? Student comes up to put the hour hand in the correct position.
- Think about what you do at lunch.
    - Share ideas. (Review "quarter past/ before" in reference to lunch.)
- Let's say lunch and recess take up one hour. What do you do in the first quarter of an hour? The next quarter? The next quarter? And the last quarter? Point at the circle with four quadrants. Map it out on the circle.

Perform Lunch Time Dance

- Students will dance in self-space the movements of what happens during lunch time.
- Half the room will perform for the other half. Audience will comment on the movements they saw. Roles switch.

Assessment

The following assessments will be used to measure students' ability to tell time and understand tempo and movement.

Whole Group Reflection – Reflect on activities

Written reflections – Journals

Adapted from Lesson Plan Template by Eric Johnson 2002

Math is Music to Our Ears: Lesson 3

Lesson Title: Money Rhythms

Length: 50 minutes

Age Group: Grade 2

Materials Needed: drum, Money Rhythm visuals, play money, big clock, easel, journals

Standards:

Math	Music	Movement
CCSS.Math.Content.2.MD.C.8 Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. Example: If you have 2 dimes and 3 pennies, how many cents do you have? **CCSS.Math.Content.2.G.A.3** Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape.	**2.1** Imitate rhythmic and melodic patterns on pitched and unpitched instruments. **2.2** Perform on pitched and unpitched instruments in rhythm while applying a steady beat **2.3** Perform rhythm accompaniments by ear.	**1.1** Perform axial movements (e.g., bend, stretch, twist, turn, swing, collapse). **1.3** Demonstrate eight basic loco-motor movements (e.g., walk, run, hop, jump, leap, gallop, slide, skip) traveling forward backward, sideward, diagonally, turning.

Learning Objectives:

Cognitive	Affective	Psychomotor/ Artistic
(1) Identify quarters and dollars and their values. (2) Partition rectangles into four equal shares. (3) Imitate rhythms. (4) Keep a steady beat. (5) Use sharp and smooth movements.	Students will appropriately use their voices to learn about money as a class or in small groups.	Students will transfer knowledge of patterns observed in money and rhythm to create their own patterns in song.

Assessment Criteria for this lesson:

Cognitive	Affective	Psychomotor/ Artistic
Can students identify quarters and dollars? Can students partition rectangles into four equal shares? Can students keep a beat with their hands and repeat rhythms with their mouths? Can students use sharp and smooth movements?	Can students appropriately use their voices and bodies to learn about money?	Can students transfer knowledge of patterns observed in money and rhythm to create their own patterns in song?

Introduce Lesson's Target Learning

How will you introduce your lesson's concept?

- I will introduce this lesson by describing that the whole purpose of the unit is to observe patterns in math, music, and movement. This class, students will be guided to understand money by learning about different rhythms.

Why are you studying this?

- To help students understand the connections between the music, dance, and math.

Integrated Activities

Whole Group Discussion

- What do you already know about money and rhythm?

Movement Warm Up

- Self space
    - Force – sharp vs. smooth movements

Rhythm Warm Up

- Gather in a circle and sit.
    - If there is not enough room, teach "Let's Move Our Desks."
        - "Let's move our desks (class: let's move our desks), so we have room to sit on the floor (class: so we have room to sit on the floor)."
- Show me your spider hands! Use these to tap on your laps the beat like this. Can everyone join me? Everybody look around. Are we all together?
- Imitating quarter and whole note rhythms on neutral syllables. (Point to self when modeling. Point to class when it is the students' turn.)
    - Quarter = Du Du Du Du
    - Whole = Du-u-u-u
- What is the difference?

Same or Different?

- Speak two patterns – use hands to show if the two patterns were same (fist fist) or different (fist hand) we should have the two patterns written out. maybe: Duuuuuu (whole) du(quarter) du (quarter) du (quarter). and du (quarter) duuuuuu (whole) du (quarter) duuuuu (whole)

- Introduce Rests
    - Rest = Sh à Du Du Du Sh
- What was different about the last pattern you heard? The sh sound. (Speak quietly) What sound do you make when a baby is sleeping? Or when you walk into the library? (Sh.) In music, silent moments are called "rests." Can everybody say "rests?"

Introduce Money Visuals

- Explain what each money visual means
    - One dollar = Du-u-u-u
    - Four quarters = Du Du Du Du
    - Rest = Du Du Du Sh
- Practice speaking rhythm to each visual with a beat

Rhythm Game

- Fast round
    - Hold up visual cards, including the tricky rhythms
    - Go slowly/ allow for beats in between?
        - Go faster?

Instructional Input – Whole Group: Introduce Fractions

- Shape doesn't matter! It is the value of the money. If I ripped this dollar in half, would it be worth anything?
- Pass around play money – dollars and quarters.
- Relate to time language "quarter past/ before" – show on clock the four quarters.
- Draw:
    - $1 above 4 quarters
        - Say rhythm together. How many symbols do we see? 4. How many quarters do we see? 4. 4/4. This is called a fraction. In math, when there is a four on the bottom, we can say "fourth" or "quarters." For example, this is 4 fourths. Because we have 4 out of 4
        - Let's add up these values. How much does a quarter equal? 25 cents. This is the symbol we use for "cents." Now let's add up all the quarters we have. How many quarters are there again? Okay, so 25 cents + 25 cents + 25 cents + 25 cents = $1. This is they symbol we use for "dollar." Do four quarters equal one dollar? Yes. So when we speak a rhythm with four quarters in it, how much is this rhythm worth? $1. Great. Let's move on to something a little bit trickier.
    - $1 above 3 quarters + 1 rest
        - Say rhythm together. How many symbols do we see? Also 4. How many quarters do we see? 3. 3/4.
        - Let's add up these values. How many cents is a quarter again? 25. How many quarters do we have? 3. Let's add 25 cents 3 times. 25 cents + 25 cents + 25 cents + 25 cents = 75 cents. So when we speak a rhythm with three quarters out of four possible quarters in it, how much is this rhythm worth? 75 cents.
    - $1 above 2 quarters + 2 rests

        - Say rhythm together. How many symbols do we see? 4. How many quarters do we see? 2. 2/4.
        - Let's add up these values. How many quarters do we have again? 2. Let's add 25 cents 2 times. 25 cents + 25 cents = 50 cents. So when we speak a rhythm with two quarters in it, how much is this rhythm worth? 50 cents. (Show a Money/ Rhythm visual with 2 quarters and 2 rests in it different from the one drawn.) Are these two rhythms the same or different? In other words, are the patterns the same or different? Show me with your hands. Different. Are these two values the same or different? Show me with your hands. Same.
    - $1 above 1 quarter + 3 rests
        - Say rhythm together. How many symbols do we see? 4. How many quarters do we see? 1. 1/4.
        - Let's add up these values. How many quarters do we have again? 1. So how much is this rhythm worth? 25 cents. (Show a Money/ Rhythm visual with 2 quarters and 2 rests in it different from the one drawn.) Are these two rhythms the same or different? Show me with your hands. Different. Are these two values the same or different? Show me with your hands. Same.

Culminating Activity

<u>Create your own Rhythm</u>

- Go back to seats
- Hand out Create Your Own Rhythm worksheets
    - Part One: Students will be given certain money values (25¢, 50¢, 75¢, $1). Their job is to design their own rhythms in the blank spots by inserting quarters, rests, or dollars. Any combination of money is acceptable, as long as the money values add up to the correct value.
    - Part Two: With their partners, the students will work together to say the rhythm.

Assessment

The following assessment will be used to measure students' ability to identify quarters and dollars and understand rhythm.

<u>Whole Group Reflection</u> – Reflect on activities

<u>Written reflections</u> – journals

Adapted from Lesson Plan Template by Eric Johnson 2002

Math is Music to Our Ears: Lesson 4

Lesson Title: Money Dance

Length: 50 minutes

Age Group: Grade 2

Materials Needed: drum, music, coin, Money Rhythms visuals, Heads/ Tails visuals, play money, easel, journals

Standards:

Math	Music	Movement
CCSS.Math.Content.2.MD.C.8 Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. Example: If you have 2 dimes and 3 pennies, how many cents do you have?	**2.1** Imitate rhythmic and melodic patterns on pitched and unpitched instruments. **2.2** Perform on pitched and unpitched instruments in rhythm while applying a steady beat	**1.1** Perform axial movements (e.g., bend, stretch, twist, turn, swing, collapse). **1.3** Demonstrate eight basic loco-motor movements (e.g., walk, run, hop, jump, leap, gallop, slide, skip) traveling forward backward, sideward, diagonally, turning.

Learning Objectives:

Cognitive	Affective	Psychomotor/ Artistic
(1) Identify all types of change and their values. (2) Speak rhythms while keeping the beat. (3) Use loco-motor and non-locomotor movements, sharp and smooth movements, and levels.	Students will be engaged as they use their voices and bodies to learn about all the different types of change and their values.	Students will perform loco-motor and non-locomotor movements, sharp and smooth movements, and levels in order to learn about the different types of change and their values.

Assessment Criteria for this lesson:

Cognitive	Affective	Psychomotor/ Artistic
Can students identify all types of change and their values, speak rhythms while keeping the beat, and use loco-motor and non-locomotor movements, sharp and smooth movements, and	Will students be engaged as they use their voices and bodies to learn about all the different types	Can students perform loco-motor and non-locomotor movements, sharp and smooth movements, and levels in order to learn about the

levels?	of change and their values?	different types of change and their values?

Introduce Lesson's Target Learning

How will you introduce your lesson's concept?

- I will introduce this lesson by describing that the whole purpose of the unit is to observe patterns in math, music, and movement. This class, students will be guided to understand money by learning about different rhythms and movements.

Why are you studying this?

- To help students understand the connections between the music, dance, and math.

Integrated Activities

Whole Group Discussion

- What do you already know about the different types of coins and movement?

Movement Warm Up

- Self-space
  - Sharp = Du du du du
  - Smooth = Du-u-u-u
- General space
- Levels

Heads or Tails Freeze Dance

- Students move around to the music in general space. Instructor determines the type of movement. When the music stops, the students freeze. Instructor flips a coin. Heads = high level. Tails = low level.

Heads or Tails Transition

- Hand out Heads/ Tails Visuals
- One student will have a variety of coins with heads. Another will have the same variety of coins but with tails. They must find each other in order to become partners. Group of 3 if necessary.

Instructional Input – Whole Group

- Teach about values of coins (quarter, dime, nickel, penny) and the dollar. The shape doesn't matter.
- Pass out play money to each pair.

Money Combinations

- With your partner, figure out how much your Heads/ Tails visual costs.
- How else can you combine coins to get that amount? Use your play money to help you find 3 combinations of coins that add up to the value you and your partner each have.

Whole Group Money Dance

- Instructor holds up visuals similar to what the students have. Teacher assigns movements to the different types of coins. Students will look at the visuals and move in self-space to the visuals.
- We should come up with the movements now.
    - one dollar- hands up
    - quarter- skip around
    - dime- jump
    - nickel- hop
    - penny- spin

Culminating Activity

Create a Money Dance

- Now it's your turn! With your partner, choose one of the combinations you created and choose your own movements for each coin.

Perform Money Dance

- Students will practice with their partners their Money Dance.
- Half the room will perform to music for the other half. Audience will comment on the movements they saw. Roles switch.
- Volunteers can share how much they dance costs.

Assessment

Whole Group Reflection – Reflect on activities.

Written reflections – journals

Adapted from Lesson Plan Template by Eric Johnson 2002

Math is Music to Our Ears: Lesson 5

Lesson Title: Fraction Notes

Length: 50 minutes

Age Group: Grade 2

Materials Needed: drum, music note visual, fraction visuals, a Ziploc bag per student (containing one whole note, two half notes, and four quarter notes), 3 fraction strips per student, 3 fraction strips for instruction to model folding with, model of Music Fraction Strips, Create a Song handout (per partner group), Elmo, journals, music

Standards:

Math	Music	Movement
CCSS.Math.Content.2.G.A.3 Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape. **CCSS.Math.Content.2.MD.C.8** Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. Example: If you have 2 dimes and 3 pennies, how many cents do you have? **CCSS.Math.Content.2.MD.C.7** Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.	**2.1** Imitate rhythmic and melodic patterns on pitched and unpitched instruments. **2.2** Perform on pitched and unpitched instruments in rhythm while applying a steady beat	**1.1** Perform axial movements (e.g., bend, stretch, twist, turn, swing, collapse). **1.3** Demonstrate eight basic loco-motor movements (e.g., walk, run, hop, jump, leap, gallop, slide, skip) traveling forward backward, sideward, diagonally, turning.

Learning Objectives:

Cognitive	Affective	Psychomotor/ Artistic

(1) Identify a half dollar and its value. (2) Use fraction terms like "whole, half, and one fourth." (3) Identify whole, half, and quarter notes and their values in common time. (4) Use loco-motor, non-locomotor, sharp, and smooth movements.	Students will be engaged as they use their voices and bodies to demonstrate fractions.	Students can perform loco-motor, non-locomotor, sharp, and smooth movements to demonstrate fractions.

Assessment Criteria for this lesson:

Cognitive	Affective	Psychomotor/ Artistic
Can students identify a half dollar and its value, use fraction terms like "whole, half, and one fourth," identify whole, half, and quarter notes and their values in common time, and use loco-motor, non-locomotor, sharp, and smooth movements?	Will students be engaged as they use their voices and bodies to demonstrate fractions?	Can students perform loco-motor, non-locomotor, sharp, and smooth movements to demonstrate fractions?

Integrated Activities

Whole Group Discussion

- What do you already know about fractions? What about note values in music?

Music Warm Up

- Review "Du-u-u-u" and "Du du du du."
- Introduce half note sound "Du-u."
- Use money visuals.

Movement Warm Up

- Students move around to the music in self-space sharp and smooth movements.
    - "Du-u-u-u"
    - "Du du du du"
    - "Du-u"

Instructional Input – Whole Group

- Hand out rectangular strips to students.
- Big clock
- * Always define the whole.
- Tape big circle on big paper. Fold it in four pieces. Shade each piece a different color.
- Tape another big circle on big paper. Fold it in two pieces. Shade in each piece a different color.
- Place the second big circle on top of the first. Show how one half equals two quarters.
- Explain this similarity to money and time. Two quarters equal two half dollars.

- Do this again but with rectangular fraction strips.
- Students will fold their fractions strips as you do.
- Show a picture of a measure in common time. Fold this into halves and quarters as well.

Fraction Strip Measures
- Pass out notes to students – one whole note, two half notes, four quarter notes.
- Tell the students to sort the notes into piles based upon appearances.
- Model where the whole note goes. Student can come up to board and point to the fraction strip that is one whole "measure" or rectangle, unfolded.
- Students will glue down notes.
- After the students fill up their fraction strips with notes, speak the rhythms altogether on "du" as a class.

I Speak, You Show
- Instructor speaks different rhythms – "Du-u-u-u," "Du du du du," "Du-u, du-u."
- Students will hold up the fraction strip measure that they heard.

Culminating Activity
Create Fraction Rhythms
- In partners, students will create their own rhythms on worksheets using the note symbols and fractions strips. They will write down their rhythms. Students must use all types of notes that they learned – whole, half, and quarter notes.
- Students will practice speaking their rhythms.

Create Fraction Dances
- Review arm movements from the movement warm up.
- While the instructor uses a drum to keep the beat, students will practice with their partners their Fraction Dance.
- Half the class performs to the other. Audience comments on what they saw. Roles switch.

Assessment
The following assessment will be used to measure students' ability to identify different fractions and different music notes by their value.

Whole Group Reflection –Reflect on activities.

Written reflections – journals

Adapted from Lesson Plan Template by Eric Johnson 2002

Math is Music to Our Ears: Lesson 6

Lesson Title: Math is Music to Our Ears

Length: 50 minutes

Age Group: Grade 2

Materials Needed: drum, equivalent values visuals, big clock, easel and marker, music, journals

Standards:

Math	Music	Movement
CCSS.Math.Content.2.G.A.3 Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words halves, thirds, half of, a third of, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape. **CCSS.Math.Content.2.MD.C.8** Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. Example: If you have 2 dimes and 3 pennies, how many cents do you have? **CCSS.Math.Content.2.MD.C.7** Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.	**2.1** Imitate rhythmic and melodic patterns on pitched and unpitched instruments. **2.2** Perform on pitched and unpitched instruments in rhythm while applying a steady beat **2.3** Perform rhythm accompaniments by ear	**1.1** Perform axial movements (e.g., bend, stretch, twist, turn, swing, collapse). **1.3** Demonstrate eight basic loco-motor movements (e.g., walk, run, hop, jump, leap, gallop, slide, skip) traveling forward backward, sideward, diagonally, turning.

Learning Objectives:

Cognitive	Affective	Psychomotor/ Artistic
(1) Tell time from an analog clock. (2) Partition circles and rectangles. (3) Identify the types of change and their values.	Students will be engaged as they represent time and money exchanges appropriately with their	Students can represent time and money exchanges with their voices and bodies through speaking rhythms

(4) Create rhythms. (5) Create dances.	voices and bodies.	and creating dances.

Assessment Criteria for this lesson:

Cognitive	Affective	Psychomotor/ Artistic
Can students tell time from an analog clock, partition circles and rectangles, identify the types of change and their values, and create rhythms and dances?	Will students be engaged as they represent time and money exchanges appropriately with their voices and bodies?	Can students represent time and money exchanges with their voices and bodies through speaking rhythms and creating dances?

Introduce Lesson's Target Learning

How will you introduce your lesson's concept?

- I will introduce this lesson by describing that the whole purpose of the unit is to observe patterns in math, music, and movement. This class, students will be guided to understand time, fractions, and money by learning about rhythms and movement.

Why are you studying this?

- To help students understand the connections between the music, dance, and math.

Integrated Activities

Movement Warm Up

- Review all concepts.
- Focus on whole, half, quarter arm movements.
- Relax on rests

Blast Off

- Fractions and movement – base of support
- Reflect on activity

Transition

- Hand out visuals to students that have equivalent values.
    - Example:
        - A quarter
        - A shaded quarter of a circle
        - A shaded quarter of a rectangle
        - A quarter note
- Students will find groups of two. Groups of three are okay if necessary.

Partner Exchanges

- One partner speaks a rhythm. The other partner echoes with the movements that the rhythm represented.
- Switch leaders.
- Then, one partner will do a movement. The other partner will echo with the sound.

- Switch leaders.

Whole Group Reflection
- Reflect on fractions, time, money, common time, note values, and types of movement.

Culminating Activity

Going to the Store Dance
- Partners
- One student will be the dancer while the other student is the musician.
- Groups will be given items with certain prices that they need to buy at the store.
- Groups will decide what time they want to go the store and what time they leave the store. These two times will become beginning and ending shapes for the dance.
- Students will then decide on the combination of coins that they want to use in order to pay for their item. They can choose the type of movement represents each coin.
- To music, the students will dance. Encourage students to act out the whole process.
- When the musicians reach the cash register is when they move to each type of coin.
- The musicians will pay by speaking a rhythm representing money. The dancer will give change by dancing the type of coins.
- Groups may not all end at the same time.
- Half the room shows the other half. Audience comments on what they saw. Roles switch.
- Partners switch roles.
- Half the room shows the other half. Audience comments on what they saw. Roles switch.

Assessment
The following assessment will be used to measure students' ability to tell time, count money, and understand rhythm and movement.

Whole Group Reflection – Reflect on activities.

Written reflections – journals

Adapted from Lesson Plan Template by Eric Johnson 2002

Appendix C

SELECTED JOURNAL QUESTIONS

Emotional Engagement: Student Enjoyment and Enthusiasm

Lessons 1 - 5	**Question**
Shape Dance Lunch Time Dance Money Rhythms Money Dance Fraction Notes	What did you like or not like about today's lesson?
Lesson 6	**Questions**
Math is Music to Our Ears	What did you like or not like about today's lesson? What is your favorite part of the whole experience?

Behavioral Engagement: Student Effort

Lessons 1 - 5	**Questions**
Shape Dance Lunch Time Dance Money Rhythms Money Dance Fraction Notes	What did you like or not like about today's lesson? What did you learn today?
Lesson 6	**Questions**
Math is Music to Our Ears	What did you like or not like about today's lesson? What did you learn today? What is your favorite part of the whole experience?

Cognitive Engagement: Academic Topics

Lessons 1 - 6	**Questions**
Shape Dance Lunch Time Dance Money Rhythms Money Dance Fraction Notes Math is Music to Our Ears	What did you learn today?

Appendix D

RUBRICS FOR SELECTED JOURNAL QUESTIONS

Emotional Engagement: Student Enjoyment Category Rubric

Score	Descriptor
3	The response indicates a state of pleasure (I liked, I loved)
2	The response is neutral (It was ok) OR reflects both pleasure & displeasure
1	The response indicates a state of displeasure (I didn't like, I hated)
0	The participant did not respond

Emotional Engagement: Student Enthusiasm Category Rubric

Score	Descriptor
3	The response indicates intense enjoyment (I loved/ I liked everything)
2.5	The response indicates fairly intense enjoyment (I liked, My favorite thing was...)
2	The response is neutral/ indicates both pleasure and displeasure
1.5	The response indicates fairly intense displeasure (I disliked)
1	The response indicates intense displeasure (I hated/ disliked everything)
0	The participant did not respond

Behavioral Engagement: Student Effort Category Rubric

Score	Descriptor
3	The response reflects exceptional effort (answered 2 questions with detail or all 3 questions in Lesson 6)
2	The response reflects good effort (answered 2 questions without detail)
1	The response reflects some effort (answered 1 question)
0	The response reflects no effort (answered 0 questions)

Appendix E

SURVEY

Math is Music to Our Ears

Rate yourself on the following. Be honest. Think about the lessons taught by Miss Amanda and Miss Elizabeth.

1. Are you a boy or girl?

   Boy Girl

2. What ***month*** and ***year*** were you **born**? _____ _____
   Month Year

PART ONE:

3. How well did you *learn* about **counting money**?

I learned it very well I did not learn it well

4. How well did you *learn* about **telling time on an analog clock to the nearest five minutes**?

I learned it very well I did not learn it well

5. How well did you *learn* about **fractions (wholes, halves, fourths, and thirds)**?

I learned it very well I did not learn it well

6. How well did you *learn* about **music (rhythms, note values)**?

I learned it very well I did not learn it well

7. How well did you *learn* about **movement (dance → loco-motor, non-loco-motor)**?

I learned it very well I did not learn it well

8. Overall, how well did you *learn* **math through music and movement** (the way that Miss Amanda and Miss Elizabeth taught)?

I learned it very well — I did not learn it well

PART TWO:

9. How much did you *like* learning about **time, money, and fractions**?

I liked it a lot — I did not like it at all

10. How much did you *like* learning about **music (rhythms, note values)**?

I liked it a lot — I did not like it at all

11. How much did you *like* learning about **movement (dance → loco-motor, non-loco-motor)**?

I liked it a lot — I did not like it at all

12. Overall, how much did you *like* learning **math through music and movement** (the way that Miss Amanda and Miss Elizabeth taught)**?**

I liked it a lot — I did not like it at all

PART THREE:

13. What can you add about how well you *learned* **math** in these lessons?

14. What can you add about how well you *learned* **music** in these lessons?

15. What can you add about how well you *learned* **movement (dance)** in these lessons?

16. What can you add about how well you *learned* **math through music and movemen**t (the way that Miss Amanda and Miss Elizabeth taught?

17. In what ways did you *like or not like* learning **math** in these lessons?

18. In what ways did you *like or not like* learning **music** in these lessons?

19. In what ways did you *like or not like* learning **movement (dance)** in these lessons?

20. In what ways did you *like or not like* learning **math through music and movement** in these lessons (the way that Miss Amanda and Miss Elizabeth taught?

Appendix F

SELECTED SURVEY QUESTIONS

Parts 3 & 4: Free Response Questions (Qualitative Data for Enjoyment & Enthusiasm)

Part 3	
Question 13	What can you add about how well you *learned* **math** in these lessons?
Question 14	What can you add about how well you *learned* **music** in these lessons?
Question 15	What can you add about how well you *learned* **movement (dance)** in these lessons?
Question 16	What can you add about how well you *learned* **math through music and movement** (the way that Miss Amanda and Miss Elizabeth taught)?
Part 4	
Question 17	In what ways did you *like or not like* learning **math** in these lessons?
Question 18	In what ways did you *like or not like* learning **music** in these lessons?
Question 19	In what ways did you *like or not like* learning **movement (dance)** in these lessons?
Question 20	In what ways did you *like or not like* learning **math through music and movement** (the way that Miss Amanda and Miss Elizabeth taught)?

Part 2: Student Self-Ratings (Quantitative Data for Enthusiasm)

Question 9	How much did you *like* learning about **time, money, and fractions?**
Question 10	How much did you *like* learning about **music (rhythm, note values)?**
Question 11	How much did you *like* learning about **movement (dance → loco-motor, non-locomotor)?**
Question 12	Overall, how much did you *like* learning about **math through music and movement** (the way that Miss Amanda and Miss Elizabeth taught)?

Appendix G

RUBRICS FOR SELECTED SURVEY QUESTIONS: EMOTIONAL ENGAGEMENT

Emotional Engagement: Student Enjoyment Category Rubric

Score	Descriptor
3	The response indicates a state of pleasure (I liked, I loved, I had fun)
2	The response does not indicate a state of pleasure (I learned, It was easy/hard); was neutral (It was ok); indicated both pleasure and displeasure
1	The response indicates a state of displeasure (I didn't like, I hated)
0	The student did not respond or responded "did not remember"

Emotional Engagement: Student Enthusiasm Category Rubric

Score	Descriptor
3	The response indicates intense enjoyment (I loved, I liked everything)
2.5	The response indicates fairly intense enjoyment (I liked, My favorite thing was...)
2	The response does not indicate a state of pleasure (I learned, It was easy/hard); was neutral (It was ok); indicated both pleasure and displeasure
1.5	The response indicates fairly intense displeasure (I disliked)
1	The response indicates intense displeasure (I hated/ I disliked everything)
0	The participant did not respond or responded "did not remember"

Appendix H

RUBRICS FOR VIDEO FOOTAGE: BEHAVIORAL ENGAGEMENT

Behavioral Engagement: Student Attention Category Rubric

Score	Descriptor
3	The student is on-task, as indicated by movement and/or focus throughout the entire performance.
2	The student is mostly on-task, as indicated by movement and/or focus throughout most of the performance.
1	The student is mostly off-task, as indicated by movement and/or focus for less than half of the performance.
0	The student is completely off-task, as indicated by no movement or focus for the whole performance

Behavioral Engagement: Student Effort Category Rubric

Score	Descriptor
3	The student exerts physical energy, as indicated by strong movements and an apparent desire to succeed (regardless of whether or not he or she follows directions)
2	The student exerts some physical energy, as indicated by fairly strong movements and a somewhat apparent desire to succeed (regardless of whether or not he or she follows directions)
1	The student exerts little physical energy, as indicated by weak movements and an apparent careless attitude (regardless of whether or not he or she follows directions)
0	The student exerts no physical energy, as indicated by the student not moving or seeming to care

Behavioral Engagement: Student Persistence Category Rubric

Score	Descriptor
3	The student demonstrates consistent effort throughout the dance
2	The student demonstrates inconsistent effort throughout the dance
1	The student dances some of the time with inconsistent effort
0	The student demonstrates no effort and/or failed to dance throughout the performance

Appendix I

MONEY RHYTHMS FORMATIVE ASSESSMENT

Money Rhythms!

Draw quarters, dollars, and rests to make Money Rhythms!

25 cents

50 cents

75 cents

100 cents ($1)

Choose one rhythm from above and draw out the *music notes* below!

4
4

Appendix J

RUBRIC FOR LUNCH TIME DANCE: COGNITIVE ENGAGEMENT

Lunch Time Dance Task (Lesson 2): In small groups of four or five, create movements in self-space of what you like to do in the one-hour period of lunch and recess. Begin with a shape that represents the time that lunch starts, switch movements every fifteen minutes (as indicated by the instructor), and end in the shape representing the time that lunch ends.

Lunch Time Dance Rubric									
	Dance Criteria							**Math Criteria**	
	Clear Beginning, Middle, and End	Utilized Self-Space in Movements				Beginning and End Shapes are Strong and Still		Appropriately Represented Time	
		Interval 1	Interval 2	Interval 3	Interval 4	Beginning Shape	End Shape	Beginning Shape	End Shape
3 (Always)									
2 (Mostly)									
1 (Rarely)									
0 (Never)									