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Art Integration, Mathematics, and Behavior

By Ashley A. Beermann

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An Action Research Master's Thesis
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Action Research Master's Thesis Approval

As the advisor for Ashley A. Beermann and behalf of the Masters of Arts in Urban Education Program in the School of Urban Initiatives at Cardinal Stritch University, I affirm that this report meets the expectations and academic requirements for the degree of Masters of Arts of Urban Education.

Penny Weikel-Rossetto, Advisor	Approval Date
Chair of the Masters of Urban Education Teaching Program	Approval Date
Dean or Associate Dean of the School of Urban Initiatives	Approval Date

Abstract

Eliciting student enjoyment and positive disposition are critical components to effective instruction and high academic achievement in any elementary classroom. Many educators struggle with connecting students to their learning, especially in mathematics. This study focused on integrating art into the classroom, specifically in the core content area of mathematics. The study sought to examine the effects of art integration on students' dispositions, students' enjoyment of mathematics, and students' academic achievement. Sixteen students in a K5 Kindergarten classroom with one primary classroom teacher participated in this study. Throughout the 6-week research period, students participated in art and non-art activities correlated to a mathematics objective during the "Apply" portion of the "Launch, Explore, Summarize, Apply" instructional model. To measure academic achievement and student enjoyment, students participated in daily exit assessments and daily enjoyment surveys on the art or non-art activity. Parents and guardians also participated in a pre- and post-test survey about their students' dispositions towards mathematics, art, and school. The results of this study show that students' exit assessment scores increased when connected to an art activity, and students' dispositions positively increased over the intervention period as observed by their parents and guardians. Results also consistently indicate that students enjoyed mathematics on a high level throughout the intervention period. Implications for future research include lengthening the study over the academic year to determine art integration's lasting effect, balancing the number of art and non-art activities to give a true and equalized sense of which activities were influential, and to create improved student surveys that better reflect students' enjoyment.

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Chapter One: Introduction

Introduction

As an educator, I have struggled with engaging students in mathematics, a subject I myself struggled with in elementary school. In my two years of teaching, I have struggled to provide meaningful activities that connect to the math objectives and interest my students. For example, many of my students would become disengaged in our whole group lessons, feign participation in group- or individual work time, and perform poorly on exit assessments. I wanted to connect math content to a hands-on experience that would stick with my students and engage them throughout our sixty-minute math block. Also, as art classes are disappearing in many urban school districts in the United States, many educators like myself are turning to integrating art into content learning to make up for the loss of art education. Knowing that my students no longer have art classes, I have struggled in integrating purposeful and focused art lessons into my classroom's busy schedule. To give my students time to create art meant I had to somehow connect art to academic content, so I decided to integrate art into mathematics as a hands-on, active activity to encourage engagement and academic achievement. With this in mind, I have tried various strategies to integrate art into content learning, but never quite understood the results of integrating art into mathematics on student mastery, student enjoyment, and students' dispositions. This desire to understand the effects of my efforts on student mastery, students' enjoyment of mathematics, and students' dispositions towards math, art, and school led me to conduct the action research for this study.

Background of the Study

After deciding to study the effects of art integration, I researched the possible outcomes of connecting art and mathematics. The studies I reviewed over the year in preparation for the

action study highlighted academic and personal benefits for students who participate in art. Gair (1975) demonstrated that, when integrated into mathematics, art increases student academic achievement and provides students a space for self-expression. This was very important in my classroom as I felt I was failing in inspiring my students to reach academic mastery in mathematics, and my classroom was not reflective of my students' personalities. Wright, John, Alaggia, and Sheel (2006) and Edens and Potter (2006) posited that through an aesthetic education, students could develop positive dispositions towards mathematics and education and expand their creativity. To me, this meant that positive dispositions and the use of critical thinking skills and creativity can lead to further engagement within mathematics, thus increasing student mastery. With these benefits highlighted by numerous studies, I sought to create a research action study that examined the academic benefits, student enjoyment, and growth in positive disposition when art activities are integrated into mathematics content.

Overview of the Study and Timeline

The purpose of this action research was to increase student mastery, increase positive dispositions towards math, art, and school, and to increase student enjoyment in mathematics through art integration. The research questions were: (1) will art integration increase students' mastery/academic achievement in mathematics? (2) Will student enjoyment of mathematics increase when integrated with art activities? (3) Will students' positive dispositions increase towards mathematics, art, and school when presented with various art activities? The 6-week study was executed using a single-subject, quantitative design. All qualitative data was given numeric representation to aid in quantitative analysis. The intervention consisted of integrating art activities based on the daily math objective into the daily mathematics block. Art and non-art objectives were linked to the state's standards for mathematics instruction, and focused on the

skills of counting, cardinality, and comparing numbers, the operations and algebraic thinking of addition and subtraction, place value and operations, measurement and data, and geometry. Students participated in the art intervention activity for approximately 20 minutes during the daily scheduled math block, and an equal amount of time was allocated to non-art math activities. Students participated in the art or non-art activity after explicit teaching of the math objective in the daily whole group lesson. During the research period, students' enjoyment and exit assessment mastery was recorded for all art and non-art math related activities. The independent variables in the research study were the whole group lesson about the daily math objective and the art or non-art activity presented to the participants. The dependent variables consisted of the participants' responses to their enjoyment of the art or non-art activity, their mastery on the exit assessments for each objective, and their parents'/guardians' responses on the pre- and post-test Parent/Guardian Questionnaire. Spreadsheets of the daily student enjoyment surveys, pre- and post-test quantitative responses, and exit assessment percentages were created to summarize the results, and descriptive statistics were used to analyze the collected data.

Summary Conclusion

The site of the research study was in an urban Midwest elementary school (3 year old preschool/kindergarten through fifth grade). The student population consisted of approximately 413 students, with the racial diversity of 1% American Indian/Alaska Native students, 1.2% Asian/Pacific Islander students, 57.1% Hispanic/Latino students, 20% African American students, and 20.8% White students. The majority of the students qualified for free and reduced lunch rates. Sixteen out of the 17 students in the classroom participated in the study, including myself as the primary educator and researcher. Three of the 16 students in the study had Individualized Education Plans and frequently moved between my classroom and the Special

Education teacher's classroom. All participants were part of the school's dual-language Spanish/English bilingual program, so received math instruction in the Spanish language. At the onset of the study, student mastery in mathematics was at 65%, 15% below the classes required student mastery level of 80%.

In the following chapter, Chapter Two Literature Review, the research action study is validated by other studies that have examined the effects of art and art integration. This chapter is broken into the three subcategories of research on (1) cognitive gains of art and art integration, (2) art integration programs, and (3) art and mathematics relationships. This research study is based upon this research and its findings.

Chapter Three, Methodology, is an overview of this research study. A description of the participants, research site, procedure, and analytical measures are provided. Chapter Three also includes a calendar with a description of each intervention that took place during the research study.

Chapter Four, Results, contains a description of the outcomes of this study on academic achievement, student enjoyment, and student disposition. Tables and graphs are included to summarize the data, and the results are presented on a whole-class average basis.

Lastly, Chapter Five, Conclusions and Discussion, describes an overview of the data and provides an explanation of the results. This chapter also includes a discussion of the strengths and limitations of this research study, recommendations for future research, and implications for personal practice.

Definitions

Art Integration: Infusing academic subjects and content learning with hands-on (art) activities that includes painting, drawing, coloring, etc.

Content Learning: Learning based in the core academic subjects of reading, math, science, and social studies.

Mastery: Students' understanding of academic content and their ability to demonstrate understanding, determined through assessment. Student mastery of 80% (determined by class average) or higher demonstrates proficient understanding of an objective.

Chapter Two: Review of Literature

The purpose of this study was to investigate the effect of art integration into academic content with a specific focus in mathematics, as well as to examine how art integration affects student behavior and attitude about mathematics in elementary school. Research suggests that integrating arts into academics increases students' academic achievement and increases students' positive attitudes towards school. This chapter is broken down into three sections. The first section focuses on the cognitive gains associated with instruction in art. The second section concentrates on the academic and behavioral gains associated with art integration programs. Lastly, the third section focuses on art integration, specifically inside mathematics instruction.

Cognitive Gains

The integration of art into academic content can improve cognitive processes for both students and adults. The skills of observation, description, and creativity are important in increasing critical-thinking, a skill highly valuable in any classroom or profession. As learners participate in art, they can heighten their observational skills, learn to describe with more detail, and expand their creativity to incorporate and analyze novel experiences. The studies in this section support the belief that integrating arts into academics promotes the expansion of the cognitive processes of description, observation, and creativity, which then advances academic achievement for student and adult learners.

Lampert (2006) sought to examine the difference of art and non-art students in employing critical thinking skills. With the understanding that novel experiences that elicit critical thinking skills are difficult to standardize, Lampert sought to study the disposition towards, or the propensity to use, critical thinking skills in her participants. Lampert studied the dispositions of

art versus non-art students and freshmen versus a juniors/seniors group to examine whether students who participated in divergent thinking through art education scored higher on a critical thinking disposition assessment.

Lampert performed a cross-sectional study of a large group of undergraduate students, evaluating the sample population on a standardized critical thinking disposition assessment. First, Lampert analyzed the data by separating the sample into four groups: freshmen with no art experience (Group 1), freshmen with experience in art courses (Group 2), juniors and seniors with no art experience (Group 3), and juniors and seniors with experience in art courses (Group 4). Second, Lampert divided the participants into art and non-art subgroups and freshmen and juniors/seniors subgroups. The data from the disposition assessment was separated into seven subscales: inquisitiveness, systematicity, truth-seeking, analyticity, open-mindedness, critical thinking self confidence, and critical thinking maturity (2006, p.218). Critical thinking disposition subscale data was then averaged and divided into three categories: (1) opposition to the critical thinking marker, (2) minimal endorsement of the critical thinking marker, and (3) consistent endorsement of the critical thinking marker.

One hundred and forty-one undergraduate students from a large east coast university participated in this study, recruited from introductory psychology courses and introductory-to-advanced art and art education courses. Group 1 consisted of 32 non-art freshmen, Group 2 of 32 freshmen art students, Group 3 of 32 junior and senior non-art students, and Group 4 of 45 junior and senior art students. All Group 2 freshmen were taking an introductory art course, eight of the 45 juniors/seniors were majors in studio art and design, and 37 out of the 45 participants in the juniors/seniors group majored in art education.

When comparing all four participant groups, Lampert found no significant mean score differences on the disposition assessment subscales. All subgroups employed minimal endorsement in truth-seeking and systematicity, and employed consistent endorsement of critical thinking maturity and open-mindedness. Unfortunately, the study does not include the mean score for analyticity, inquisitiveness, and critical thinking self-confidence, as these data sets do not show any significant differences between the two larger subgroups. When comparing the freshmen and juniors/seniors groups, the juniors/seniors group scored significantly higher than the freshmen in truth-seeking, systematicity, and inquisitiveness. Lampert also found that all arts students scored significantly higher than non-arts students in truth-seeking, critical thinking maturity, and open-mindedness. Interestingly, non-art students only scored higher than art students in the subscale of systematicity. These results demonstrate that the art students may have had a higher propensity to think critically about the different ramifications and possible solutions to a situation (truth-seeking), to think of more than one plausible option or judgment in a situation (critical thinking maturity), and to be aware of conflicting views and biases in a given situation (open-mindedness). Lampert posits that, while art students scored lower than non-art students in systematicity, it does not detract from art students' capacities towards critical thinking because systematicity does not support the divergent thinking necessary for critical thinking.

Lampert's study is important when considering the impact of art education across the curriculum. This study demonstrates that students who participate in art courses may achieve a higher level of critical thinking, which they can apply to other academic domains. Also, this study supports the idea that art education may positively influences students' education. Through art integration, educators may expand creativity and critical thinking capacities within

their classroom, and divergent thinking may allow students to better understand difficult concepts.

While Lambert (2006) studied adult students and their critical thinking capacities on a standardized test, Hsaio (2010) studied the early formation of critical thinking in primary school. Through picture book art appreciation activities, Hsaio explored the cognitive gains associated with emphasizing art in the classroom.

Hsiao (2010) studied possible cognitive gains through art by examining whether picture book art appreciation activities affected students' creative thinking and drawing abilities through the lens of picture books as art medium. Hsaio focused on two research questions; "Research Question One: Through the picture book appreciation activities, how do the instructional materials impact children's creative thinking?" and, "Research Question Two: What are the differences between parents' pre- and post-test scores on perspectives of children's drawing behaviours at home after participating in picture book appreciation activities?" (Hsiao, 2010, p. 144)

Data were gathered from digitally recording the students as they worked and categorizing their talk about art into four categories: analytical, descriptive, interpretative, and judgmental (Hsiao, 2010) over 16 weeks. Parent pre-test (September 2007) and post-test (January 2008) questionnaire responses were tracked on a Microsoft Excel graph.

The sample consisted of 27 children: 21 five-year-olds and 6 four-year-olds in a kindergarten classroom in a southern Taiwan city. The researchers were aided by the homeroom teacher and an early childhood education intern.

For Research Question One, the researcher discussed the front cover's illustration and then the illustrations on each page with the students during each intervention/story reading. The

researcher used Question and Answer to prompt more description of the illustrations from the students. To scaffold their descriptions and push students to focus more on artist technique, the researcher introduced a video about one artists' medium and how that artist created the artwork for his popular children's books. Students were encouraged to comment and make connections between the books, the books' illustrations, and their own experiences. Students' talk and responses were then transcribed and categorized as descriptive, analytical, interpretation, or judgmental. Students then participated in creating artwork based upon the story that was read to them. For Research Question Two, parents were given a pre-test and post-test questionnaire about their student's drawing habits and behavior before and after the 16 weeks of intervention.

For Research Question One, the researchers found that students always offered observations about illustrations, and toward the middle and end of the assessment period, made more detailed comments about their observations and interpretations of the feelings conveyed through the illustrations. Around this time, they started to draw more and paid more attention to the illustrations during each reading, as it became common practice to analyze each story and its illustrations. The study also showed a positive correlation between art instruction and increased drawing at home. For Research Question Two, parents reported that students had increased their drawing at home, as well as their appreciation for their siblings' artwork and their confidence in sharing and talking about their own artwork.

This study can be used to validate the integration of art into other classroom subjects; its findings show a growth in critical thinking, description, and observation based upon these students' ability to describe in more detail a picture in a story, which allows them to further analyze a text on a deeper level. Students in the lower grades need to practice this type of "reading of illustrations" to further understand and comprehend a read aloud on a deeper level as

they practice skills in comprehension and story sequencing. Also, participating in manipulation through constructing artwork is helpful for students to practice focusing in on a book's theme and acknowledging special characteristics such as unique illustrations. This study is also helpful when looking at the increase of artwork being done at home; if teachers integrate art into homework, homework would become more enjoyable and memorable as a personal link between learning and self.

The previous study focused on the cognitive skills of description and observation over a period of intervention experiences. The next study further promotes the acquisition of enhanced description and observational skills in adult students when integrated with art instruction.

Honan, Pellico, Freidlaender, and Fennie (2008) studied whether concentrated viewings of artwork heightened observational skills in a class of nursing students. The researchers hypothesized that the nurses' heightened observational skills would be evident in their ability to make more alternative diagnoses than the half of the class that did not participate in the art viewings.

Data were collected by having all of the nursing students diagnose six pictures of patients. The number of alternative diagnoses were counted, and analysis and *t* tests were used to find the differences in scores on each photo between the students who participated in the art viewings and the students who did not.

The sample consisted of 66 students enrolled in their first semester of a nursing program. Thirty-four participated in the art viewings, and 32 learned traditional strategies in the classroom. Seventy-eight percent of the participants were white, 94% were women, and 77% held a baccalaureate degree in the arts.

The experimental group, broken into small groups of six students, participated in an art viewing experience for 90 minutes. Students were taught to, "…discriminate, compare, and contrast artistic intentions, as well as learn how to decode objects' meanings and extract information by direct observation" (Pellico, Freidlaender, & Fennie, 2008, p. 648). Students were given 10 minutes to write down notes on six different paintings, and shared and discussed these paintings within their small groups, first by describing them and then by interpreting each painting's meaning. Students were prefaced not to leave out observations and descriptions they felt did not accurately match the feel of the paintings. All students were then convened to diagnose six different photographs of patients. Each student was given five minutes to observe each photograph, five minutes to record all observations in writing, and then three minutes to record their interpretation of each patient's illness.

The researchers found that students who participated in the art viewings made significantly more observations than the control group of students. The intervention group made 51 to 68 comments on five out of the six photographs, while the control group made 36 to 55. The intervention group also made more acceptable objective findings than did the control group.

This study shows how important observational skills can be, and how art can directly influence this positive growth in observational skills and creativity. While these nursing students may be able to make a creative alternative diagnosis that may save a life, using art in facilitating the use of description and observation in elementary education could also grow students' critical thinking skills in all subject areas. While this study was done with adult learners, elementary school students could expand their observational and creativity skills drastically; they have not yet fully developed a lens for how they view input and new experiences (in contrary to adults).

This study also shows that observing and understanding of art can positively influence, develop, and transfer skills to other subject areas.

Moving beyond regular primary and adult education, the following study explored the benefits of art for students with learning disabilities. Through heightening description and observation skills, Gair (1975) explored how art integration can aid in thought processing and visual expression as a manner of communication.

Gair (1975) sought to examine whether an art-based remediation program would improve structuring and sequencing abilities in students with learning disabilities. In this study, Gair wanted to explore whether art integration increased students' abilities to remember and express learned information. Focusing on psycholinguistic abilities, Gair studied whether a 7-week art-based remediation program would increase the rate of development and expression in a small group of students with a varying range of disabilities.

Gair sought to understand whether art interventions supported and increased students' abilities to receive environmental information, organize it on the representational level, remember the information on the automatic level, and express it visually. Based upon a standardized art rating scale, Gair also sought to measure whether the students' receptive-expressive performance would be influenced by the art intervention program.

Students were assessed on five visual subtests and a two-part art task to measure their receptive-expressive and pyshcolinguistic abilities before introducing the art program. Subscales of the visual tests included visual reception, manual expression, visual closure, visual association, and visual sequential memory (1975, p.55). Integrated into the students' daily schedule, the art program was implemented over a 7-week period for one hour each school day. At the end of the 7-week period, the five visual subtests and the two-part art task was again administered. Students'

art projects were judged by art education experts, and the pre- and post-test data were analyzed and compared.

Twenty elementary school children with a range of learning disabilities participated in the study. The participants ranged between 7 and 12 years of age and attended a special school for students with learning disabilities. The participants had IQs that ranged from 72 to 125, with a mean of approximately 102, and exhibited poor gross and fine motor development, hyperactivity, lack of perceptual integration, passive aggressive behaviors and aggressive tendencies. During the research period, students were aided by one special education teacher, two teacher aides, three diagnosticians, and three art education experts.

Before beginning the art program, the classroom teacher and teacher aides participated in a one-day training to become familiar with the research study and art program, and were provided with a manual that included vocabulary lists for all 28 art tasks. Students were then assessed on the five subtests and the two-part art task as a pre-test device before implementing the art program. The two-part art task included drawing and representing a simple design and creating a self-portrait within the school environment. Students were given as much time as needed to complete the two-part art task. Separated into the four program goals of communication (looking, listening, saying, and doing), students viewed 140 slides encompassing seven major concepts (20 slides per concept). The 7 major concepts included, (1) differences and similarities through pattern, (2) outline through shape, (3) figure-ground relationships through negative and positive space, (4) scanning and focusing through aesthetic identification, (5) movement and rhythm through dots and lines, (6) two and three dimensional shape through light, dark, and texture, (7) whole-part relationship and visual analogy through structure (1975, p.59).

At the end of the program, each child had created four projects, which were then rated on the art rating scale to create a quantitative measure for rating receptive-expressive behavior.

T- test analysis showed significant differences (positive change) in visual reception, visual association, visual closure, visual memory, manual expression, and receptive-expressive performance between pre- and post-test performance. Analysis of the *t*-tests and the student art projects demonstrated students' use of visual association and visual memory skills, verifying that the art program's goals worked on different levels for individual student's learning styles. With this increase in visual expression, students showed increased psycholinguistic functioning and a growth in the rate of development.

This research is important to educators because it suggests that students with learning disabilities may improve their cognitive functioning through the use of art as a communication tool. This idea can be expanded to assume all students, regardless of learning disabilities, may benefit from integrating art into their daily schedules in connection with their grade level curriculum. While the art program was proven to be successful in increasing students' receptive-expressive abilities, more research needs to be done to explore visual expression as a total communication process. Through understanding exactly what feature of visual expression connects non-cognitive, pre-formal levels to the logical-conceptual level of thinking and processing, educators may be able to reach more students with disabilities through art integration.

In review, these studies demonstrate that cognitive capabilities can be advanced through art integration in a variety of subject matter and experiences. Lampert (2006) explored the increase in divergent thinking with art education exposure, and Hsaio (2010), posited that students may build description and observational skills through studying art in illustrations, increasing their understanding of text through heightened interpretational skills. Honan Pellico,

Freidlaender, and Fennie (2008) established that even a singular art experience could enhance adult student observational skills, leading to an increased creativity in offering multiple differential diagnoses. Gair (1975) also exposed art's ability to aid in communication, retention of material, and thought processing in children with learning disabilities. These studies indicate that if students participate in the arts, they may build description, observation, and processing skills that widen their creative lens within multiple genres and experiences. Through art and heightened divergent thinking, students may increase their academic achievement in school as well as influence their skills as professionals.

Art Integration Programs

Through direct instruction in art and integrating art into academic content areas, students may improve their academic achievement, expand their creativity, improve their self-esteem, and increase their motivation in difficult subject areas. Also, students who participate in the arts may create personal connections with their learning as they connect academic content with self-expression. The studies in this section highlight the gains in academic achievement, motivation, creativity, and self-esteem experienced by students who participate in art integration programs.

Luftig (2000) studied the effectiveness of the SPECTRA+ program, an art integration program in which students learned to produce, observe, and critique art, while also learning about art in historical and cultural contexts throughout the school curricula. In this article, Luftig studied whether the SPECTRA+ program would, "…enhance the academic achievement, creativity, self-concept, locus of control, and appreciation of the arts in a diverse group of elementary school students at three grade levels" (Luftig, 2000, p. 209).

The SPECTRA+ study measured self-esteem, locus of control, creative thinking, academic achievement, and appreciation of the arts, using valid standardized tests. Students took

pre-tests and post-tests over a two-day period. Students took the tests in their regular classrooms, proctored by an experimenter. The classroom teacher and at least one aid in each classroom helped students with any questions they had.

Six hundred and fifteen students (in second, fourth, and fifth grade) from four elementary schools in two Southwest Ohio cities participated in the study. These four elementary schools were from two separate districts (listed here as District A and District B). Both cities were mid-sized and based in industrial and service economies. All the participant elementary schools applied for the SPECTRA+ program, and were matched with control schools of similar demographics. Control schools consisted of modified and full control schools; modified receiving a new, non-arts related program (to control for the Hawthorne effect), and full receiving nothing but the standard curriculum.

After pre-testing, the four SPECTRA+ schools launched the program. Students participated in art, drama, dance, and music classes for one hour each week, and received visits by Artists-in-Residence (anywhere between two weeks to nine months) throughout the school year. Classroom teachers participated in arts-integration professional development, and were expected to keep careful empirical records of arts-integration activities and experiences. Arts-integration was highly emphasized and present in all academic subjects.

School District A showed interesting results. In the creative thinking assessment, students in SPECTRA+ scored significantly higher in overall creativity than the full and modified control group. Subtests of the creativity test included measures in fluency, originality, abstractness of titles, elaboration, and resistance to premature closure. In the measure of fluency, or the ability to provide multiple responses to stimuli, and abstractness of titles, or the ability to provide unique titles to artwork, there were no significant differences between groups. In the measure of

originality, or the uniqueness of responses to stimuli, SPECTRA+ students scored higher than the control groups. In the measure of elaboration, or the ability to discern theme as a function of creativity, the modified control group scored the highest, followed by the SPECTRA+ group and then the full control group. In the measure of resistance to premature closure, or the ability to keep oneself open enough to generate an original idea, only the SPECTRA+ second and fifth grade students made any significant gain.

In the measure of academic achievement, multiple domains were analyzed, including total reading, total math, math concepts, math application, and math comprehension. In total reading, there were no differences between the three groups, and in total math, only males in SPECTRA+ and full control group males made any significant gains. The SPECTRA+ females scored lowest in total math. In math concepts, only SPECTRA+ males made any positive gain, with SPECTRA+ females faring worst out of the three groups. In math application, no differences were found among the three groups. In math comprehension, SPECTRA+ students scored significantly higher than the modified and full control groups.

In School District B (which only had a full control and SPECTRA+ group), SPECTRA+ students scored slightly better in total reading than the full control group students. SPECTRA+ students also scored higher in reading vocabulary and reading comprehension. In total math, math concepts, and math application, only fifth grade students were allowed to be tested, and there were no significant differences found between the two groups.

For the measures in self-concept, locus of control, and appreciation of the arts, the results for District A and B were combined. In total self-esteem and academic self-esteem, there were no differences between groups, but in general self-esteem, the full control second and fourth grade and modified second grade students scored significantly higher than other groups. In social

self-esteem, SPECTRA+ males showed the highest social self-esteem, with SPECTRA+ females scoring relatively low, and SPECTRA+ fourth grade and second grade groups scored highest on parental self-esteem. While there was no significant difference between groups in locus of control, SPECTRA+ students scored significantly higher in appreciation of the arts.

The results from this study show a causal link between arts-integration and achievement. Students who participated in the arts expressed more creativity and originality, which are important to higher thought-processes in academics, such as critical-thinking. While the gains by SPECTRA+ students in academic achievement barely differed from achievement made by the other control groups, it would be interesting to see if a longitudinal study of the SPECTRA+ program would show more advanced academic gains based upon increased critical-thinking skills through the increase of creativity and originality. Parental self-esteem was shown to increase, and probably led to more positive child/parent interactions. The growth in the appreciation of the arts is important to note as well because it allowed students to make a personal connection between themselves and their schooling and to participate in lifetime learning (as they will be able to participate in and appreciate the arts throughout their lifetimes). Overall, it is evident that students do not suffer from arts-integration programs, but make personal as well as academic gains when art is integrated and emphasized in academics.

The previous study focused on academic achievement and behavioral aspects affected by an art integration program, demonstrating a casual link between art integration and an increase in student achievement and positive behavior in a normative sample of students. In the next study, the affects of an art integration program on academic achievement and behavioral changes within an at-risk group are highlighted.

Gardiner, Fox, Knowles, and Jeffrey (1996) sought to examine the relationship between academic achievement and increased positive behavior in a first grade arts integration program. The researchers studied (1) whether an arts integration program focused on skill development in eight first grade classrooms would elevate student math and reading scores on standardized achievement tests, and (2) whether this program would positively influence student behavior.

The researchers collected academic data by comparing past Kindergarten achievement scores from standardized achievement tests for the state with the same standardized achievement tests, taken after the arts-integration intervention. Students participating in the arts-integration program were also compared to a control group classroom, which only participated in the regular arts classes as provided by the school district. Teachers also evaluated each intervention student during the program four times on standardized questionnaires to measure attitudinal changes. Attitudinal measures were compared with attitudinal measures taken before the start of the arts-integration program. After the 7-month intervention program, all students in the experimental and control groups were assessed again on their state standardized achievement tests.

Ninety-six students between the ages of five and seven in eight first grade public school classrooms participated in this study. Participants were separated into either intervention classrooms or standard curriculum classrooms (control groups). Based on their Kindergarten achievement test scores, the students in the intervention group started below the control group's test scores in math and reading upon entering first grade. While not stated, the control group seemed to be comprised of students on grade-level, and how the children were selected for intervention or control groups was not mentioned. Also, the intervention students' average behavior ratings started behind those of the control group's in the standard curriculum classrooms.

Over seven months, students in the arts intervention classrooms received instruction in a music and visual-arts curriculum that focused on sequential skill development. The control group received the standard music and art instruction for first grade. Unfortunately, the research article does not name a specific curriculum nor describe the intervention program. During this time, teachers rated their students on questionnaires to assess behavior and any behavior changes. How teachers remained unbiased (since it was probably assumed positive behavior would increase inside the intervention group) was not stated. When these questionnaires were given during the seven months was not mentioned; it is assumed that they were spaced equally over the 7-month arts-integration program. At the end of their seven-month intervention, all students in the experimental and control groups took the standardized achievement tests.

The researchers found that the arts intervention program did increase students' test scores in both reading and mathematics. Seventy-seven percent of the intervention students who were behind caught up to the control group's progress or moved ahead of grade-level in mathematics, and the intervention students also caught up to the control group in reading. The teachers' ratings on classroom behavior also reached equality with the control group by the end of the seven months. Gardiner, Fox, Knowles, and Jeffrey write that this, "statistical equality… might explain the equality between the groups on reading, but not fully the improvement in maths (maths, as written in the article)." (1996, p. 284) The researchers heavily based the recorded academic growth and achievement in the increase of positive attitude and behavior in the intervention group's students. Interestingly, the researchers followed the students into the next school year, and found similar results after implementing the same arts-integration program. Not surprisingly, students who received the arts-integration program over two years performed highest on mathematical achievement.

While this study has some obvious faults and lack of information, it supports that student achievement can be raised by integrating arts into the classroom, especially if the arts integration is based on specific skills students need to develop. It was surprising to see such exceptional growth in mathematics, but this also demonstrates that art not only affects literacy, but all areas of the curriculum. The growth in positive behavior shows classroom teachers, especially in the younger grades, that artistic expression and manipulation is not only helpful in increasing academic success, but also in building a culture inside the classroom that welcomes and encourages students. This study is useful in that students who entered behind others were able to succeed when art was introduced as a learning medium. The art integration program probably allowed the students who started behind to make a personal connection with their learning that they had lacked in Kindergarten, which then led them to make deeper connections with the academic content. Knowing that students learn in different modalities, it is important to encourage art throughout the school day to allow students to manipulate and connect with academic content.

In congruence with Gardiner, Knowles, and Jeffrey, the next study by Wright, John, Alaggia, and Sheel (2006) examined the affects of a community-based, after-school art program in Canada. Similar to the at-risk population studied by Gardiner, Knowles, and Jeffrey, the participants in the following study experienced similar growth because of an art intervention program.

Wright, John, Alaggia, and Sheel (2006) suggest that, while art programs are purposed as beneficial to the community, there is little examination of their results on participants' artistry, social and psychosocial skills development, and affect on parent and student relationships. The researchers write that the lack of generalizability of other studies on school, after-school, and

after-school, community-based art programs inhibit an understanding of the effectiveness of art programs. Wright, John, Alaggia, and Sheel also posit that the inability to generalize findings also impedes researchers from understanding what program elements are critical to a successful arts program.

In this study, Wright, John, Alaggia, and Sheel sought to examine the effectiveness of the National Arts and Youth Demonstration Project (NAYDP), a Canadian after-school, community-based arts program. The goals of the NAYDP longitudinal study were to: (1) determine if a 9-month after-school, community-arts program can successfully engage youths 9 to 15 years old from low-income communities, (2) assess participants' artistic and social skills development, (3) establish whether community-based arts programs are successful in improving psychosocial outcomes, and (4) understand the perceptions of the youth and parents who participated in the program (2006, p.636) The researchers sought to generalize what program features were effective and the overall success of after-school, community-based arts programs.

Analysis consisted of a multi-method evaluation strategy. The researchers collected attendance records, behavior checklists from students, parents, and the research assistants, and parent and student interviews. Pre-test youth and parent questionnaires and emotional and conduct measures were administered and repeated every three months during the art program, with a follow-up post-test six months after the intervention. Observational data was collected by the research assistant to measure students' participation, behavior, skill development, and completion rate. At the completion of the program, 15 students and one parent per each student were randomly selected for personal interviews. These interviews were transcribed and coded by theme.

One hundred and eighty-three youths ranging from 9 to 15 years of age participated in the study, aided by an instructor, two to three assistants, and a research assistant. The five sites were considered to reflect Canada's regional and cultural diversity. Youths were categorized as 59% White, 26% Aboriginal, 11% Black, 6% Asian, 5% Latin American, and 4% Other. Participants were divided into five different locations, encompassing low-income rural and urban communities. Each site was chosen based upon a strong mission, stability, and credibility within the community.

The arts program intervention took place over a period of nine months. After acceptance to the program, each site recruited participants. Each site also created skill development and social goals that increased in rigor over the intervention period. Students participated in 74 sessions on theater art, visual arts, and media arts, meeting twice a week for 90 minutes. Regular family nights were held to increase parent involvement.

The results were divided by each program goal and compared to a different Canadian art program as a control. NAYDP was successful in recruiting low-income youth, with 31.5% reporting the use of welfare and 40% reporting an income lower than 20,000 (2006, p.642). The NAYDP's second goal of high attendance was proven successful with over 80% attendance for the 9-week program. The NAYDP was also successful in significantly increasing art skills, pro-social skills, participation, and task completion as indicated by standardized measures. In comparison to the control group, the NAYDP decreased conduct and emotional problems at a greater rate. Results from the parent interviews indicated that students developed group skills and peer relationships. The researchers concluded that, while the program was successful in meeting its goals, the study was limited by rater bias and differences between the control and intervention

groups. The researchers suggested that further studies of art programs should be conducted to better understand the impact on different sample sizes and within different communities.

This is an important study in that it highlights the possible effects of the arts on diverse communities and the possibilities of engaging at-risk youth in positive expression. While further research needs to be conducted, art programs may increase academic achievement when integrated with academic subjects due to the high attendance and increased engagement indicated by the NAYDP. When considering the classroom, this study demonstrates a successful intervention that may help educators increase positive behavior, student enjoyment, artistry and self-expression in academics.

While the previous study did not focus on academic gains, Smithrim and Upitis (2005) exhibited that significant gains in academic achievement may be possible through art integration programs. Smithrim and Upitis (2005) also examined participants' motivation and behavior when engaged in another Canadian art integration program.

Smithrim and Upitis (2005) studied the effectiveness of the nationwide Learning Through the Arts (LTTA) program in raising achievement and the affects of art instruction on engagement in Canada's elementary schools. Smithrim and Upitis wanted to investigate the overall affect of the 3-year LLTA program, while keeping in the mind the differences of application expected based on schools' individual differences.

While Smithrim and Upitis studied six research questions, this article focused on two of their objectives: "To determine if students in LTTA schools benefited from the program as evidenced by positive changes in attitudes towards the arts and learning and by achievement in mathematics and language…" and, "…to link students' school achievement with views and experiences of school subjects and out-of-school activities" (Smithrim & Upitis, 2005, p. 112).

Data collection was done both quantitatively and qualitatively. Data were collected not just from students participating in the study, but also from parents, artists, teachers, and administrators. Students participated in standardized achievement tests, scored writing samples, and attitudinal surveys. The researchers gathered qualitative data through open-ended survey questions, personal interviews, and focus group interviews of students. Achievement was quantified and measured in Grades 1 and 2 through two problem-solving/response questions from standardized achievement tests, and students in Grades 3 through 6 took the full set of the standardized achievement tests. The reading portion measured comprehension, sequencing, grammar, and vocabulary, and the math portion measured mathematical application, geometry concepts, computation, and estimation skills. All students participated in a standardized writing prompt.

Fifty-five schools participated in the LTTA program across six sites located in Vancouver, Calgary, Regina, Windsor, Cape Breton, and Western Newfoundland, and 4,063 students were surveyed. The data collection, surveys, and start of participation occurred in waves, in accordance to the LTTA program, which started with Grades 1 and 4 in the first year, first, second, fourth, and fifth grades in the second year, and first through sixth grades in the third year. Each site also had control schools, which had no initiatives in place that were related to art. LTTA schools were matched with these control schools in an attempt to control outlying factors (such as socioeconomic status). Two thousand, six hundred and two students were surveyed from these control schools.

While procedures were only outlined in the article as the standard LTTA program plan, the LTTA website offers more insight to the program's implementation. Over a 6-week period, artist-educators visited the LTTA classrooms, and led a classroom activity (at least four times per

week). Artists and teachers worked closely together to develop these activities and integrate them into the curriculum. Teachers also attended artist workshops and trainings in preparation for the program. During these lessons, teachers observed their students, and afterwards worked with the artist-educator to evaluate each student. Between artist visits, the teacher continued the art activity. At the end of each period/year, students in both the intervention and control groups were assessed and parents were surveyed.

After regression analysis was performed on the data, the researchers only found higher performance in mathematics in the areas of computation and estimation in the LTTA students. Looking at the students' out-of-school activities, there was no significant increase in arts-related activities. There was a strong correlation between engagement and involvement in the arts, as reported by all groups surveyed. Other interesting findings were noted, such as an elective mute who decided to speak for the first time and that LTTA sixth grade girls were happier to come to school in comparison to their control schools' peers.

We can learn a lot from this study. First, it is evident that the arts played some role in personal engagement and motivation. This is a crucial piece to support, especially in urban schools were many factors outside of school preoccupy and distract students from their learning. If an arts-integrated curriculum and artist visits were introduced to elementary students in Milwaukee, academic engagement might follow and keep students on a path to success in future grades. Also, with the loss of arts classes, programming such as the LTTA program could continue to promote active exploration, problem-solving, and creativity within our students as well as teach classroom teachers how to properly integrate the arts into a heavily-scripted curriculum.

In the Smithrim and Upitis's 2005 study, motivation and personal engagement were discussed in relation to art integration in academic content. In the following study, creativity is discussed in relation to art integration programs, and the effectiveness and duration of art integration programs as aesthetic academic interventions is examined.

Acer and Ömerodlu (2007) studied the effects of whether an aesthetic education heightened a 6 year old's ability to make aesthetic judgments, based on the knowledge that the ability to make aesthetic judgments is linked to student creativity, awareness of surrounding stimuli, and critical thinking skills. The researchers studied whether there was an increase of aesthetic judgments in children who received an aesthetic integration program, and whether there were any critical differences between the students' judgments inside the integration program.

Data were collected in multiple manners. First, an inquiry form was used to gain knowledge about the participants; including socioeconomic information about their parents (age, education, and profession). A standardized test of aesthetic judgment was also given before and after the aesthetic intervention program, in which students viewed 38 pairs of pictures, one representing low aesthetic quality and the other high aesthetic quality. Students were asked to choose between the two pictures, based on which they believed to have high artistic value. Item analysis was done to quantify participants' responses.

This study took place in Ankara, Turkey, and the sample consisted of 77 children; 38 girls and 39 boys. Students were randomly selected throughout Ankara's schools, and included children from lower as well as higher socioeconomic levels. The students were split into three groups: 22 in the experimental group, 23 in the control group, and 32 in the placebo group.

Over a period of 10 weeks, students in the intervention group participated in a twice-weekly aesthetic education program, for approximately two hours each day. Through studying

artists and their artwork, students were guided through art critique, "…to make children notice the difference between looking and seeing" (Acer & Ömerodlu, 2007, p. 337). Aesthetic principles were incorporated (for example, tone, contrast, repetition, etc.), but the authors did not mention whether they were explicitly taught to the intervention students. Technology was used to present artwork to the students, and students also participated in outings to visit art galleries and artist workshops. The students in the placebo group received instruction that did not support aesthetic judgment development, and the control group did not receive any instruction. The article does not specifically say whether the placebo group's instruction was art related or not. All students took the pre-test and post-test, and the intervention group also took the post-test one month after the program to investigate the longevity of their aesthetic knowledge.

The results were interesting in that the experimental and control group's scores went down between the pre-test and post-test, and there was a slight increase in score for the placebo group. The slight increase and decrease were not statistically significant. An interesting finding was that students who participated in the experimental group showed an increase in aesthetic judgment between the post-test and the retention test administered one month later, but this increase was not statistically significant. There were also no significant differences between gender and socioeconomic level in the findings. The researchers concluded that students in the experimental group showed no significant increase in their ability to make aesthetic judgments because the intervention program was not long enough. Acer and Ömerodlu write, "During our study, the children in the experimental group experienced activities about aesthetics and art critique for the first time in their lives and for a short period of time. Time limitations can therefore be regarded as an obstacle for the development of aesthetic judgment" (2007, p. 340). The researchers also concluded that no significant difference between socioeconomic groups

revealed that the families of the participants did not significantly incorporate art within their lifestyles at home.

Educators can take away two conclusions based on this study. First, it should be understood that while the art intervention program did not work to increase aesthetic judgment, it maybe because the intervention period was short-lived. Like in any academic subject, constant review and application are necessary to grow concrete skills and knowledge. Thus, the longevity of this program was a failure, not the program itself. When presenting art to students, it should be done throughout the school year, and should also be integrated into the curriculum to thoroughly teach art, art critique, and aesthetic judgment to students. Only through lasting exposure to art and art concepts will students learn to "see" and not just "look", and to develop the critical thinking and creativity skills so often linked to art instruction and integration. Second, it is obvious that art and an aesthetic education are being lost; families in neither high nor low socioeconomic levels are focusing on art. While this study took place in Ankara, Turkey, these situations are similar to what is occurring in education in the United States; it is now the job of the educator to expose all children to art and develop the skills associated with art, regardless of socioeconomic status.

In review, these studies suggest that art integration programs may increase academic success, personal enjoyment, and motivation inside school. Luftig (2000) found that reading achievement might increase within an art integration intervention group, and Gardiner, Fox, Knowles, and Jeffrey (1996) found that both reading and mathematics achievement might increase with art integration for at-risk students. Wright, John, Alaggia, and Sheel (2006) demonstrated that art integration programs might increase positive dispositions in an at-risk group of students. Smithrim and Upitis (2005) also discovered academic growth in mathematics

with art integration. This evidence shows that academic achievement is correlated to art integration in the classroom, and that students are engaging with art in a meaningful context. These same studies also noted increased positive changes in behavior and motivation, suggesting that students are positively engaging with art and creating personal connections with art and content that are allowing for the increase in academic success. Also, the studies in this section suggest that there are multiple factors that contribute to the success or failure of art integration programs, and whether their outcomes meet the intended goals. For example, Acer and Ömerodlu (2007) suggested that there was no significant growth in aesthetic judgment as a measure of creativity because the intervention did not last long enough, suggesting that art integration programs need to occur throughout elementary school and that more longitudinal studies need to be conducted to see true student progress. If the results from these studies are taken into consideration, educators will be able to advance academic achievement, personal engagement, creativity, and motivation inside their classroom.

Arts in Mathematics

In the previous studies, mathematics can be positively affected by the integration of art into the classroom. Mathematics in elementary school is highly influenced by visualization skills as students learn to create representations of mathematical problems in order to effectively solve them. Integrating art into mathematics may help students to practice these visualization skills, and skills related directly to art (such as drawing, the use of overlap, etc.) aid students in properly representing mathematical problems. Art integration into mathematics can also increase a student's motivation within the subject area as personal engagement is promoted within a difficult subject. The studies included in this section further the suggestion that art and

developing art techniques play an integral role in a student's success and motivation in mathematics.

Edens and Potter (2008) sought to examine the possible connection between art and mathematics in a large sample of fourth and fifth grade students. The researchers studied the possible relationships between schematic and pictorial visualization ability, spatial ability, and drawing skills in solving math problems, and also studied the difference between the performance of female and male students. Edens and Potter proposed four questions based on these possible relationships. They studied whether schematic or pictorial visualizations of math problems led to correct answers, and whether there was a relationship between spatial ability and problem solving and spatial ability and producing mathematical visual representations. Edens and Potter also studied whether male and female students differed in their use of visual representations as well as in spatial ability, drawing skills, and problem solving, and whether drawing skill was related to visual representation, problem solving, and spatial ability.

Spatial ability, problem solving, mathematical representation, and drawing skill were assessed and analyzed by Edens and Potter. Spatial ability was measured on a 0 to 7 scale and required students to visualize, orient, and mentally manipulate given information about the features of a desert island. Mathematical representation was assessed by having students complete a math problem related to the depth of water in a lake around the island. Students earned points (amount not listed in article) for using spatial proportions, number labels, pictorial elements, and for a correct answer. Researchers then judged each picture to be schematic or pictorial. Problem solving was assessed by accuracy on the depth question, as well as on three other problem-solving tasks that included using numbers, a graph, and a mathematical representation. Students received zero to 12 points for these problem-solving tasks. Drawing skill

was assessed with a drawing prompt that exemplified different cognitive levels of visualization, where students could earn zero to 13 points.

Two hundred and fourteen students in fourth and fifth grade participated in the study. One hundred and one students were in fourth grade and 113 were in fifth grade. The sample consisted of 128 African American students, 71 White students, four Asian students and three Latino students. The numbers of female and male students were approximately equal. The elementary school received average state test scores, and the study took place during the period of one of the students' scheduled art classes.

Students were presented with a booklet of math problems that focused on visualization/spatial ability, drawing, and mathematical problem solving tasks. Teachers and researchers did not assist students during the activity, and students were asked to do their best possible. Students were allowed the duration of their normally scheduled art class to complete the task, and students who did not complete all the required tasks within the booklet were excluded from the study. The students' answers were then analyzed by the researchers, using standard mean deviation scores.

A significant relationship was found between schematic representation and problem solving, but no significant correlation was found between pictorial representation and problem solving. Students with a higher level of schematic drawing had a higher score in problem solving, and many students that answered the question wrong, but had a correct schematic representation, only made errors in computation. Edens and Potter also found a significant relationship between spatial ability and problem solving; spatial ability correlated to schematic representation ability. There was no correlation between spatial ability and pictorial representations. The researchers also found that female students were more likely to construct schematic representations while

male students were slightly less likely to use schematic representations, although the female students did not outperform the male students in problem solving or spatial ability. The female students significantly outperformed the male students in drawing ability. Drawing skill was significantly correlated to constructing schematic representations, and interestingly, students who made pictorial representations rated lower on drawing skill. This may be due to the high cognitive demand of drawing techniques on the drawing skill assessment. A significant relationship was found between drawing skill and problem solving, but no correlation was found between drawing skill and spatial ability.

This is an important study to understand when considering the need for art education for elementary school students. Students who were able to skillfully draw representations of math problems were more likely to answer them correctly, and students who answered the math questions correctly demonstrated a higher level of drawing skill, such as the use of overlap. In contrast, students who only used a very low-cognitive pictorial representation did not do well on the math questions. These findings show us that an in depth art education that focuses on the more difficult cognitive techniques of art and representation can translate to success in other academic areas. Understanding the artistic techniques needed to construct appropriate schematic representations can help students to properly visualize a math problem, and will also lead to further success in professional fields that require advanced visualization and drawing skill, such as architecture. Through art education, students can benefit from learning these necessary techniques and practicing representational tasks that improve their spatial ability, problem solving, and visualization.

The following study, also conducted by Edens and Potter, again focused on the ability of a student to answer mathematical problems when the content area is integrated with art. In this

study, Edens and Potter (2006) investigated the improved academic achievement in mathematics when integrated with art, as well as the affect of art integration in student motivation in mathematics.

"Educators often look to visual arts as a way to teach visual perceptual skills required by state standards in subjects such as math (e.g. measurement, patterning, geometry, lines, angles, rotation of shapes, symmetry)," wrote Edens and Potter (2006, p.44). Edens and Potter investigated whether drawing skill was linked to success in solving math problems by studying elementary students' performance on a drawing task as well as on a math task that required drawing. Edens and Potter also wanted to know if drawing as a visualization technique helped students to solve math problems, as well as determine if an individual's drawing skill was related to the ability to draw and solve a math-drawing task. The authors also sought to discover if motivation was linked to students' performance on these drawing and math-drawing tasks. Motivation was broken down into three subtypes: self-efficacy, entity/incremental view of ability, and intrinsic motivation.

Mathematical representation was measured by a drawing task that had students find the depth of a lake, given the clue that, "…a 12 foot pole projects ½ foot above the surface and has 2 ½ feet buried below the bottom of the lake" (Edens & Potter, 2006, p. 49). Students earned four possible points for accuracy for attempting the drawing, providing an accurate drawing, providing number labels, and providing accurate number labels, respectively. Students earned an additional three points for providing a correct answer, two points for an answer that was close, and one point for a wrong answer.

Drawing skill was measured with a drawing prompt that had students draw themselves and their friends on a playground with the school behind them and a dog in front of them. Their

drawing prompt was assessed under four criteria: drawing all the required parts, use of overlap, including details, and level of Case's central conceptual structure for drawing (Case, 1996; Case, Griffin, McKeough, & Okamoto, 1992; Dennis, 1992). In drawing all required parts, students earned three points for drawing themselves, the school, and the dog (one point each). In use of overlap, students earned three points for using overlapping correctly, two for not attempting overlapping, and one for overlapping errors. Students earned one to three points for using detail, and three points for demonstrating integrated biaxial structure, two for biaxial structure, one for uniaxial structure, and zero for preaxial structure. Two researchers rated 10 drawings together to align their assessment, 10 alone with which to compare their agreement on assessment measures, and then rated the remaining drawings individually.

Motivation was assessed through a student questionnaire, which focused on self-efficacy, entity/incremental view of ability, and intrinsic motivation. Contradictory statements were included, and any questionnaire with contradictory answers was excluded from the motivational part of the study.

One hundred fourth graders and 113 fifth grades in a southeastern United States elementary school participated in the study, and none had an identified learning disability. All students received art instruction for 45 minutes from the same art teacher.

Students were given an art drawing task, a mathematical representation-drawing task, and a motivational scale with which to rate their attitudes during the drawing tasks. Students received 45 minutes (their regular art class period) to complete the three tasks, which were provided in a handout. The students were not instructed on how to complete the tasks.

Overall, students did not do well on the drawing task. Edens and Potter report that, "Only 6% demonstrated the use of Case's highest spatial structure, a *Stage 4 – Integrated Biaxial*

perspective" (Edens & Potter, 2006, p. 50), which was normal for their grade-level. Only 24% of students used overlapping, and 30% included details. Interestingly, fourth graders outperformed the fifth graders; the researchers concluded this was probably due to lack of motivation or investment in the drawing task. Fifth graders showed more cognitive maturity based on Case's levels, although the differences between fourth-graders and fifth-graders were not statistically significant.

In the mathematical drawing task, 98% of students did a drawing, but only 27% made accurate drawings that depicted the mathematical problem. Fifty-five percent of students provided labels, but only 11% were accurate. Fifth graders were not more likely to correctly answer the question than the fourth graders, but were significantly more likely to draw an accurate representation of the problem.

Edens and Potter found that students who stated they used drawing for math did not significantly achieve higher scores, but had higher math motivation. Interestingly, they found that students felt more confidence (self-efficacy) in math than in art, but students reported liking art more (72%) and having a higher intrinsic motivation in art.

The researchers concluded that, while overall drawing ability was helpful in accurately depicting a mathematical drawing task, it did not correlate with correctly answering the mathematical problem. While drawing for math appears to be helpful, it was inconclusive whether accurately drawing the mathematical problem aided in the solution of the problem. The researchers found that correctly answering the mathematical drawing task was correlated to self-efficacy in math, and the quality of the mathematical drawing was not significantly related to either self-efficacy or intrinsic motivation. Motivation in art and performance on the drawing task were significantly correlated.

These findings are interesting because of the motivation exemplified by the students in creating art and the lack of art technique demonstrated by the students tested. Even though students had a higher confidence in mathematics, they enjoyed art more, and had a high intrinsic motivation in creating their art. This shows us that art in mathematics, as well as in school, enhances students' enjoyment in school. If more curricula were art-infused, students would probably have higher intrinsic motivation within other academic subject areas. Also, students' higher confidence in math, but higher enjoyment of art, shows that they hold their artwork at a personal level and are more likely to care about criticism of their artwork. This personal connection to something inside school is very important to build intrinsic motivation when art is integrated into other subjects. Making learning a personal experience could help solidify the retention of academic content, especially within difficult academic subjects that may seem uninteresting to students.

The following study by Forseth (1980) supports the increase in motivation and attitude found by Edens and Potter (2006) in the previous study. This study also indicated a change in creativity for students who participate in art integration in mathematics.

Forseth (1980) posits that the intercommunication between the logico-mathematical mode of thinking and the iconic/art mode of thinking may help students understand complex concepts and increase students' academic achievement (p.23). Through positive art experiences, Forseth suggests that students will continue their art education, thus increasing their academic achievement because of the intercommunication of the logico-mathematical and iconic thinking modes. In this study, Forseth investigates whether these thinking modes interact positively in a sample of elementary students.

The study focused on whether art activities would influence achievement in and attitude towards mathematics, and whether art integration into mathematics would change students' attitudes toward art. Forseth also sought to investigate any change in the creative thinking traits of, "…flexibility, fluency, elaboration, and originality…" (p.23). Forseth proposed seven hypotheses: (1) there will be no differences in attitudes towards art, (2) there will be no differences in attitudes towards mathematics, (3) there will be no differences in achievement in mathematics, (4) there will be no difference towards "flexibility", (5) there will be no difference towards "fluency", (6) there will be no difference towards "elaboration", and (7) there will be no difference towards "originality" (p. 23).

Over a six-week period, participants took standardized pre- and post-tests to measure achievement, attitude, and creative thinking skills. The standardized creativity test measured four components: fluency, flexibility, elaboration, and originality (p.24). Before initiating the intervention, the researcher verified there was no significant difference between the control and experimental group's pre-tests. Teaching styles were also analyzed as "direct" or "indirect" to aid in organizing and interpreting student data.

Six hundred and sixty-nine fourth grade students from eight Florida elementary schools participated in the research study. Students were divided into 30 different classes, taught by 14 classroom teachers. Experimental and control groups were randomly assigned, but each school had at least one control and one experimental group. Fifteen classes participated as control groups and 15 as experimental groups.

The control groups received standard mathematics instruction, and the experimental groups received standard mathematics instruction supported with art activities. Classroom teachers created art and math activities as needed; each student participated in approximately two

to five regular math classes per week and approximately three art integration activities per week (it is not stated which group received what amount). While not explicitly stated, it is assumed that the control groups received no art integration in mathematics. It is also not explicitly stated whether the control groups participated in any kind of art instruction during the research period. Students received mathematics instruction for 45 minutes per day. Sixty-eight art activities were created to support mathematical content knowledge while also emphasizing art concepts. Various art materials were supplied to the students throughout the research period.

Forseth found no significant difference between the control and experimental group for six of the seven hypotheses, with the exception of the second hypothesis. Attitudes towards mathematics increased significantly within the experimental group. While the researcher writes that six of the seven hypotheses were not significant, she also mentions that there was a significant relationship in "elaboration". How the researcher connected the creativity trait of "elaboration" to Hypothesis 2 without rejecting Hypothesis 7 is not stated. While data on teaching style was not presented, Forseth suggests that an indirect style would be favorable in increasing creativity. Forseth concludes that art integration into mathematical content learning may increase positive attitudes toward mathematics, and that the iconic mode of thinking may interact favorably with the logico-mathematical mode. In conclusion, the researcher recommends that further research should be conducted to examine whether art activities increase positive attitudes towards other academic subjects.

This research is interesting for educators in that it demonstrates that art integration may increase positive attitudes towards a target subject. While the presented data is flawed, this study suggests that students may become more engaged with content when they express content knowledge in different manners. Longer studies need to be conducted to study whether an

increase in positive attitude may also increase content achievement and art enjoyment after a longer period of art intervention.

These studies show that art and art techniques are important in mathematics when visualizing and representing mathematical problems. Edens and Potter (2008) furthered the suggestion that spatial ability and visualization are important mathematical concepts that may be directly influenced by a student's capacity to use art and art skills, such as drawing. Also, Edens and Potter (2006) demonstrated that creating a personal connection between art and mathematics can help to solidify academic content and increase personal motivation and engagement within the subject. Similarly, Forseth (1980) indicated that art could influence positive attitudes toward mathematics and increased creativity. These studies demonstrate that students would benefit personally and academically from art instruction linked to mathematics through increased integration, and that more research is necessary to solidify the relationship between art integration and increased mathematics skills.

Conclusion

It is crucial to understand how students benefit academically and personally from integrating art into academic content. The cognitive capabilities of description, observation, creativity, and thought processing are advanced and expanded through art integration in a variety of subjects and experiences. Lampert (2006) and Hsaio (2010) demonstrated that students could build description and observational skills through studying art, and Honan Pellico, Freidlaender, and Fennie (2008) established that even a singular art experience could enhance student observational skills and creativity. Moving beyond regular education, Gair (1975) indicated that art integration could increase thought processing and communication skills in students with

disabilities. Inside our classrooms, the development of these skills will increase students' academic achievement in school as well as influence their skills as future professionals.

After investigating what skills are promoted through art integration, it is necessary to understand the influence of art integration programs that work towards developing these skills. Art integration programs can increase academic success, personal enjoyment, and motivation inside school as supported by Luftig (2000), Gardiner, Fox, Knowles, and Jeffrey (1996), Wright, John, Alaggia and Sheel (2006), and Smithrim and Upitis (2005). These studies exhibited that academic achievement is correlated to art integration in the classroom, and demonstrated that students were engaging with art in a meaningful and personal context. This personal connection was evident in the positive growth of student behavior and motivation, demonstrating that art in the classroom was reaching students who might have been at risk for academic failure. The study by Acer and Ömerodlu (2007) also established that future art integration programs need to truly be a part of a student's education over an extended period of time to truly influence behavior and academic progress.

Once programs understand the benefits of art integration and increase their duration of art intervention within the content areas, it is important to focus with a content-specific lens on mathematics. Both studies conducted by Edens and Potter (2008 and 2006, respectively) and Forseth's study (1980) showed that art integration was important in mathematics when visualizing and representing mathematical problems, increasing engagement and motivation, increasing students' mathematical competence through the use of art and art skills, such as drawing. This tells educators that creating a personal connection and personal engagement between art and mathematics can help to solidify academic content. When art is infused into mathematics, elementary students benefit academically and personally.

The reviewed studies indicate a link between art integration, academic achievement, and personal enjoyment in school. After analyzing these findings, the investigator determined it was justifiable to create an art integration program in a core content area.

Chapter Three: Methodology

The purpose of this research study was to investigate the effects of integrating art into mathematics on academic success on math objectives and student behavior. Did participating in art heighten students' understandings of daily math objectives and increase their enjoyment of, and positive attitude towards, mathematics? The goal of this research study was to analyze whether students increased their retention of daily math objectives by visualizing the math content through art activities and whether students' positive attitudes and positive behavior increased through the hands-on nature of art.

Participants

Seventeen students and one classroom teacher in a K5 Kindergarten classroom participated in the research study. The nine boys and eight girls were all between 5 and 6 years of age. Five students spoke Spanish as their native language and 12 were English-dominant. The students came from a range of backgrounds, including White, African American, and Latino families. Three students had Individualized Education Plans: two for speech and one for behavior, and were invariably pulled out to another classroom for Special Education Services during the Math block.

All participants were enrolled full-time and had attended class since the beginning of the school year. The research study was conducted at a bilingual elementary school that serviced four-year-old Kindergarten through fifth grade. Located in an urban district in the Midwest, the school consisted of approximately 40% Latino, 30% African American, and 10% White students. The surrounding community also reflected the school's racial diversity. The majority of the

students at the school qualified for free and reduced lunch services as provided by the state for students of low socioeconomic status.

Description of Procedures

Art integration occurred over a 6-week period in the spring of 2012 (see Table 1 below). Students participated in art and non-art activities during the daily math block, with art experiences ranging from two to four times per week. The art integration intervention consisted of math objective-based art projects that students completed during the Application portion of the LESA (Launch, Explore, Summarize, Assess/Apply) Math and Science Instructional Design. Students were provided with many art resources, such as markers, crayons, glue, sequins, feathers, etc., and were led through multi-step art projects by the classroom teacher during whole-group instruction. Non-art activities included games with manipulatives, worksheets, and board games. After whole-group instruction of a math objective, students were given approximately 20 to 30 minutes each day to complete an art or non-art math activity. During this Application portion, students worked in their assigned spots at three different tables, or worked in pairs at the tables. For some activities, students rotated through three different centers, each table consisting of one project/game. During the math activity, students were called one by one by the classroom teacher to complete an exit assessment question on the math objective (see rubric in Appendix A). After the math period, students were then asked to rate their enjoyment of the art and other non-art activities on a smiley face rating scale (Appendix B). Pre- and post-research surveys (see Appendix C) on students' dispositions towards math, art, and school were also completed by the participants' parents/guardians.

Table 1

Date	Art or Non-Art Activity	Description of Activity	Math Skill	Exit Assessment	Enjoyment Assessment Administered?
4/30/12	Art	Whole group activity: Make a poster of the families of 6 using cut out magazine circles, poster divided in half, one addend per side	Addition families of 6	Demonstrate one way to make 6. Yes = 100%, No = 0%	Yes. Students circled 1 of 3 smiley faces to express their enjoyment of each activity: a "frown" face, subtitled, "let's not do that again", a regular "smiley" face, subtitled, "It was okay", and an "excited" face, subtitled, "That was awesome!" Each smiley was then given a numerical value from 1 to 3, with 1 correlating to the least enjoyment, or the frown face. Two points were assigned to the regular smiley, and 3 points were assigned to the "excited" face for data collection and analysis.
5/3/12	Non-art	Partner Activity, Time matching game: match times between written and analog clock, cut out cards and play in pairs	Tell time by the hour on analog and digital clocks, recognize that different clocks can represent the same hour	Match written time (7:00) to analog time (7:00 and 9:00 presented). Yes = 100%, No = 0%	Yes

5/4/12	Art	Individual/Partner activity: Create monsters out of brown paper bags. Googly eyes, sequins, feathers, markers and crayons, cut out fruits to feed monster	Tell "how many more" the monster ate. Partner adds x number of fruits while other partner looks on, then adds x number more fruits when partner is not looking, then must calculate how many more fruits the monster ate using addition/subtraction properties	Calculate how many more were added in Monster Bag demonstration: Started with 3, 2 more added with student looking away. Yes = 100%, No = 0%	Yes
5/8/12	Non-art	Partner Activity, Time matching game: match times between analog and digital clock, cut out cards and play in pairs	Tell time by the hour on analog and digital clocks, recognize that different clocks can represent the same hour	Match digital and analog clock: 2 digital and 2 analog examples provided to choose from. Yes = 100%, No = 0%	Yes
5/9/12	Art	Whole group activity: Read "The Grouchy Ladybug" by Eric Carle, fingerprint ladybugs on leaves on whole group poster, divided in half by vine with leaves; each leaf received one addend, complementary addend on opposite side's leaf	Addition families of 10	Demonstrate 1 way to make 10. Yes = 100%, No = 0%	Yes
5/14/12	Non-art	Individual activity: Complete 2 function machine worksheets	Properties of adding +1 and +2 to consecutive numbers	Answer 2+4 as presented by a function machine example. Yes = 100%, No = 0%	Yes

5/15/12	Art	Individual activity: Read "The Rainbow Fish" by Marcus Pfister, create an addition sentence by fingerprinting differing numbers of fish (addends), decorating them with sequins, decorating the background with crayons, and writing an addition sentence	Understanding addition sentences	Represent a correct addition sentence in your artwork. Yes = 100%, No = 0%	Yes
5/16/12	Art	Individual activity: cut and paste the intervals of 5 on previously constructed analog clocks	Tell time to the 5-minute interval	Order the numbers on your clock correctly. Yes = 100%, No = 0%	Yes
5/17/12	Non-art	Group activity: Play board games in groups of 3. Table 1: Chutes and Ladders (Spin and count how many squares to progress). Table 2: Dice Animal Puzzle (Roll dice, add either dice piece, animal piece, or number of fingers piece to number puzzle piece). Table 3: Dice and Counter Game (Partner game, each player rolls two dice, counts up number of dots. Player with highest numbers wins a counter, whoever has the most counters when all are gone wins)	Count on, represent numbers (i.e. with points on a die, squares on a board game)	Summative assessment: Observation: Was student working? Yes = 100%, No = 0%	Yes

5/18/12	Art	Individual Activity: Create your own dollar bill and money book. Illustrate each page: Illustrate your own dollar bill, color items with price tags, draw what you would buy with 100 dollars	Understand the value of $1	Summative assessment: Observation: Was student working? Yes = 100%, No = 0%	Yes
5/21/12	Art	Individual Activity: Read "Polar Bear, Polar Bear, What Do You Hear?" by Eric Carle. Cut out geometric shapes out of construction paper and create an animal. Construction paper previously painted after viewing an Eric Carle video on how he creates his paper, animal based upon their animal books from literacy block	Review and name geometric shapes	Summative assessment: Observation: Was student working? Yes = 100%, No = 0%	Yes
5/22/12	Non-art	Group Activity: Play math games. Table 1: Chutes and Ladders. Table 2: Dice and Counter Game. Table 3: Addition/subtraction worksheet.	Understand addition and subtraction under 10, practice counting on from a previous number	2+ 3 = Answered correctly = 100%, incorrectly = 0%	Yes
5/23/12	Art	Whole Group Activity: Color zoo picture, vote with zoo picture on favorite animal graph	Understand graph properties	Answer 2 graph property questions: 1) Which animal had the most votes? 2) Which animal had the least votes? Answered 1 part correctly = 50%, both parts correctly = 100%	Yes

5/24/12	Art	Individual Activity: Paste 100 sequins on 100 chart	Understand and represent numbers 0 - 100	Recognize 47? Answered correctly = 100%, incorrectly = 0%	Yes
5/25/12	Art	Individual Activity: Color parrot (in connection to literacy and studying animals), create an AABB pattern with four feathers as a tail	Understand AABB patterns	Demonstrate 1) AABB pattern, 2) Continue AABB pattern. Answered 1 part correctly = 50%, both parts correctly = 100%	Yes
5/29/12	Art	Individual Activity: Read "The Hungry Caterpillar" by Eric Carle, construct a caterpillar by rolling dice, counting number of points, and drawing the body part represented by that number	Count points on a die, understand that numbers can stand as representations/codes	Summative assessment: Observation: Was student working? Yes = 100%, No = 0%	Yes
5/31/12	Art	Individual Activity: Caterpillar worksheet, draw and color number of body "circles" as identified next to caterpillar's head	Count and represent numbers 0 - 10	Summative asssessment: Observation: Was student working? Yes = 100%, No = 0%	Yes
6/1/12	Art	Individual Activity: Create an addition sentence based on foods eaten by the "Very Hungry Caterpillar", students' choice of what foods and how many were eaten. Cut and color caterpillar and food items, paste on construction paper	Construct and represent an addition sentence	Summative assessment: Observation: Was student working? Yes = 100%, No = 0%	Yes

6/6/12	Non-art	Individual Activity: Count how many trees, benches, fence posts, windows, cars, and clouds are outside	Count objects in an environment, understand numbers represent real objects	Count and write correct number on worksheet. 1 correct answer: 16.7% 2 correct: 33.3% 3 correct: 50% 4 correct: 66.7% 5 correct: 83.3% 6 correct: 100%	Yes
6/7/12	Art	Individual Activity: Count three items of choice outside, illustrate and count objects	Count objects in an environment, understand numbers represent real objects	Count and write correct number on worksheet. 1 correct answer: 33.3%. 2 correct: 66.7% 3 correct: 100%	Yes

Description of Data Collection

Data were collected from three different sources. Parents'/guardians' observations of their child was collected in pre-and post-test surveys on school, math, and art, student enjoyment surveys were administered after each activity, and exit assessments (or quick assessments based on a one or two-part question) were given for each student present during the Application period.

In the parent/guardian questionnaire, parents/guardians answered seven questions (see Table 2) based on their child's dispositions towards math, art, and school. Each answer was based on a numerical scale, with answers for Questions 1 through 4 worth five possible points and answers for Questions 5 through 7 worth three possible points (see Table 2).

Table 2

Point scale for questions 1 through 4:
1 = Never 2 = Rarely (1 time per week) 3 = Sometimes (2 times per week) 4 = Often (3 times per week) 5 = Very frequently (4 or more times per week)

Point scale for questions 5 through 7:
1 = Dislikes 2 = Indifferent 3 = Enjoys

Question Number	Question	Focus on Art, Math, or School Disposition
1	How much does your student talk about math at home?	Math
2	How much does your student talk about art at home?	Art
3	How many times per week does your student create art at home? I.e. coloring, drawing, painting, etc.	Art
4	How many times per week does your student do math not in the weekly homework at home?	Math
5	How much does your child like school?	School
6	How much does your child like art?	Art
7	How much does your child like math?	Math

Students' enjoyment of the art and non-art math activities over the 6-week period was collected on a smiley face rating scale (see Appendix), consisting of the categories: "Let's not do that again", "It was okay", and "It was awesome!" Each category was given a numerical value

from 1 to 3 for data analysis, with “Let’s not do that again” receiving one point, “It was okay” receiving two points, and “It was awesome!” receiving three points.

Students’ assessments of the daily objective were given a percentage based on two different methods: (1) the number of parts correct in each question, or (2) whether the student was participating in the activity, with 100% for full participation and 0% for no participation (see Table 1).

Conclusion of Methodology

The purpose of this research study was to facilitate an increase in math understanding and increase positive behavior through the integration of art projects into the daily math block. Students experienced art and non-art activities during the research period, and assessment data of their objective mastery was collected daily. Enjoyment data was collected from the students for each art and non-art activity, and parent observation data was collected before and after the research period to quantify any noticeable changes in disposition towards math, art, and school.

Chapter Four: Results

Introduction

The purpose of this research study was to investigate the effects of integrating art into mathematics on academic success and student enjoyment of and disposition towards math, art, and school. The researcher questioned whether integrating art activities into mathematics would help to increase students' academic knowledge of mathematics and increase students' positive dispositions towards math, art, and school. The researcher also sought to examine the relationship between exit assessment mastery and student enjoyment. The researcher used a single-subject, quantitative design to execute the study. All qualitative data was given numeric representation to aid in quantitative analysis. The intervention consisted of integrating art activities based on the daily math objective into the daily mathematics block. During the research period, students' enjoyment and exit assessment mastery was recorded for all art and non-art math related activities. Students participated in the art intervention activity for approximately 20 minutes during the daily scheduled math block, and an equal amount of time was allocated to non-art math activities. Students participated in the art or non-art activity after explicit teaching of the math objective in the daily whole group lesson. The independent variables in the research study were the whole group lesson about the daily math objective and the art or non-art activity presented to the participants. The dependent variables consisted of the participants' responses to their enjoyment of the art or non-art activity, their mastery on the exit assessments for each objective, and their parents'/guardians' responses on the pre- and post-test Parent/Guardian Questionnaire. Spreadsheets of the daily student enjoyment surveys, pre- and post-test quantitative responses, and exit assessment percentages were created to summarize the results, and descriptive statistics were used to analyze the collected data.

Presentation and Summary of Data

Parent/Guardian Questionnaire pre- and post-test data. The researcher analyzed data from the Parent/Guardian Questionnaire for each pre- and post-test questionnaire separately. The researcher averaged the scores to find the average rating given by parents/guardians for each of the seven questions. The results for both tests indicate the art integration intervention had some positive impact on students' dispositions towards art, math, and school. Figure 1 shows that the average ratings increased on the Pre- and Post-Test Parent/Guardian Questionnaires for Question 1, 4, 5, and 7. This growth indicates that the art integration intervention increased students' dispositions toward math, art, and school as observed by their parents/guardians. The data also indicates a decrease for Questions 3 and 6, suggesting that the intervention did not increase students' dispositions in all categories. Interestingly, Question 2 indicates no change in rating. For Question 1, parents/guardians increased their ratings of their student's math talk at home from 2.92 to 3.86, showing an increase in rating of 0.94. This rating indicates that students talked about math at home more frequently between April and June. For Question 4, parent/guardian observations of students displayed a modest increase in the amount of math done at home (outside of the weekly homework) from 2.86 in April to 3.17 in June. For Question 5, parents/guardians increased their ratings of their child's enjoyment of school from 2.5 to 2.67, with an overall increase of 0.17. For Question 7, parents/guardians also modestly increased their ratings of their child's enjoyment of mathematics from 2.43 to 2.83, with an overall increase of 0.40. For Question 2, parent's/guardian's ratings of how often their student talked about art at home maintained a rating of 4.14. For Question 3, parents/guardians observed a drop in art done at home, decreasing their rating from 4.43 to 4.29, an overall decrease of 0.14. For Question 6, parents/guardians also observed a decline in enjoyment of art, decreasing 0.10 from 2.93 to 2.83.

Table 1 summarizes these ratings. In comparing the average overall increase in ratings and the overall decrease in ratings, the average increase of 0.45 for Questions 1,4,5, and 7 is greater than the average decrease of 0.12 for Questions 3 and 6.

Figure 1

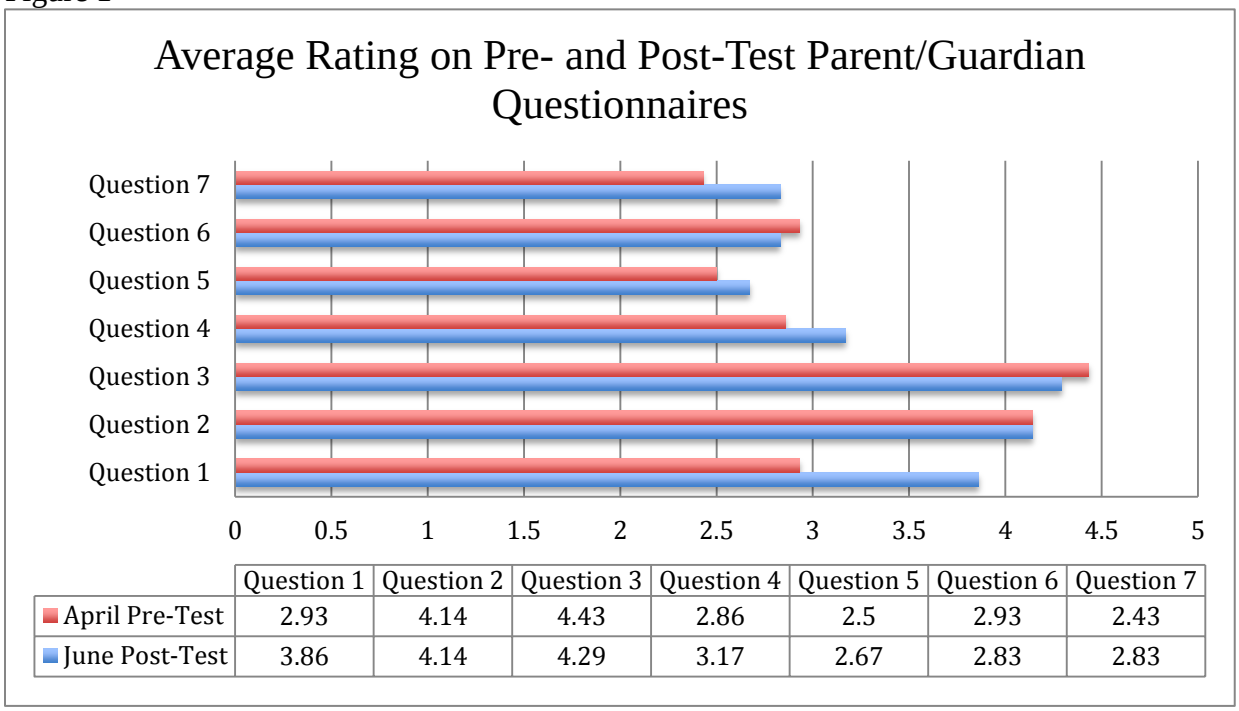


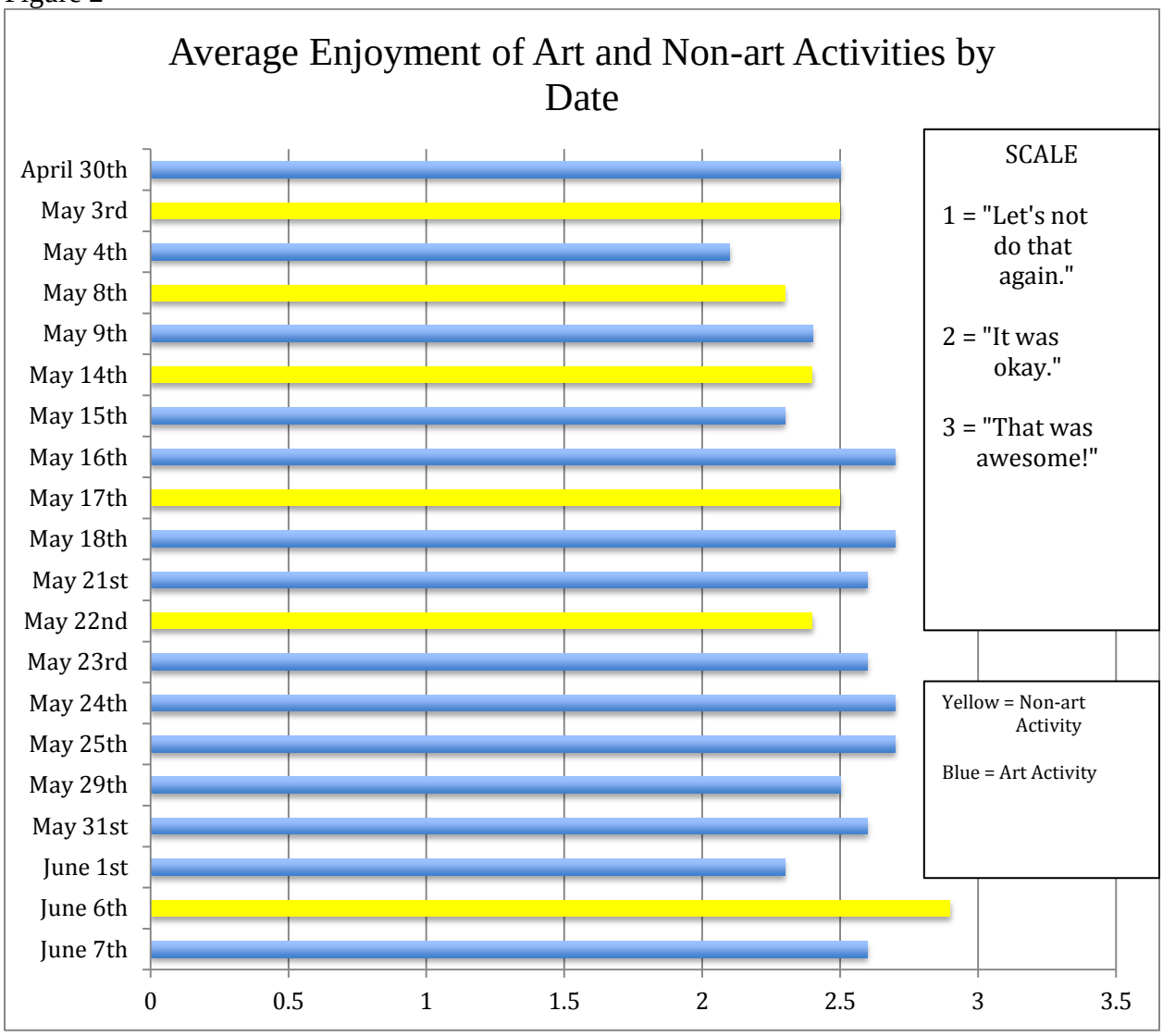
Table 1

Average Rating Between April Pre-Test and June Post-Test

Question #	April Pre-Test Average Rating	June Post-Test Average Rating	Overall Increase/Decrease in Rating
Question 1	2.93	3.86	0.93
Question 2	4.14	4.14	0.00
Question 3	4.43	4.29	-0.14
Question 4	2.86	3.17	0.31
Question 5	2.5	2.67	0.17
Question 6	2.93	2.83	-0.10
Question 7	2.43	2.83	0.40

Enjoyment of art and non-art activities daily survey data. While parents/guardians rated their students' dispositions before and after the intervention period, students were asked to rate their enjoyment of each math objective daily. To analyze the average enjoyment surveys taken by each student for each art and non-art activity, the researcher averaged the scores for each intervention instance and labeled them by date. Graph 3 shows each rating by date, with yellow correlating to non-art activities. Overall, students enjoyed all activities, whether art or non-art related. For all recorded dates, the average rating never fell below a 2, or "It was okay", indicating that, on the average, students enjoyed all the activities during the intervention period. Averaging the total responses shows that students rated their enjoyment of art activities at 2.52 and non-art activities at 2.5. A *t*-test of the art and non-art averages resulted in a *p-value* of 0.83, indicating that the difference between the art and non-art averages is not significant.

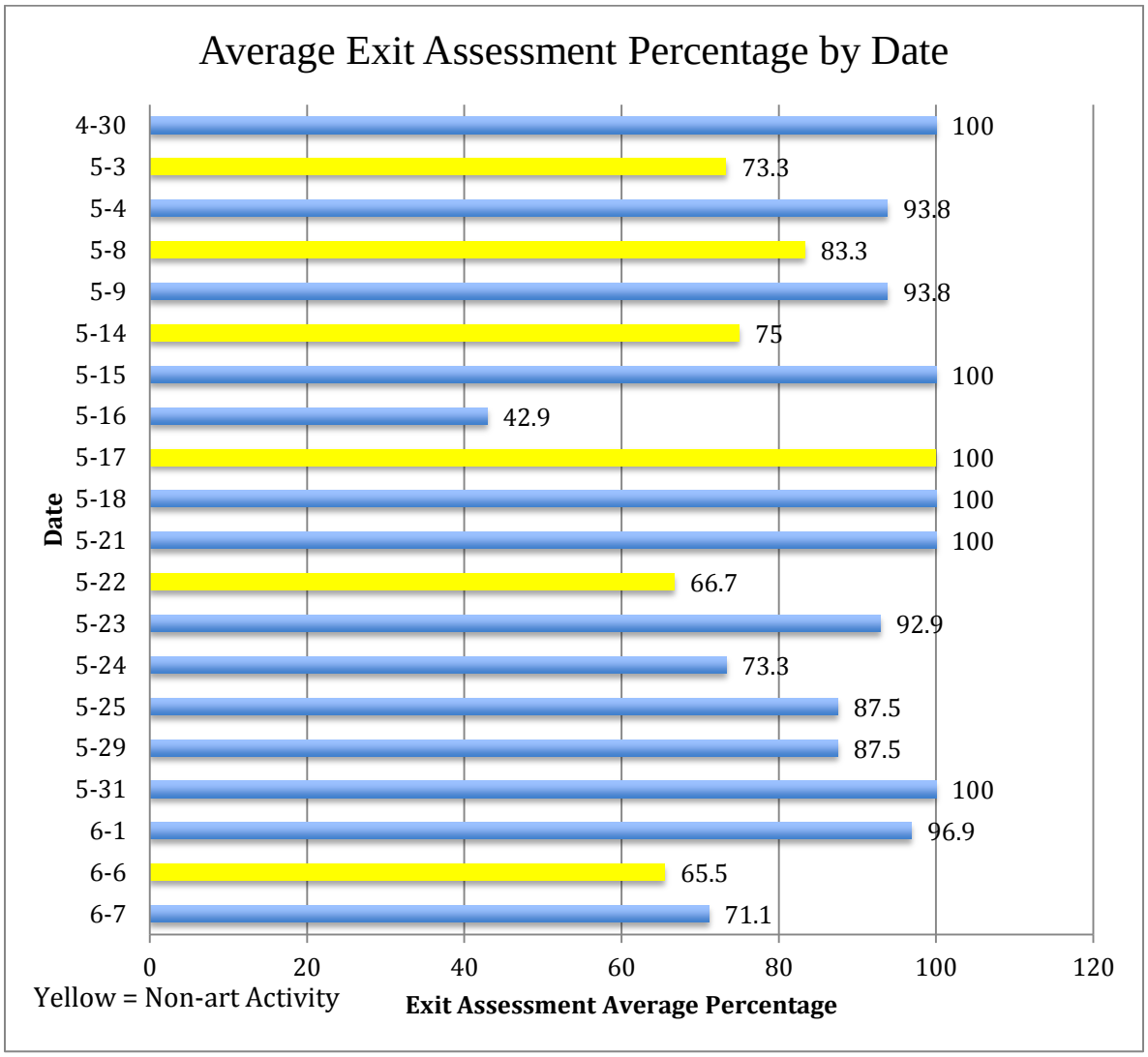
Figure 2



Daily exit assessment data. In agreement with the Parent/Guardian Questionnaire, the intervention also positively increased students' exit assessment percentages. To analyze the exit assessment data from each art and non-art related objective, the researcher averaged each student's mastery score over the intervention period. Then the researcher found the average percentage for each art and non-art related objective. An average score of 80% or above demonstrates mastery of the objective. Three out of 14 art integration interventions did not qualify as proficient mastery of the subject, indicating that 78.6% of the art integration

interventions were successful in teaching the intended objective at a high level of student mastery. Four out of the six non-art interventions failed in reaching 80% mastery, or were 33% effective in reaching sufficient mastery. Figure 3 represents the exit assessment average for each intervention instance. Interestingly, a high average exit assessment percentage did not correlate to higher enjoyment of the art or non-art activity. After conducting a correlation test, the correlation coefficient value r = -0.34 indicates a low correlation between average assessment percentage and average enjoyment.

Figure 3



Findings and Summary

Analysis of the data showed a positive increase in math objective mastery when related to art activities and an overall positive increase in students' dispositions towards math, art, and school occurred during the intervention period. Parent/Guardian Post-Test scores increased for five out of the seven questions, and the average increase was significantly larger than the average decrease. After *t*-test analysis, the art intervention was shown to have no significant difference when considering the dependent variable of the students' enjoyment ratings of art and non-art related activities. When considering the third dependent variable of student mastery of math objectives, the results indicate high mastery levels on the daily exit assessments when connected to art activities. Statistical analysis shows that the average percentage of student mastery was higher when connected to an art integration activity, and the average percentage was closer to, or surpassed, the mastery percentage of 80%.

Chapter Five: Conclusions and Discussion

Introduction and Brief Overview of Results

Research suggests that when educators integrate art into the classroom, students improve their academic achievement as well as their attitudes towards mathematics and school (Gardiner, Fox, Knowles, & Jeffrey, 1996). Students in urban districts around the United States are falling farther and farther behind academically, and mathematics is no stranger to this achievement gap. To assist struggling students, the researcher integrated art into mathematics and sought to examine art's relationship with academic achievement, student enjoyment in mathematics, and student disposition towards art, mathematics, and school.

The research questions for this study were: (1) Will integrating art into mathematics increase students' positive dispositions towards mathematics, art, and school as observed by their parents/guardians? (2) Will art integration increase students' enjoyment of mathematics inside the classroom? (3) Will art integration increase students' academic achievement in mathematics? The intervention consisted of: (1) explicit teaching of a math objective through a whole group lesson, (2) integrating art materials through a focused art project into partner or individual work time, and (3) assessing students' mastery of the math objective. The dependent variables were students' enjoyment of the art or non-art activity, students' mastery of the objective, and parents'/guardians' observations of their students' dispositions. The impact of the intervention was measured through pre-test and post-test parent/guardian questionnaires, daily student enjoyment surveys, and daily exit assessments to measure student mastery of the objective.

Current research on the cognitive affects of art, the effectiveness of art integration programs, and the benefits of the direct relationship between art and mathematics support this

research study. Gair (1975) demonstrated increased thought processing skills with art intervention, and Honan and Pellico (2008) demonstrated the higher achievement and divergent thinking of adult nursing students after a singular art exposure event. Wright, John, Alaggia, and Sheel (2006) exhibited increased student engagement and decreased negative behavior when students participate in art, and Forseth (1980) revealed an increase in creativity and positive attitude towards mathematics. With the support of this research and the background research presented in Chapter Two, this study's research questions were developed and the effects of art integration were analyzed after the 6-week intervention period.

Explanation of Results

The findings from this research study exhibit an increase in student academic achievement when art is integrated into mathematics and an increase in positive dispositions towards math, art, and school when art is integrated into content learning. When considering the Parent/Guardian Questionnaire pre- and post-test results, the average increase of 0.45 versus the average decrease in rating of 0.12[1] demonstrates that students increased their positive dispositions towards mathematics and school and minimally decreased in their positive dispositions towards art and creating art at home. This increase in positive dispositions to mathematics is supported by the research of Smithrim and Upitis (2005) and Forseth (1980). Forseth (1980) writes, " Natkin (1966) has shown that students who have pleasant associations with math may come to have more positive attitudes and less anxiety toward math…" (p.22). The results also indicate that there was no significant difference in enjoyment between art and non-art activities on students' daily enjoyment surveys. Overall, students demonstrated a high

[1] The average increase and decrease was taken from the pre- and posttest averaged scores for Questions 1 through 7 in the Parent/Guardian Questionnaire. This demonstrates that parents increased their average scores by approximately half of a point on Questions 1,2,4,5,7, and decreased their average scores by only one-tenth of a point on Questions 3 and 6.

enjoyment in mathematics, with an average rating of 2.5 for non-art activities and 2.52 for art activities (on a 1 to 3 scale). These averages indicate that students rated all classroom activities between, "It was okay," and "It was awesome!" Analysis also shows an increase in mathematical academic achievement when connected to art integration activities. Potter and Edens (2006) write that, "As Winner & Cooper (2000) explain, the arts can serve as an entry point that piques the interest in an academic area of an otherwise unmotivated student" (p.56). Seventy-nine percent of the art integration activities yielded a high level of student mastery (at or exceeding 80%), and only 33% of the regular, non-art activities produced high student mastery. This shows that students understood and retained more mathematical concept knowledge when integrated with an art activity. While the results indicate there was a low correlation between the average assessment percentage and a high rate of enjoyment, there were no ratings for art activities that fell below a "2", or the rating of "It was okay." This indicates that students enjoyed all art and non-art activities presented during the intervention period.

Strengths and Limitations of the Study

From the researcher's perspective, this study had many strengths and limitations. One limitation of this study was the ambiguity of the students' responses on their enjoyment surveys. Possible outside factors, such as the desire to copy friend's responses and the desire to please the classroom teacher, could have led to the high ratings for both art and non-art activities. The Parent/Guardian Questionnaire also yielded strengths and weaknesses. Using the parents'/guardians' responses, it was easier to truly visualize what each student thought about math, art, and school. While the daily student enjoyment surveys yielded some insight, the Parent/Guardian Questionnaire revealed whether the art integration had a lasting impact outside of the school atmosphere. A weakness of the Parent/Guardian Questionnaire was the outside

control of the parents in returning the questionnaires. At the start of the research period, parents/guardians returned 14 out of 16 questionnaires, but only returned seven out of 16 at the end of the research period. It is conceivable that the ratings data would be more meaningful if all parents'/guardians' voices were taken into account. Another weakness of the research study was its design. While students participated in 13 art-integrated activities, they only experienced six non-art activities. Had the number of art and non-art activities been equal, the results may have been more meaningful. Finally, the duration of the intervention and the attendance of the students were also limiting factors in the research study. Students participated in a short intervention period of 19 days, and many students did not participate in all the activities because of absences. The researcher believes that an ideal time period for this type of study would be a full academic year in order to effectively norm students to the daily enjoyment survey process and to fully understand the academic growth of each student.

Recommendations for Future Research

This study indicates students' positive dispositions increased towards school and mathematics and academic achievement improved with art-integration activities; future research similar to this study's design would be valuable for educators who desire to increase art, math achievement, and positive dispositions inside their classrooms. Future designs that expand the intervention period and equate the number of art and non-art activities would likely improve the understanding of the effects of art integration in mathematics. Also, increased parent/guardian participation would yield a more valid understanding of the effect of art integration on students' dispositions. In further studies, a modified enjoyment survey, such as coding students' verbal responses to activities, would be helpful in truly understanding what level of enjoyment and engagement each participant experienced with each activity. A research assistant would also be

useful in helping to prompt student work and response during the art and non-art activities. Through these modifications, future practitioners could elicit more pertinent data from the art integration intervention.

Conclusion: Implications for Personal Practice

While this research study indicated the positive influence of art in mathematics, I believe that further studies over a longer period of time are necessary to truly understand the impact of art on students' dispositions and achievement in mathematics. Further research under more ideal conditions will lead a better understanding of art's influences on young students. This research study has provided me with significant insights to the learning process and the importance of long-term planning. I have also gained understandings of the significance of engaging a student population through arts integration and cross-curriculum planning to provide significant learning experiences. Through purposeful long-term planning, educators can effectively integrate art into the curriculum, providing students with engaging experiences and strong links to academic content. Educators can also provide students with art content knowledge through integration when education budget cuts have removed art classes from public schools. Personally, I will continue to integrate art into mathematics, and will expand art integration into literacy, science, and social studies as well. This will allow my students to connect to their education and create products that demonstrate their knowledge and academic achievement. Moving a step further, I would like to connect art content and art skill standards into the art activities my students experience to further their knowledge of art and different art mediums, such as photography, portraiture, and screen printing. By providing my students with different critical thinking/mathematical and artistic skills to develop, art mediums to try, and modes of expression, I hope to increase my students' engagement in school and solidify the links between art, positive

dispositions, and academic achievement. This research will also be shared with colleagues as best practice to reaffirm the use of art inside of academic content and to ensure a quality education for all students.

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Appendix A

Student Rubric for Daily Exit Assessment

Student Name: _____ Date: _____

Math Objective: _____

Question: _____

Room for Student Work (if necessary)

Student Score: ____ correct / ____ total parts X 100 = _____%

Appendix B

STUDENT DAILY SURVEY

Name: _____ Date: _____

This is what I felt about math today:

I was bored, let's not do that again

It was ok!

I loved it!

Appendix C

Parent Questionnaire
Art, Math, and Behavior

Student Name: _____ Date: _____

*Note: Please answer these questions honestly; in no way will your child be penalized for your answers. You will be asked to complete this questionnaire again at the end of the research period. This questionnaire will be used to analyze any change in behavior or attitude towards mathematics and art after participating in the art integration activities.

For questions 1 through 4:
Scale
1 = Never
2 = Rarely (1 time per week)
3 = Sometimes (2 times per week)
4 = Often (3 times per week)
5 = Very frequently (4 or more times per week)

1. How much does your student talk about math at home?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very frequently

2. How much does your student talk about art at home?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very frequently

3. How many times per week does your student create art at home? I.e. coloring, drawing, painting, etc.

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very frequently

4. How many times per week does your student do math not in the weekly homework at home?

1	2	3	4	5
Never	Rarely	Sometimes	Often	Very frequently

For questions 5 through 7:
Scale:
1 = Dislikes
2 = Indifferent
3 = Enjoys

5. How much does your child like school?

1	2	3
Dislikes school Does not like to come to school	Indifferent	Enjoys school Enthusiastic to come to school

6. How much does your child like art?

1	2	3
Does not like art	Indifferent	Enjoys art Very frequently does art at home

7. How much does your child like math?

1	2	3
Does not like math Prefers other activities	Indifferent	Enjoys math Frequently counts things in environment