

EFFECTS OF SCIENCE AND ART INTEGRATION ON URBAN
PREKINDERGARTEN AND FOURTH-GRADE STUDENTS

by

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July 2013

DEDICATION

This is dedicated to my wonderful parents who always encouraged me to achieve my goals.

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ABSTRACT

This study investigated the effects of art and science integration on students that live within an urban community. The students used art concepts to enhance their observation skills. A variety of data were collected during this study; including-pre and post assessments, surveys, interviews, observations, and student projects. The data were used to determine the effects on student awareness of their environment, comprehension, attitudes, and motivation. The educator's attitudes and motivation were studied as well. The study found an increase in the students' awareness of their environment, long-term memory skills, attitudes, and motivation. The study indicated mixed results of the educator's motivation and attitude.

INTRODUCTION AND BACKGROUND

At times, teaching urban students about life science is difficult. Students may not be aware that animals exist in the city and create a shelter with materials found in a city (Sterling, 2010). Of course, it is not the student's fault that they have little practical knowledge; however, I wonder what would happen if students played outside instead of constantly playing video games? As a child raised in the city, I recall observing insects and other animals while I played outside in my backyard.

Every year I teach, I contemplate how to motivate students to become more aware of observing science in their daily lives. Recalling science facts is not the same as applying the skills in real-life scenarios. I used different ideas learned at workshops until I discovered one idea that benefited my students, which was to teach one concept in two different subjects such as science and writing. As an elementary school teacher, I know the importance of concept integration and the huge benefits it provides. I wanted students to explore the city they live in while walking in their neighborhood exploring the various shapes, lines, colors, and textures that organisms use to survive in their habitat. Eventually, students could discuss their observations or other important locations to create family time. Instead of the parents teaching their children, the children can teach their parents and/or siblings ways to be observant while smelling the roses. I believe that parents and siblings are not the only positive effect when students are more observant of their surroundings. Teachers benefit by having a positive attitude and enthusiasm when students are observant. Anytime students show an interest in a topic, teachers are encouraged to pursue the interest. If students are more observant, elementary teachers

may be encouraged to participate in art and science integration trainings to learn how to use the concept in their lessons.

A few years ago, I began to integrate science into language arts and mathematics to teach the concept for a longer time. Whenever I integrated science into math or language arts, the students appeared to retain the information better.

Two years ago, I attended several trainings in art and science integration. Typically, teachers do not think to integrate the arts into the core subjects of reading, writing, mathematics, social studies, and science. Globalization allows more people to work together with different backgrounds and encourages people to work together to solve answers. Leonardo da Vinci and Albert Einstein were both successful scientists and artists. Artists and scientists both explore and identify patterns and perception (Oppenheimer, 1972).

I have always been nervous and terrified of art; however, an hour into the training I saw art in a new light. Art is a not black and white sketch in a perfect portfolio or a stunning marble statue that stands out in a room, but has endless possibilities when educators are not afraid of creativity. Two years ago, I used a design and build landform lesson and for the first time I saw Title 1 students, economically disadvantaged, excited about a lesson. Usually, the students did not communicate effectively during a small group setting, but students respected all ideas and asked real life scenario questions.

I knew I had to explore the possibilities of science and art integration with urban students since I made a huge breakthrough with only two lessons. Perhaps, science and art integration could be the missing piece to complete the puzzle with student awareness

in urban settings. My goal is for students to be aware of the world around them in any setting by observing organisms' color, shape, and texture.

The students I work with remind me of paintings in an art gallery because each one has a unique background and story to tell. Majority of the students are similar to a still life portrait until someone observes the tiny details that other people ignore and are suddenly seen in a light. Most of the students do not speak English as their native language and at times a language barrier is formed. The school I teach at is located inside the Shanghai Zoo, which classes have access to during the school day. The school's toddler-to 6th grade student body consists of 350 students from 35 countries. Due to the school's location and organic garden program, the students are aware of life and environmental science. However, they are not taught ways to observe organisms or objects. I believe art will be a creative and powerful tool to introduce students to discuss observations and use their senses to capture quick science opportunities in a large urban setting.

An interest in using science and art to create urban student curiosity during science lessons lead to my primary focus question: What are the effects of integrating science and art on students' understanding of science concepts? One primary question is not enough to deepen my understanding of science and art integration, so three subquestions will be used to help with the project. The subquestions are: what are the effects of integrating science and art on my attitude and teaching practices; what are the effects of integrating art and science on students' awareness of science concepts and principles; and what are the effects of integrating science and art on students' interest and their attitudes and motivation?

A group of people will assist me in order to effectively implement my project and answer all of my questions. My support team includes Carmelita, a friend I taught with in Houston that completed the same art trainings as me. Alex, art teacher, observed me throughout the process to ensure I used an art perspective during my lessons. Also, Adrienne, the librarian, provided me with additional research ideas. Aelred, a copy editor for a Shanghai expat magazine assisted with the final edits. Jewel Reuter, PhD was my capstone advisor and provided guidance and feedback over the last few years. Suzanna Soileau, ME, was my science reader.

CONCEPTUAL FRAMEWORK

Integration in the elementary core subjects, which include math, science, language arts, and social studies have been used for years; however, recently educators experimented with science, art, observation and creative thinking skills during lessons. These efforts were made to enhance instruction and to motivate students to observe objects or organisms with greater detail. Educators are currently interested in ways to improve students' observation skills (Riley, 2011). Students attempted to draw realistic images in their science journals after their observations. Instead of lecture - based instruction, educators are attempting to discover ways to teach higher level thinking skills, increase students' observation skills, and demonstrate how scientists use art techniques in their daily lives. According to Riley (2011), art integration teaches content area through the use of the arts. Students use both sides of their brain at the same time, which allows material to be learned in a variety of ways.

Integrating art helps students to better understand science concepts. Educators often believe a student may not know an answer and overlook limited student exposure.

A teacher in Brooklyn, New York assumed students did not comprehend a life science vocabulary word because they were unfamiliar with the term. However, the students did not have prior knowledge of a plant and the educator took initiative to set up a field trip at a local park to explore plants through the use of senses (Mazor, 2011). After students observed and drew plants, they were able to discuss basic botany concepts. Botany is not the only science concept to use art integration within a lesson to improve observation skills and content. According to Baggett and Shaw (2008), research suggests that art integration increases elementary students' academic performance as well as student engagement during lessons. One teacher used an ancient Japanese fish-printing project with elementary students by teaching fish anatomy and art elements. After the lesson, students were able to accurately discuss both concepts. Not every educator has time for painting activities, but sketching is another way to use art within the science classroom. One elementary student sketched a wasp's body with precise details by observing its elongated body and inward bent legs. A wasp specimen allowed him to use his observation skills to observe and sketch the small details (Robson, Hickey, & Flanagan, 2005). Educators that do not have access to specimens or field trips due to lack of funding can use images to help improve students' understanding of science concepts. A person is constantly surrounded by images in their daily lives and people ignore them or no longer see the relevance (Vasquez, Comer, & Troutman, 2010). Teaching students ways to interpret visual images is a different way to provide student meaning to a word, which helps students comprehend and synthesize information (Vasquez et al., 2010). If students are able to comprehend a word meaning, they are more successful at understanding the science concept.

Art integration improves teachers' attitudes and motivation. According to Benedis-Grab (2010), "For a science teacher in a city, it can sometimes be a challenge to find curricula that are geared specifically toward urban students" (p.22). According to Cavicchi, Chiu, and Hughes-McDonnell (2009), educators should step back and become an explorer and learner with their students as well as draw, label, and write in a journal to document learning. The teacher moves from lecture based learning to guiding students in areas of interest. Teachers that incorporate more creativity and inspiration into their lessons observe an increase in student engagement as well as their own (Riley, 2011). Integration amongst subjects increases positive educator attitudes, job satisfaction, and collaboration within the school's environment (Jacobs, 1989). Jenny Montgomery, an art teacher at the Dayton Regional STEM School, frequently team-teaches with a science teacher and believes this opportunity allows her to make connections between subjects (Robelen, 2011). According to Fisher and McDonald (2004), a music teacher listened to a colleague's boredom with a lesson and offered to discuss ways art could be used in weather lessons. They collaborated together on ways to create a school wide theme and a performance at the end of the unit. They were aware of time limits and each person researched their own ways to integrate the theme into their lessons to ensure lessons flowed together. At the end of the collaboration project, more educators were interested in their project and ways they could use a similar approach within their classroom.

An educator's previous experiences' influences the way curriculum is planned, taught, and interrupted (Bryan & Tippins, 2005). Educators often want to improve instruction and increase their own motivation or attitude during a lesson, but are lacking content knowledge. The National Science Foundation provided research grants and

workshops to bring awareness that art should be included in STEM lessons (Robelen, 2011). Various workshops are annually held in educators' communities to introduce new ideas or different approaches to teaching content. Educators that attend these workshops learn new ideas that increase their motivation and attitude.

The use of art improves students' science concept awareness. According to Kim (2011), second- grade students in a large urban city with tall buildings believed environment meant the countryside. Students that live in urban communities may not have access to a park or garden due to various factors including low income or lack of transportation. Educators may not be aware students lack certain experiences. Student drawings allow educators to assess prior knowledge and experiences before future science concepts are taught. A student-drawn picture provides insight as to the way a student observes their environment or world. Educators can use this insight to guide instruction as well as teach student misconceptions. Once students are aware of their environment, they begin to use higher-order thinking skills to discuss ways their environment might change in the future. Scientists and artists perceive their past and future experiences and raise awareness of their environment by encouraging the general public to recognize organisms and objects people learned to ignore or were never taught to observe (Oppenheimer, 1972). One way to improve students' observation skills is through the use of Gyotaku lessons. These lessons naturally allow students to observe fish anatomy and art elements or processes in an effective way (Bagget & Shaw, 2008). Perception influences the way people perceive their environment and should be taught with observation skills at a young age throughout a student's education.

Early childhood students may not recall observations during an outside investigation and drawings might appear to resemble random lines; however, photographs from their observations help students recall a previous lesson. Young students walk the school's property to take pictures of science related objects and discover science is everywhere (Bradbury, Gross, Goodman, & Straits, 2010). If possible, students should be taught ways to identify science within their community. Students in urban settings can explore different natural and man-made homes and buildings prior to a walk in the community they live to observe, sketch, and discuss the various structures to assist with creating their own buildings in the classroom. Students applied the science content learned during the walk to the structures made in their classroom. They had to consider the use of shape and size when designing their buildings. Structures are not the only science concepts that are found within a city.

According to Sommer (2008), many people visit Aula Verde, Puerto Rico every year to observe the students awareness and success the community has had in urban ecology education. A few years ago, an unsafe abandoned area behind a school was transformed into an outdoor learning space. Students have the opportunity to observe plants and insects and to apply their observations through the use of arts and crafts. This program allowed students to become more aware of their environment and demonstrate their understanding through the arts. Through the use of observation, students can provide detailed pictures and labels in their science journal.

Dirnberger discovered success including drawings in science journals throughout the school year by increasing elementary students' awareness of the scientific world around them during observations and explorations (2006). Nyberg and McCloskey

(2008) realized the importance of scientific drawing and students should be taught ways to draw their observations by using the following art concepts: lines, shape, color, texture, size, and to focus on one part at a time to draw a realistic image of an animal. According to Chessin and Zabder, a unique science and art integration program included problem solving and decision-making skills during plant science lessons with an emphasis on drawing a leaf's correct shape, lines, space, and color (2006).

Science and art improves student awareness with older students as well. Petzoldt (2008) taught middle school students a science and art integration unit, which spanned over several weeks at various locations within the students' community to discover science is everywhere including art museums. The students' final project included a piece of artwork and a short explanation of the art and science concepts used in their project. The art was displayed in an art gallery where students discussed the science discovered in each art piece as well as the art techniques the artist used to create their piece during instructional time and a community evening viewing of the various pieces students created during the life science unit. Students were able to apply the concept into a new situation instead of taking a test with multiple-choice answers. Students brought science and art awareness to their community.

Review of the literature indicates art and science integration increases student motivation while students spend more time exploring the world around them. One way art can be used within a science lesson is through the use of science journals. Student journals become a valuable tool for students to replicate realistic observations through the use of their senses. The most significant change occurs when the curriculum shifts from teacher-led to student-led where students learn to be more effective communicators.

According to Dirnberger (2006), “You can lead a student to nature, but you can’t (necessarily) make the students observe” (p.47). Students’ motivation and pride increased during a plant art integration study through the introduction of drawing techniques, labeling drawings during observations of native plants, and bulbs were planted in student created pots (Stellflue, Allen, & Gerber, 2005). Participation in a student-led project motivated students to use a school garden to observe plant species, research plants growing in the garden, sketch, and paint the plant drawings to create a field guide, which was used during a school celebration where students led public tours (Franks & Vore, 2010). One community arranged nature walks for elementary-secondary students. The students became excited about this space and took their parents to the nature trails to share their experience, observation skills, and science skills (Weise, 2012). A fifth-grade class became interested in feathers they found on the ground and they became more enthusiastic as they found more. The educator wanted to build the students’ enthusiasm and curiosity and bought sterilized bird feathers. The art teacher coplanned with him to help integrate art concepts with direct observations in nature. At the end of the week, students were able to explain the importance of a bird’s shape, color, and patterns (Froshchaur, 2008). According to Wenham (1998), recording observations of what we know instead of what we see and develop improves our understanding and relevance to our present concerns and allows us to observe and record with more detail and accuracy.

Oppenheimer (1972) stated students often feel dissatisfied during a class until a new skill is introduced as a way to help comprehend an idea. Arts integration programs increase student attendance, student behavior, student motivation, and student

achievement (Riley, 2011). Art promotes higher-order thinking skills within a classroom. Science enthusiastic students develop an appreciation for art and art enthusiastic students fill engaged during science lessons (Wenham, 1998).

In 2002, the Jet Propulsion Lab (JPL) launched a new program, which integrated science, art, math, and technology. *Imagine Mars* allows students to research and explore the scientists, artists, engineers, and other community workers within their city when designing a 100 person futuristic community on Mars. Students have to consider water, soil, and air when they create their community, which is made from recyclable materials. Students use art techniques to create an attractive design instead of mismatched reusable products. As students construct the product, they must consider shape and structure techniques in order to have a working product. Students will not have a successful structure if they do not have the science content needed to complete the assignment. Sometimes students must make revisions to sustain a functional community. In the end, students realize building a community on Mars is not as easy as building a community on Earth. Students are encouraged to share their knowledge through the use of art, music, or drama. The students' attitudes improved since they were able to use their creativity to display their knowledge by using the multiple intelligence they most associate with learning. Students become in charge of their own learning instead of the educator using a test to assess understanding (NASA, 2013).

In summary, various institutions including museums, schools, and university programs are studying ways to implement science and art into their curriculum. Students can comprehend a difficult science concept through the use of art and creative thinking,

retain the information longer, and student and teacher attitudes and motivation are increased.

METHODOLOGY

Project Treatment

Data were collected for comparison during a nontreatment unit and treatment unit to determine the outcomes in the classroom environment based on the changes I implemented. The data included the use of various art projects to show student growth and creativity. The use of interviews and tests are important; however, students are unable to demonstrate their creativity.

A nontreatment unit was conducted prior to the treatment units to compare students' awareness and attitudes. During the nontreatment unit, students studied plant parts and a plant's life cycle without discussing art concepts. Treatment 1 introduced colors, shape, line, and texture during a garden study. Students completed the garden study prior to the light, shadow, and color art integration study. The art focus concentrated on size, lines, and shadows while the science content focused on different plant shadows cast throughout the school day and different objects that are opaque, translucent, and transparent. Lastly, a critical thinking and design project summed up art and science concepts learned during the month through students constructing a light shadow box by using a box with different designs cut out. A flashlight was placed inside the box along with color paddles. A test was given before and after each unit.

Before the nontreatment unit was implemented, data were collected to compare the outcomes based on the changes implemented. The nontreatment unit, plant parts and plant life cycle, focused on identifying parts of a plant based on a classroom model. The

function of each part was taught through traditional teaching methods including lecture and note taking skills. Students labeled the parts of a plant. Neither art nor garden exposures were taught during this unit. Picture and books were used during this unit. The pictures were used to sequence events during the life cycle while the books provided while the books provided information about each stage. A “How to Plant a Seed” paper was written after the lesson. Students’ writing topics also included written observations on the plant’s growth in their interactive science journal. Research materials such as books, PowerPoints, and websites were available to students as additional sources. The nontreatment unit eliminated art activities during all lessons. Data were collected and compared after the unit ended.

Students began the first treatment unit, botany and art integration after the Chinese New Year break. The treatment units integrated art and critical thinking skills into science lessons. The painting “*A Sunday Afternoon on the Island of La Grande Jatte*” by George Seurat was introduced to students to discuss color, shape, and line. An introduction to pointillism, which is a painting technique entailing tiny colored dots which creates an image, was discussed. After the discussion, students observed a plant outside during different times of the day and used pointillism to paint their observations. Students created their painting by placing yellow, green, and brown dots onto paper to create a plant image. I spoke with each student about their observations, focusing on colors, shape, and line. The answers were not provided to students; however, inquiry questions were asked, pointing out the unique features of the plant they chose to paint. After the paint dried, students labeled their picture and taped it into their science journal. The next lesson began with a short mini-lesson to discuss basic shapes, followed by an

additional mini-lesson focusing on basic lines. Students practiced drawing the basic shapes and combining the basic shapes in their journal with different lines to create pictures. “*Almond Branches in Bloom*” by Vincent Van Gogh was displayed during the lesson in order to point out shape and line. After the mini-lessons, students’ observed different shapes and lines associated with the plants. Students took their basic lines paper outside to explore the different lines observed on different leaves to match the lines found on leaves. The veins on a leaf, shape, size, color, texture, and holes on the plant were pointed out to students. Two leaves from the same plant were used for leaf rubbings to discuss lines associated with each leaf and students discovered each leaf is unique. Students taped their leaf rubbings in their science journal. They identified each leaf’s shape, color, and type of line associated with their leaf rubbing on the same page as the leaf rubbing. Pictures were taken of the plants for students to recall their observations. Students used line and shape during their drawings to create a realistic drawing. Labels and observations were added to each drawing. The last lesson summed up the unit and students applied color, line, and shape in their plant drawing.

The second treatment unit focused on shadows and size with a science focus on opaque, translucent, and transparent. “*The Stroll*” painted by Monet was used to discuss shadow, size, and light. Students began the treatment by drawing a plant and the shadow outside, in the classroom with the lights off and blinds closed, and then in a dark room with no windows. A shadow length lesson was taught throughout the school day. Students observed how a plant’s shadow changes in relation to the Earth’s rotation. Pictures were taken of the plant and the shadows to recall the observations during the lesson. Students used their pictures during the next lesson by gluing them in their science

journal and adding labels along with observations. Students described the shadows observed at different times of the day. After students had a basic understanding of shadows, they experimented with the amount of light that passes through various objects. Pictures of Francois Pompon's animal statues were discussed with students to provide ideas on ways to create a Play-Doh sculpture of the animal they researched. Students were provided with different materials that were opaque, translucent, and transparent to create the best statue shadow cast midday. The materials included wax paper, foil, saran wrap, clear plastic cups, bathroom cups, and black painted cups. I modeled how to construct a panda bear clay statue since I didn't grow up observing a panda bear in the zoo and wanted to learn more about these animals. I modeled the use of color by using black and white clay in the shape of circles and ovals to create the Play-Doh panda bear. A lamp was used to model the statue's shadow. Students drew the material used that created the best shadow in their science journal. Students began to prepare for an art gallery by watching a video of various art museum set-ups including a museum's layout. Students used their clay sculptures to create an art gallery, which was part of the second treatment unit.

During the last treatment unit, students used all of the art concepts learned during the month to design and construct a light box. Students used a light box earlier in the year; however, a quick mini-lesson was needed. Students used a light box by observing and drawing a plant, lamp, and shadow cast in their science journal. At the end of the day, students were asked to bring empty boxes, which would be used to create a light box. Students worked in groups of four to draw a sketch of their light box. Group discussions allowed students to discuss which materials would build the best light box.

Students used the rest of the class to create their light box. The light box should not only work, but is a work of art as well.

The next activity students used various materials including sand, gravel, cotton balls, glitter, and paint to create the art design for their box. The light boxes were placed on a shelf to dry before the next day's lesson. The following day, students set up their light box and each group was provided with a flashlight to test their light box. Students predicted if their light box would work and wrote observations including how their light box worked. Each group discussed ways to improve their light box prior to their presentation. The teacher allowed students to make their own corrections; however, a final presentation rubric was provided to guide students. The students used the data from the trial of which light box cast the best shadows to create a poster with labels explaining the process. The unit ended with students presenting their light box and poster. Each group discussed the science and art concepts, which were used to create the light box.

Data Collection Instruments

The data collected from the assessments, surveys and interviews were used to compare qualitative and quantitative data. These data compared the effects of science and art integration on science concept understanding, environmental awareness, attitudes and motivation.

A timeline of the treatment units can be found in Appendix T. The timeline allowed me to thoroughly observe students during the pre and posttreatment units and collect important data. The research project lasted eight weeks and consisted of one nontreatment unit and three treatment units. Each treatment unit included a life, environmental, or physical science topic, art concepts, and one project. The project

began in January 2012. The nontreatment unit, plant parts and life cycle, lasted for two weeks. The treatment units, botany and art study, light and art integration study, and critical thinking and design, each lasted two weeks. The project was completed by March 9, 2012.

During the action research, two different grade levels were chosen to show which group participated and learned more. A total of 20 students from one fourth grade and one prekindergarten classroom participated in the research to rule out age as a factor with science and art integration. The prekindergarten class consisted of seven girls and five boys. This class had large differences in academic and language levels. On the other hand, the fourth grade class had proficient English speakers and the student academic levels were similar. The fourth grade class was a small class, six boys and two girls, most of the students were in the same class the previous school year. Most of the classes contained between 10-16 students per class with more students in the younger grade levels compared to the older grade levels.

The school's diversity brings a unique perspective to the classroom since teachers are encouraged to promote cultural awareness. The student body consists of 60% Asian and 40% Western. The largest student populations are Korean, Japanese, German, and American. Teachers use cultural exposure as much as possible during their lessons. Ethnicity was considered when selecting six students from each grade level to participate in a student interview process. Each student was interviewed individually pre and postunit with all units in a setting where other students could not hear their classmate's responses. If other students were not able to hear their responses, hopefully, the four non-native English speakers felt more secure to provide accurate answers. The students

selected lacked a diverse socio economic status since 19 students were from high income families.

The school is located in one of the largest green spaces in Shanghai. Ponds, open spaces, trees, wooded areas, green house, an organic garden, and animals in the zoo provide inquiry lessons for the science curriculum. The school participates in an environmental organization called Roots and Shoots and holds an Earth Day Celebration every year. Science is emphasized at the school and is an important part of the school curriculum. However, I feel students only know random science facts and do not apply their skills to new situations.

In order to ensure all data were collected for each research question, a triangulation matrix, which is shown in Table 1, summarizes the three sources of data, which were collected during the nontreatment and treatment units for comparison. The triangulation of data helped organize a variety of instruments required for each unit. A variety of data allowed me to narrow in on the background of the big picture instead of just the main focal point. Data were collected from students, teacher, and a colleague's perspective and provided qualitative and quantitative data to answer the focus questions and subquestions.

Table 1
Data Triangulation Matrix

Project Question	Data Source 1	Data Source 2	Data Source 3
<i>Primary Question:</i>			
Understanding of life, environmental, and physical science concepts through science and art integration	Pre and posttreatment survey	Pre and postunit student assessments	Pre and postunit concept Interview
<i>Secondary Questions:</i>			
Teaching attitude and motivation	Teacher journal	Peer observer	Pre and post teacher Survey
Students' awareness of science concepts in an urban area	Student art projects	Interview	Pre and posttreatment Survey
Student motivation and attitudes	Pre and posttreatment survey	Pre and posttreatment interview	Teacher observations

Prior to the treatment units, the students completed a preunit survey, assessment, and a concept interview. The interview questions allowed me to have a starting point associated with student awareness of science in urban settings and their attitudes towards

science lessons. The preunit assessments are shown in Appendix A, B, and D. Along with the preunit assessment, students completed a Color Symbol Image activity, located in Appendix C. The CSI activity, concept interviews, and assessments contributed to answering the primary focus question. The assessment for each unit is shown in Appendix E, F, and G. The comparison of the pre and postunit assessments answered the primary question.

My attitude and motivation were assessed through the use of a teacher reflection journal, colleague observation, and a teacher survey. I wrote in a daily journal using the prompts shown in Appendix H. The journal entries were compared during the units to determine the effects from the treatment. A colleague was invited to observe my attitude and motivation during the project. An example of the prompt the colleague used can be found in Appendix I. These observations provide helpful insight to evaluate my attitude and motivation. I also completed a survey, located in Appendix J, before and after each unit. All of the data were used to compare the effects the treatment units had on my attitude and motivation.

Data were collected to compare students' science concept awareness within their community. Students completed various projects to demonstrate their understanding and creativity. Students wrote a "how to" paper during the nontreatment unit, the rubric can be found in Appendix K. The criteria of the paper focused on completion, understanding of concept, organization, and grammar. Each treatment unit used an art and science project at the end of the treatment unit. The projects were scored by rubrics, located in Appendix L, M, and N.

Interviews were also used to determine the effects art made on science concept awareness. Prompts for these observations are shown in Appendix O. Students were selected based on their school enrolment date. Three students attended the school for one year and three students attended the school for four months. Students that attended the school last school year participated in a weekly science specials class and were taught life and physical science. This special was no longer available to students. A survey was used before and after each unit to make students aware of their own environmental awareness. The survey is located in appendix P.

Various data were collected on students' attitudes and motivation. The pre and post treatment survey is located in Appendix Q. Every student completed a survey during the pre and post treatment units in order to determine student attitudes and motivation. The students were allowed to sit anywhere outside or inside the classroom during the survey because students would feel comfortable sitting where they would like and felt relaxed since other students could not see their responses. The surveys allowed me to determine student thoughts and feelings associated with science lessons. Interviews allowed students to elaborate their answers and provided more insight. Six students participated in the interviews. Students were selected based on the length of time they lived in Shanghai. Two students were new arrivals, two lived in Shanghai for one year, and two lived in Shanghai for two years. The students at RBIS have different language levels and come from various parts of the world. Education is taught differently in each of their countries. The amount of time they lived in Shanghai was the most consistent factor. Students were individually interviewed in the science room while the other students remained in their homeroom class. The questions asked for this interview can be found

in Appendix R. Teacher observations of students' attitudes and motivation were conducted throughout the units. Prompts for these observations are shown in Appendix S.

DATA AND ANALYSIS

Data were collected in one nontreatment unit and three nontreatment units to compare the effects art plays in a science classroom. Data collected from the pre and post unit assessments were used to calculate the percent change from the nontreatment and treatment units and allowed comparisons based on the percent change. An average score and percent change from each unit can be found in Table 2. The data indicated students showed higher scores during treatment units than the nontreatment unit.

Table 2
Average Scores of Unit Pretest and Posttest, (N=20).

Unit Data	Nontreatment Unit	Treatment Unit 1	Treatment Unit 2	Treatment Unit 3
Preassessment	30	40	40	50
Postassessment	50	80	70	80
Percent Change (%)	67	100	75	60
Normalized Gain	0.29	0.67	0.58	0.60

Note. All assessments out of 100 points.

After analyzing the data between all three units, the three treatment units showed a larger increase in percent change than the nontreatment unit. The first treatment unit showed the most increase. It appeared to me that the increase was due to the student familiarity and comfort level of plant parts. The higher percent changes in the treatment

units shows the art connection had a positive effect on student assessments. The three treatment units preassessment scores were higher than the nontreatment unit preassessment score. These data suggest that students observing more of their surroundings and making natural connections helps them to understand concepts. The three treatment units showed a higher gain and supported the project.

Pre and Post unit concept interviews were used to collect data to determine the effects of science and art integration. The concept interviews allowed students to explain their reasoning instead of worrying about spelling and grammar errors while writing their answers on paper. ESOL, English for Speakers of Other Languages, students worry about written mistakes and their ideas are often difficult to write on paper. The students are able to verbalize their thoughts much easier as well as demonstrate more confidence. The results from the concept interviews are found in Table 3.

Table 3
Average Scores of Unit of Concept Interviews, (N=6).

Unit Data	Nontreatment Unit	Treatment Unit 1	Treatment Unit 2	Treatment Unit 3
Preassessment	3	5	4	6
Postassessment	5	9	8	8
Percent Change (%)	67	40	100	33
Normalized Gain	0.29	0.4	0.67	0.5

Note. All interviews out of 10 points.

The data indicates a higher gain after the second treatment unit. Students showed smaller increases during treatments 1 and 3. The average pre assessment scores were

higher than the nontreatment score. Treatment 1 expanded on botany topics from the nontreatment unit. Students begin learning about plant parts at Rainbow Bridge International School when they are three years old; therefore, the majority of the questions were easy for them to answer. The second treatment unit focused on shadows and light sources, which students typically do not have a lot of exposure with these topics. The third treatment unit combined all of the concepts learned during the two previous treatment units; therefore, students were familiar with the content in the preassessment.

Pre and post surveys were used to help students recognize their own familiarity with their own science and observation awareness. A Likert scale question format was used after the nontreatment unit and the three treatment units. The results are shown in Figure 1.

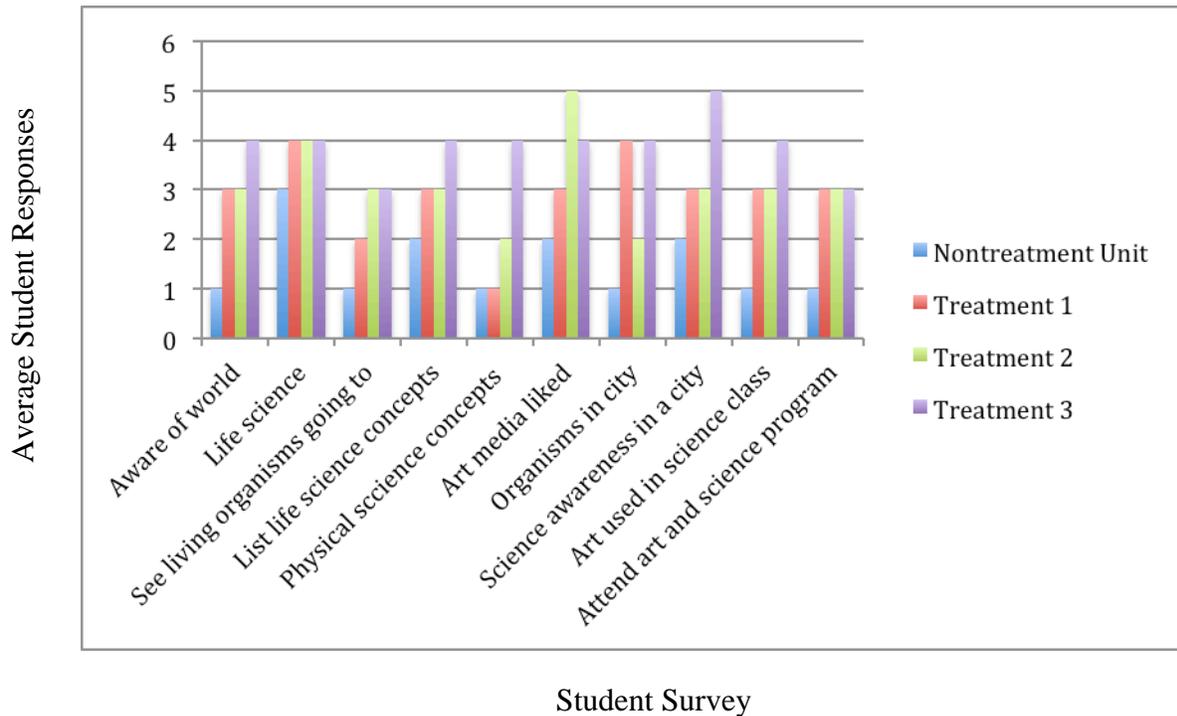


Figure 1. Average student response for survey questions based on student science awareness, ($N = 20$). *Note.* 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree.

The data show that students became more aware of their environment and of science concepts after each unit. They became more interested in the science and art integration after they were exposed to the lessons. Many students take the bus to school or their parents bring them in a car, which made it challenging for them to observe several organisms in transit to school. The students were busy talking to their friends and did not pay attention to the environment. The students that walked to school became more aware of organisms they passed after each unit. Overall, the survey showed a positive impact on students' awareness of their environment and science concepts.

Science and art integration showed a positive impact on my teaching attitude and motivation. A peer observer, journal entries, and a pre and post treatment survey were

used to assess my attitude. One data source was a journal used to determine the effects of science and art integration on my attitude and motivation and used to record my reflections after lessons by using the prompt located in Appendix H. I began my journal writing during the nontreatment unit and continued writing entries during each of the treatment units. My attitude and motivation mirrored the student's attitudes and motivation.

During the nontreatment unit, I was not motivated to teach the same lessons I teach every year. My lack of enthusiasm was shown in a reflection stating, "Today, I was bored as I walked around monitoring students label parts of a plant on a worksheet. I think the students were aware of my lack of enthusiasm since they labeled the parts in complete silence." There were several journal entries that discussed my lack of motivation and students were not engaged during the lessons.. It became obvious that these lessons were not enhancing students' education.

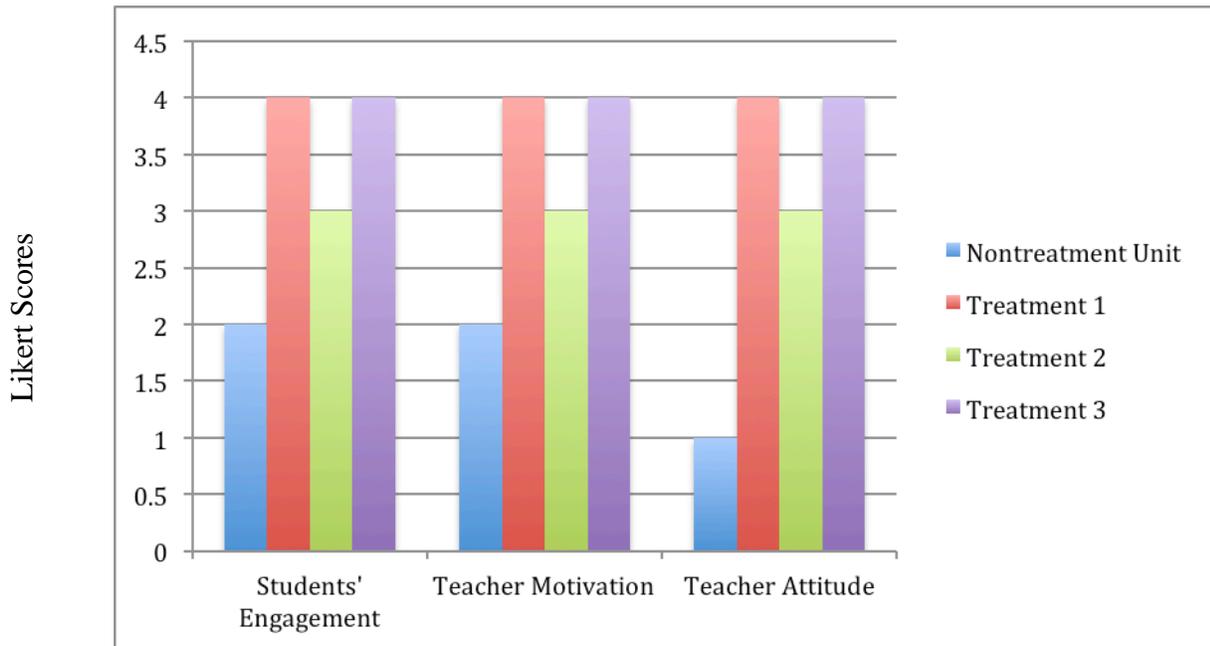
During the first treatment unit, my motivation and attitude showed a positive increase. My positive attitude was shown in an entry stating, "Students are discussing a leaf's shape, size, and lines observed. All students are actively engaged and asking each other questions. Students wanted to take leaves back to the classroom to observe at a workstation with magnify glasses and microscopes. I can't wait to set up this space for students to explore. The students' enthusiasm had a positive effect on my attitude." The art integration showed a positive impact on everyone in the classroom, including me.

During the second treatment unit, my motivation and attitude slightly decreased. One entry stated, "The students are not discussing observations as much and do not appear to be confident. This could be from a lack of student understanding, or students

can tell there are moments I am not as enthusiastic as the first treatment unit. I am familiar with the concepts; however, do not have as much background with the art concepts. I hope the students and I become more enthusiastic throughout the remainder of the unit.” This showed there were areas that needed to be changed to improve attitudes.

During the third treatment unit, my motivation and positive attitude increased. My motivation and positive attitude was shown in an entry stating, “The students are using the art and science skills learned during the previous treatment units to create creative projects. All students are excited to view each other’s projects and listen to the presentations. I provided positive feedback at the start and end of each class to encourage all students during their project. My enthusiasm was evident to the students and encouraged them to apply the skills learned over the past few weeks. The journal allowed me to reflect after each lesson and motivated me to work harder and model a positive attitude, which made a positive impact on students.

Another source used to assess my attitude and motivation was to have a coworker conduct an observation during the nontreatment unit and all three of the treatment units. The prompts are listed in Appendix I. The results from the coworker’s rating focusing on student engagement, my motivation, and attitude are located in Figure 2.



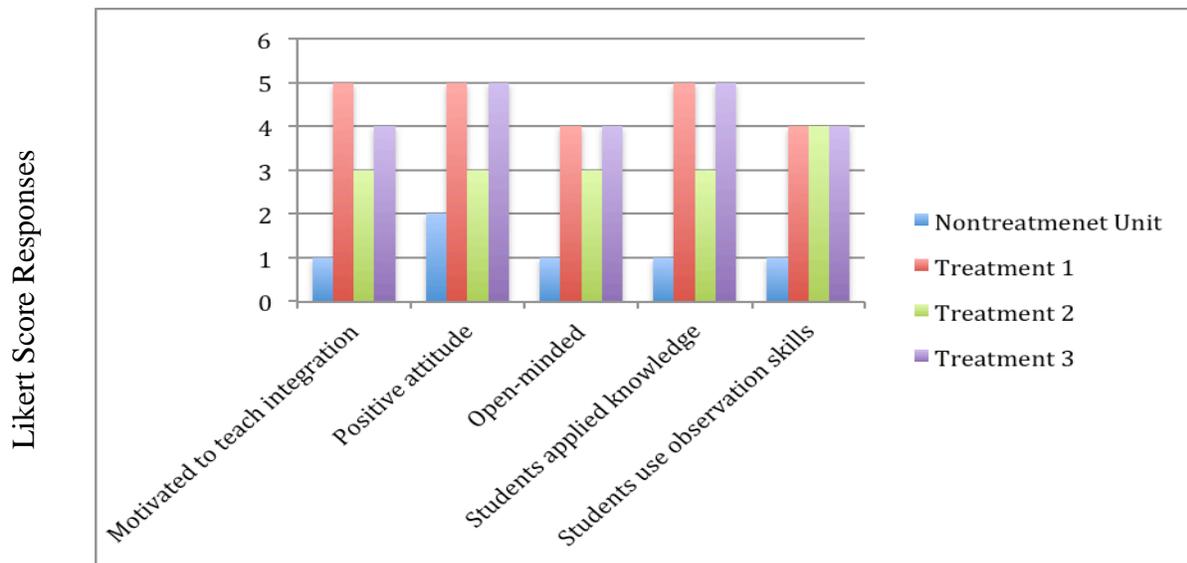
Rating Categories

Figure 2. Coworker's Rating During Student Engagement, Teacher's Motivation, and Teacher's Attitude. *Note.* 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree.

The data indicates the treatment units affected my engagement and attitude.

However, the data showed a positive increase on my attitude during the first treatment and a slight decrease in motivation during the second treatment followed by an increase during the third treatment unit. During the second treatment unit, the coworker wrote, "The teacher does not appear to be as enthusiastic teaching light sources as she was during the plant unit. It is obvious she feels more comfortable teaching life science concepts. The students were engaged; however, are not as motivated as they were in the previous unit." My positive attitude created a more positive classroom environment where students were encouraged to participate, even though there were times motivation was low.

I completed a survey, which is located in Appendix J. The surveys were used to help me reflect on my attitude and motivation during the study. Five surveys were completed for the nontreatment unit and six were completed during the treatment units. The averages for each unit were found and the results are displayed in Figure 3.



Teacher Survey Responses

Figure 3. Average teacher's rating for teacher survey. *Note.* 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree.

The data showed that my teaching motivation and attitude increased from the nontreatment unit to the treatment unit. This could be because the students and I were eager to learn about science concepts in a new way. However, my motivation and attitude decreased after the second treatment unit. This could be a reflection of my lack of confidence with the concepts. There was an increase in motivation and attitude during the third treatment. Even though there was a decrease during the second treatment unit, the overall affect was higher than the nontreatment unit.

Student awareness of science identified in an urban area showed an increase after each treatment unit. Art projects, an interview, and a survey were used throughout the study.

Various art projects were use throughout the study with the exception of the nontreatment unit. During the first treatment unit, students painted a plant picture and labeled the parts of the plant. Students were enthusiastic while painting a plant in an outdoor setting. One student stated, “She is painting the same plant as me, but hers looks much different from mine.” This student used his observation skills to discover differences amongst student perceptions of the same organism.

A different art media was introduced during the second treatment, which provided confidence for students who were not able to draw as well as their classmates. Students used Play-Doh to create a statue that was used to cast shadows. A prekindergarten student was excited to tell his classmate that his statue was magical because the shadow was able to move locations. This comment made me realize a mini-lesson on shadows would be required within the next few days.

During the third treatment unit, students used all of the science and art concepts to create a light box. The older students used science vocabulary during their group discussions while the younger students used basic words to explain the reason certain materials should be used for their box. The younger students had the basic idea, but were unable to recall the science vocabulary.

Overall, the art projects allowed students to become more are of their community and improved their observation skills. The older students were able to recall the science

vocabulary during their discussions and give examples of ways shadows, light materials, and plants are observed within their community.

Pre and post unit surveys allowed students to reflect on their awareness of the science concepts found within their community. A Likert scale question format was used to display student answers. The results are shown in Figure 4.

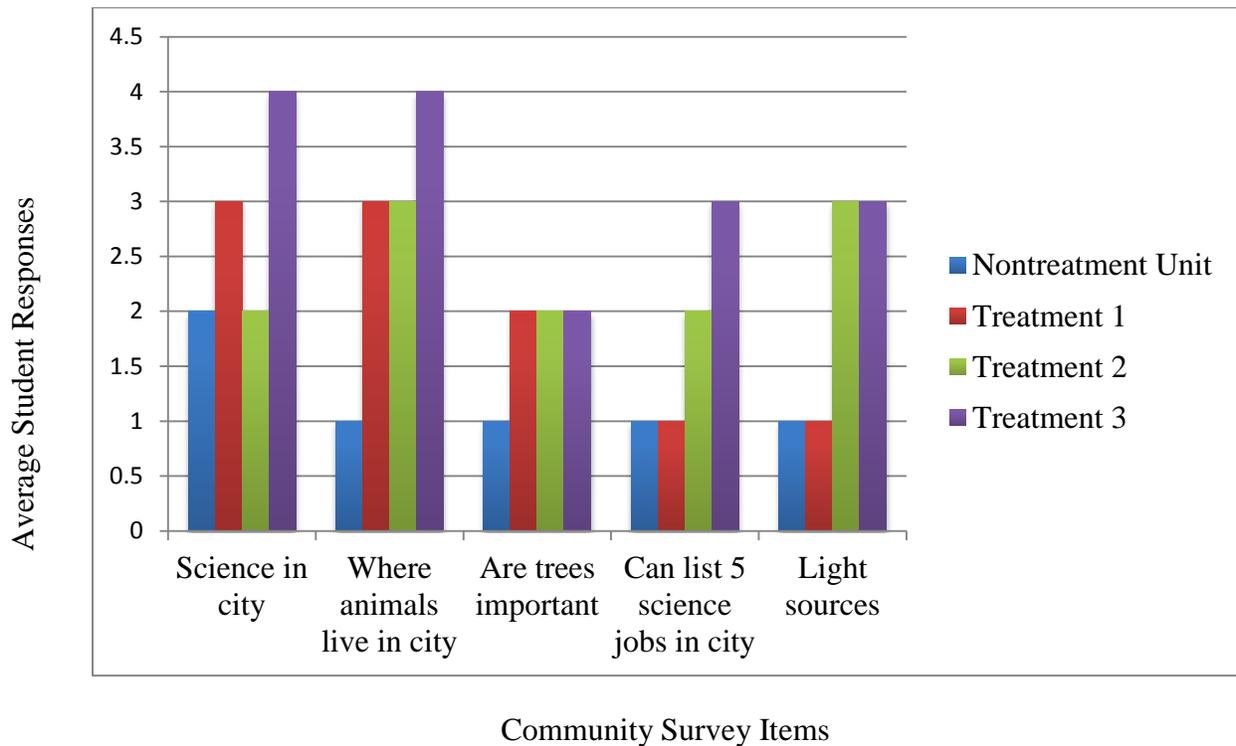


Figure 4. Average rating for science awareness in community survey. *Note.* 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree.

The results indicated there were areas that students need more time to fully develop such as science jobs and the importance of trees. The other questions showed students felt knowledgeable concerning certain aspects of science within their urban environment. Interviews were used to collect data to determine student awareness within their community. Students became more aware of the science within their community

after the treatment units. The results from the concept interviews are found in Table 4.

Table 4
Average Scores of Unit of Awareness in Community Interviews, (N=6).

Unit Data	Nontreatment Unit	Treatment Unit 1	Treatment Unit 2	Treatment Unit 3
Preassessment	1	3	4	5
Postassessment	2	6	5	8
Percent Change (%)	100	100	25	60
Normalized Gain	0.11	0.43	0.17	0.60

Note. All interviews out of 10 points.

Students elaborated their answers after each treatment unit. The nontreatment unit showed a large increase; however, majority of the students were unable to answer most of the questions during the interview. Several students didn't attempt to answer questions they didn't know the answer to while other's response was "I don't know".

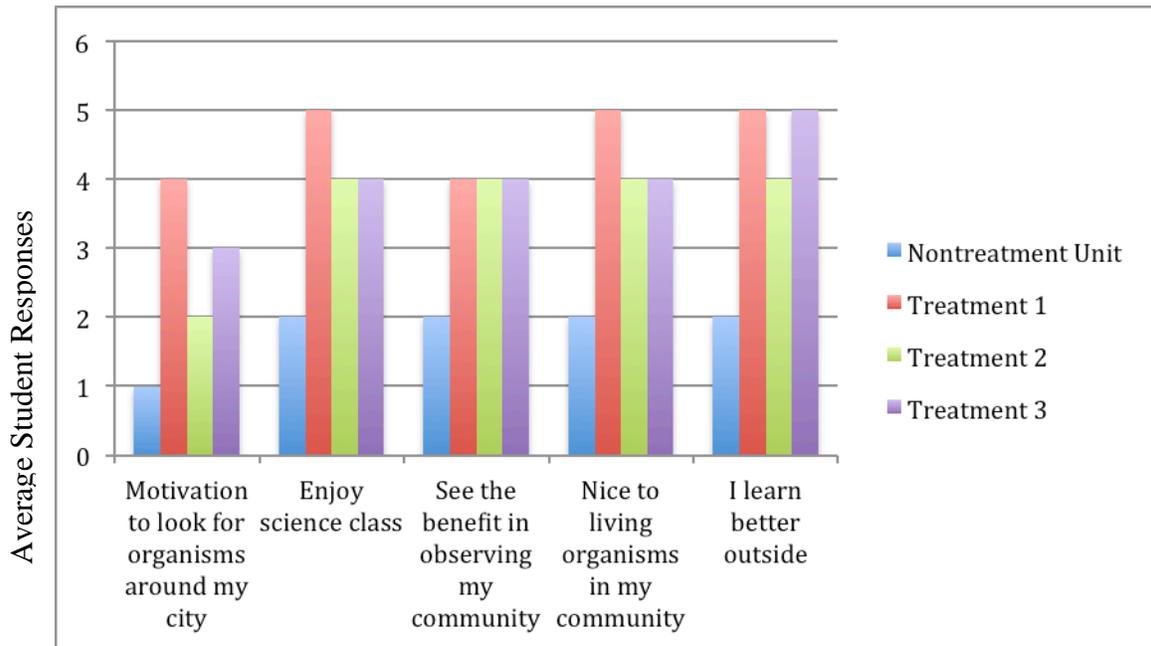
The percent change remained the same after the first treatment unit; however, students were able to answer more interview questions than were answered after the nontreatment unit. Students attempted to answer unknown questions with basic answers.

During the second treatment unit, there was an increase in the pre interview and students were able to provide more details in their answers. However, the post survey was not as successful as the first treatment unit. Most students were able to answer about half of the interview questions without a wait time.

The percent change increased from the second treatment unit to the third treatment unit, but the percent change was not the highest during the study. The data show students were able to answer half of the questions during the preinterview, which means students would have to answer every question correctly to show the same percentage gain as the nontreatment unit and treatment one. The students were able to answer the most questions after treatment three, as well as provide the most elaborate responses.

The data from the interview shows students were able to answer more questions about the science identified in their community after each treatment unit. Students were accountable for their own motivation and attitudes during the units. Majority of the students were confident with the survey, but lacked confidence during the interviews. The teacher observations were able to pinpoint the areas during the treatment units that made students uncomfortable.

A survey was used to ask Likert scale questions focusing on their own attitude and motivation during the nontreatment and treatment units. The results of the surveys are shown in Figure 5.



Selected Survey Questions

Figure 5. Average student responses for selected survey questions based on attitudes and motivation, ($N = 20$). *Note.* 5 = Strongly Agree, 4 = Agree, 3 = Undecided, 2 = Disagree, 1 = Strongly Disagree.

The data show students increased in every question during the first treatment unit because they were confident with the skills and were excited to try new lessons. Students decreased in almost every question during the second treatment unit. The students were unfamiliar with some of the concepts during this unit. They were motivated as well as improved their attitudes during the third unit. Overall, the students felt motivated, confident, and had a positive outlook during the treatment units.

Pre and post unit interviews allowed students to verbalize their answers and explanations. The results from the student interviews are found in Table 5.

Table 5
Average Scores of Student Motivation and Attitudes, (N=6).

Unit Data	Nontreatment Unit	Treatment Unit 1	Treatment Unit 2	Treatment Unit 3
Preassessment	2	5	4	4
Postassessment	4	8	6	7
Percent Change (%)	100	60	50	75
Normalized Gain	0.25	0.6	0.33	0.5

Note. All interviews out of 10 points.

The data percent change decreased from the nontreatment unit. Students scored higher on the treatment pre assessment units, which didn't yield for as much of a percent change. The majority of the students were confused with the skills during the second treatment unit, which were used for the third treatment unit. The student responses after the second treatment allowed me to review and explain the art and science skills during the third treatment unit.

During the three units, I observed students' attitudes and motivation on science and art integration. The prompts for the student observation can be found in Appendix G. A rating was provided for student engagement, motivation and attitude to help interpret the data. An average from the nontreatment and treatment units are displayed in Figure 6. Five days were observed during the nontreatment unit and six days for the treatment units.

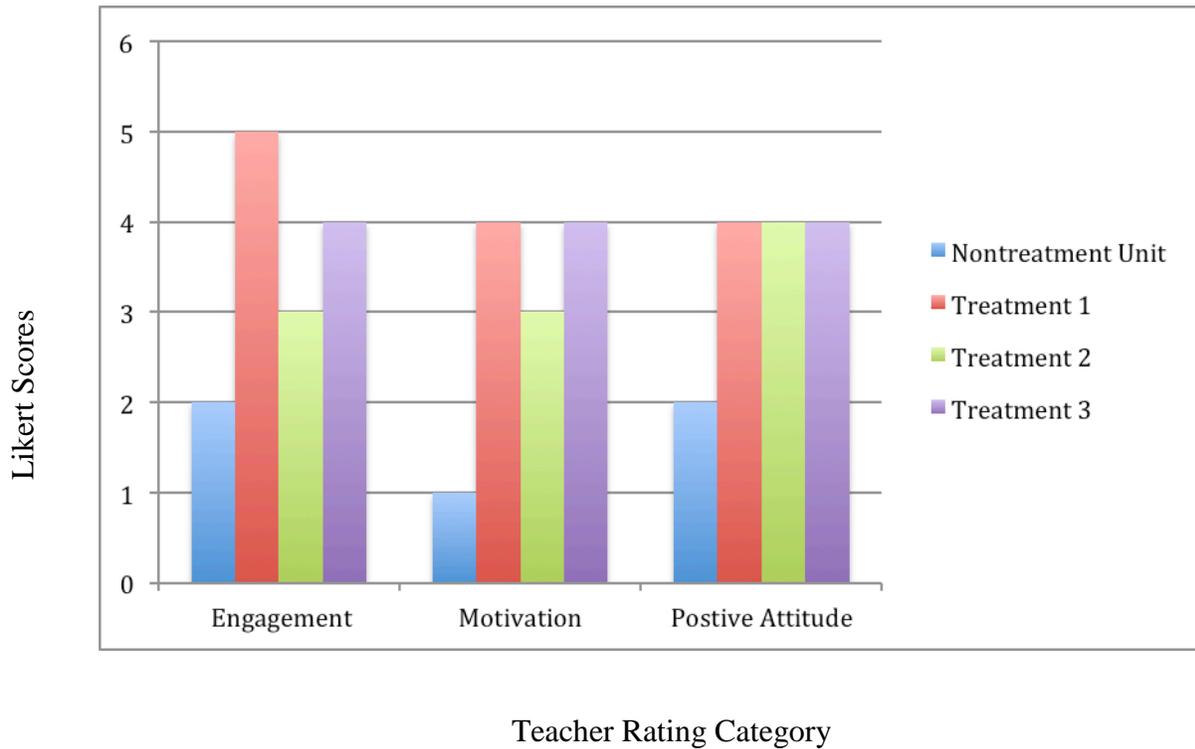


Figure 6. Average teacher rating during each unit focusing on students' engagement of motivation and a positive attitude. *Note.* 5 = Excellent, 4 = High, 3 = Undecided, 2 = Low, 1 = Very low.

The data showed that the level of student engagement increased during the first treatment unit and slightly decreased during the second treatment unit. The data also showed a dramatic increase in motivation from the nontreatment unit to the treatment unit. The motivation slightly dropped during the second treatment unit. The students' attitudes showed a significant increase from the nontreatment unit to the first treatment unit. However, the student attitudes remained the same during the treatment units.

During the first treatment unit, I wrote an observation comment stating, "Students are not motivated to write a paper and are off task. They were able to label the parts of a plant within a few minutes and wanted to color the picture." I wrote an observation note during the first treatment unit stating, "Students are running around the garden to observe

as many plants as possible. They are discussing their observations with peers and are adding details to their drawings including labels.” The data indicate that art had a positive effect on student engagement, motivation and attitude. The data also suggest that once the students were comfortable with the art integration their attitudes remained high. The students’ motivation appeared to be affected by motivation.

INTERPRETATION AND CONCLUSION

The purpose of this project was to determine the effects of science and art integration on students’ understanding of science concepts. The surveys, tests, and concept interviews showed an increase of student understanding in all treatment units compared to the nontreatment unit. The use of art impacted the ways students learned the information and decreased misconceptions. The survey data confirms students were more aware of science concepts and their environment by the end of the second treatment unit. There was a slight increase in student awareness during the first treatment unit; however, most students were unable to list different art media and physical science concepts. Students were unaware of various art media because they mostly draw or paint during their art class and they were more confident with life science topics than physical science topics. Students elaborated on their answers during the interview as the project progressed. Also, the wait time to answer a question decreased during the project. With all of the data, I was able to conclude that art had a positive effect on students’ science understanding.

Another purpose of this project was to become aware of my teaching attitude and practices. A teacher journal, peer observer, and surveys were used to collect this data. The data showed that art had a positive effect on my attitude. The journal entries showed

a slight decrease in my enthusiasm during the beginning of the second treatment since I was not as confident about the art aspect; however, the students' enthusiasm encouraged me to work harder. I enjoyed the feedback from my co-worker because he was able to observe tiny attitudes and practices that I never would have realized. For example, he observed I enjoy art as long as I do not have to draw. I was enthusiastic during the painting discussions and making students aware of the science details used in art media. The survey I completed after the second treatment had more strongly agree circles than at the beginning of the project. Art integration had a negative impact on my attitude during the second treatment, but by the end of the project I had a confident and positive attitude.

Another purpose of this project was to investigate students' scientific awareness of their community. Student art projects, interviews, and a survey indicated a positive increase in their awareness. Younger students became more observant during the first treatment unit while the older group of students required more time. Both groups of students were excited about their art project and used art and science vocabulary during the treatment. At the end of the project, all students were able to provide more elaborate answers during the interview as well as answer all of the questions. The survey indicated a slight increase in student awareness after the first treatment unit, but a greater increase after the second treatment. The data indicated students became more aware of their environment and stopped to search for science in their community.

The purpose of this project was to also investigate the affects on student attitudes and motivation. Data was collected through the use of a survey, interview, and teacher observations. The survey showed a slight decrease at the beginning of the second treatment, which coincided with my negative attitude and lack of motivation. Students

were more enthusiastic to communicate during the final interview and provided positive feedback. My observation notes changed throughout the project based on the students' attitudes as well as my own. The quantity of notes increased during the decrease phase during the second treatment. Several observations indicated students were not comfortable discussing the science and art concepts at the same time. However, once the positivity vibe was felt in the classroom, students became motivated to complete the activities as well participate in science and art discussions. Therefore, art and science integration had a positive effect on student attitudes and motivation.

This project indicated science and art integration had a positive effect on student comprehension and motivation; however, the project has areas that could be improved or further researched. The first improvement would be to implement this in every primary grade level. Educators willing to participate could implement the project on a wider scale, which would allow better comparison amongst similar age groups. I would also use unfamiliar science concepts because the data might show more of an increase in student awareness and motivation. Another change would be to have different surveys for early childhood students. I read the question to them and they verbally answered. I realized it would be better for early childhood students to have a survey with pictures they could circle their answers. Instead of writing the answer they dictated, they could draw a picture to show their answer. If the picture is unclear, the teacher could write a note beside the picture. The use of an iPad would be another change I would recommend because students could record any personal observations at any point during the project. The interviews could be recorded as well for students to compare responses from the beginning of the project to the end of the project. Another change would be to discuss

the artist who painted the painting with students. I believe students would be interested in learning about the artist's life history. The last change I would make would be to allow students to dissect a plant. I recently read an article where an educator teaches observation skills by students applying their skills while dissecting a plant. After the dissection, they create a painting of a plant to demonstrate their observations during the dissection. These small changes might provide more accurate data to help understand the effects of science and art integration.

VALUE

Educators need to learn new ways to teach students every few years in order to meet the needs of different learning styles. Often this means, educators must step outside of their comfort zone to learn additional skills. This project allowed me to learn more about art, which is outside my comfort zone. Also, this project allowed me to observe students' attitudes and ability to recall science facts through the use of science and art integration. The results helped my students and I realize science includes more than experiments and scientific reading. This project indicated the arts can be used during a core subject to improve observation and memorization of basic science facts. The results encouraged me to include more art during science lessons to reach the artistic learners. In order to include additional art or music into lessons, I need to attend trainings or co-plan with the art and music teachers.

The results from this project could be used in any core classroom. Art and music could be easily used in any of the core subjects to help reinforce a concept. Educators in any grade level or language setting could use the results to apply to any lesson. Art

integration teaches students additional observation skills, which are important skills students' use throughout the school day.

Educators often are frustrated when students are unable to remember concepts; however, many continue using the same teaching practices. The same project could be adapted for various grade levels or content areas. A social studies teacher could use art integration during map or landform lessons. Photos of famous artwork can be found online and used to teach landforms. Students could use clay to create a map or landforms. A primary math teacher could use art when teaching 2D and 3D shapes. The students could discuss shapes observed in paintings before painting their own picture or building a sculpture. A writing teacher could display a painting bought at a dollar store that students could use to write a description paper. Also, students could paint a picture and write a how to on "How to Paint a Picture" instead of writing the usual "How to Make a Peanut Butter and Jelly Sandwich." There are many lessons educators could use to reinforce students' understanding and concepts. The way a student perceives the world around them effects their comprehension and art allows them to observe details with a different lens.

An educator could continue this project in a variety of ways in order to gain more knowledge on this study. A longer time span would be beneficial to determine the length a student is able to retain concepts. The use of art during physical or chemical science lessons would provide more validity since these concepts are typically more challenging for students to comprehend and process. Educators that teach in schools where art and music programs are being cut due to a decrease in school budgets could implement this project to show the importance of these programs in schools. Even though art integration

teaches observation skills, some students may become discouraged if they lack art skills. Educators may need to include several different art options including an art computer program.

I believe this project benefited my students in two important ways. First, students were able to comprehend a concept and retain it longer. The second benefit was an improvement in students' attitudes during lessons, especially the fourth graders. Students became more aware of the school environment and looked for living organisms on the school grounds. They asked more in depth questions during a lesson or while observing animals or plants. Students that continue to use these skills will become better observers and inquirers.

Science and art integration motivated me to learn more about art, which use to be a stressful topic for me. I realized there is more to art than drawing, which means I can find an art media that doesn't make me nervous. As the project continued, I became more excited to include art in my lessons. I always used a lot of kinesthetic activities since I am a kinesthetic learner and always pushed the art and music to the side since it made me uncomfortable. The results from the project encouraged me to use art and music more often in class. In my opinion, the next step should be to teach students how to add detail to their drawings and draw realistic images by using observation skills and the five senses.

Students realized art is important in their learning process. They wrote a song in class one day and were eager to write additional songs in different subjects with their classroom teacher. The students discussed the requirements needed to write their own song. A few days later, the teacher allowed them to write their own song during a math

lesson. The students seemed excited their teacher listened to a way they wanted to demonstrate their learning to her. I believe the students will ask their teacher to continue to use art and music during other subjects to help them retain the information. The students' excitement made me realize various types of art integration was more important to them than I realized.

Another interesting observation during the project was ethnicity and English language skills didn't make a difference in students' attitudes towards science and art lessons. Korean and Dutch students shared similar enthusiasm during the treatment units. Students from various countries and language abilities were able to retain the science facts better, used their observations to ask higher-level questions, and became more aware of their environment.

This project made me realize I would like to submit an article to *Science and Children* after I present my capstone project. Teachers at my school and my previous school are interested in my results; however, I want more teachers to be aware of the impact art has on students. The most frustrating part of this project was the beginning when I tried to find references. Science and art integration isn't widely used and an article might bring awareness to more educators.

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APPENDICES

APPENDIX A

PRE AND POST UNIT CONCEPT INTERVIEW QUESTIONS

Pre and Post unit Concept Interview Questions

1. Where have you observed science in Shanghai? Explain.
2. Where can a bird find food, water, and shelter while living in the city? Explain.
3. Which animals have you observed living near your house? Explain.
4. Describe the plants you observed near your house.
5. Are all leaves on a tree or plant the same? Explain.
6. Are all trees near the school bare in the winter? Explain.
7. How do artists use the world around them in their work? Explain.
8. Which skills help an engineer with their job? Explain.
9. Why do you like to study science? Explain.
10. How do shadows change throughout the day?
11. Is there anything you wish I would have asked you? Explain.
12. Draw and list the five basic plant parts.
13. Which part of the plant absorbs water and minerals?
14. Which part of the plant produces seeds?
15. Which part of the plant supports the plant and carries water throughout the plant?
16. What is the difference between opaque and translucent?

17. How can you change a transparent object to an opaque object?
18. How does a shadow change throughout the day?
19. Why do people observe shadows?
20. Can shadows be observed at night? Explain.

APPENDIX B

PRE AND POST UNIT SURVEY

Pre and Post unit Survey

Use SA for strongly agree, A for agree, U for undecided, D for disagree, and SD for strongly disagree to complete questions 1, 2, 5, 7 and 10. Circle the response which describes you. Please write complete sentences for the other questions.

1. Are you aware of the world around you? SA A U D SD

Explain.

2. Do you enjoy science class? SA A U D SD

3. What living organisms did you pass on your way to school today?

4. List some life science concepts.

5. Do physical science concepts make you nervous? SA A U D SD

6. What kind of art media are you interested in?

7. Do you search for organisms while walking in the city?

SA A U D SD

8. Why should students be aware of life and environmental science when they live in a large city?

9. How can art be used during science class?

10. Would you attend an after school art and science program?

SA A U D SD

11. When do you observe a shadow?

12. Where do you observe a shadow?
13. I can create my own shadow. SA A U D SD
14. Which plant parts do you eat?
15. Is a tree a plant? SA A U D SD
16. How do botanists identify plants?
17. What is the name of the process plants use to make their own food?
18. Light passes through all objects. SA A U D SD
19. I know the differences between transparent, translucent, and opaque.
SA A U D SD
20. How do people create shadow puppets?

APPENDIX C

CSI ACTIVITY

CSI Activity

Name:

Date:

Color	Shape	Image
What color is science?	What shape is science?	What image is science?

APPENDIX D

NONTREATMENT PRETEST AND POSTTEST

Nontreatment Pretest and Posttest

1. Draw and explain the plant life cycle.
2. Write a definition for the word plant.
3. Why are roots important to a plant?
4. Why are leaves important to a plant?
5. What is photosynthesis?
6. What would happen to a town's crops if they experienced desertification?
7. List ways people use plants.
8. Why do people plant different seeds in different seasons?
9. How much time is needed before a plant sprouts?
10. Why should people use organic gardens?

APPENDIX E

TREATMENT ONE PRETEST AND POSTTEST

Treatment One Pretest and Posttest

1. Draw and explain the plant life cycle.
2. Write a definition for the word plant.
3. Why are roots important to a plant?
4. Why are leaves important to a plant?
5. What is photosynthesis?
6. What would happen to a town's crops if they experienced desertification?
7. List ways people use plants.
8. Why do people plant different seeds in different seasons?
9. How much time is needed before a plant sprouts?
10. Why should people use organic gardens?

APPENDIX F

TREATMENT TWO PRETEST AND POSTTEST

Treatment Two Pretest and Posttest

1. List objects that are transparent.
2. List objects that are opaque.
3. List objects that are translucent.
4. What is a shadow?
5. Describe a time you observed a shadow.
6. Why does a shadow cast different lengths during the day?
7. List objects that produce light.
8. How do artists use light in their paintings?
9. How do artists use shadows in their paintings?
10. Which objects do you need in order to create a shadow in a classroom?

APPENDIX G

TREATMENT THREE PRETEST AND POSTTEST

Treatment Three Pretest and Posttest

1. Why is a plant not transparent?
2. What is a light box?
3. How can you create a plant's shadow in the classroom?
4. How do you use a light box?
5. What is a light source you can use in a light box?
6. How can you increase the plant's shadow length in a light box?
7. How does a plant's shadow differ in a classroom and outside?
8. Would a fake plant cast a different shadow from a real plant?
9. Why are shadows important?
10. How can you change the direction a shadow is cast in a light box?

APPENDIX H

TEACHER JOURNAL WRITING PROMPTS

Teacher Journal Writing Prompts

Date:

Grade level:

Activity:

Reflections on activity: 1 2 3 4 5

Comments:

My motivation level during the activity: 1 2 3 4 5

Comments:

My display of a positive attitude towards the activity: 1 2 3 4 5

Comments:

My attitude towards students: 1 2 3 4 5

Comments:

Additional comments:

I was open minded: 1 2 3 4 5

Comments:

Students applied knowledge and skills: 1 2 3 4 5

Comments:

Students used observation skills: 1 2 3 4 5

Comments:

Additional comments:

APPENDIX I

TEACHER PEER OBSERVER

Teacher Peer Observer

Date:

Name of lesson:

Teacher motivation observed during lesson. 1 2 3 4 5

Comments:

Teacher attitude observed during the lesson. 1 2 3 4 5

Today's lesson used science and art integration. 1 2 3 4 5

Comments:

Today's lesson had positive teacher and student communication: 1 2 3 4 5

Comments:

Today's lesson allowed students to think about the world around them: 1 2 3 4 5

Comments:

Today's lesson allowed for student problem solving: 1 2 3 4 5

Comments:

Today's lesson was successful: 1 2 3 4 5

Comments:

Students were engaged during today's lesson: 1 2 3 4 5

Comments:

Additional comments:

APPENDIX J

TEACHER ATTITUDE AND MOTIVATION SURVEY PRE AND
POSTTREATMENT

Teacher pre and posttreatment survey questions

	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
1. I am motivated to teach science and art integration lessons.	5	4	3	2	1
2. I have a positive attitude about student observations during inside and outside lessons.	5	4	3	2	1
3. I am open-minded about the use of art in science lessons.	5	4	3	2	1
4. I believe students applied their science knowledge in a creative way.	5	4	3	2	1
5. The students use observation skills in the area they live.	5	4	3	2	1

What parts of the treatment worked well?

What parts of the treatment did not work well?

What changes need to be made for future lessons?

Additional comments:

APPENDIX K

HOW TO PLANT A SEED RUBRIC

How to Plant a Seed Rubric

Criteria	Exceeds Expectations	Meets Expectations	Approaches Expectations	Needs Improvement
Completion	Work is complete and finished to an outstanding degree.	Work is complete and finished.	Work is in progress.	Work is incomplete.
Understanding of concepts	Superior understanding of concepts. Awareness of steps to plant a seed.	Understanding of concepts evident in work. Most planting steps are mentioned.	Minimal understanding of concepts.	No understanding of concept.
Organization	All steps are in a logical order.	1-2 steps are not in the correct order.	More than 3 steps are not in the right order.	0 steps are in the correct order.
Grammar	0-5 mistakes	6-10 mistakes	11-15 mistakes	16 + mistakes

APPENDIX L

PLANT PICTURE RUBRIC

Plant Picture Rubric

Criteria	Exceeds Expectations	Meets Expectations	Approaches Expectations	Needs Improvement
Completion	Work is complete and finished to an outstanding degree.	Work is complete and finished.	Work is in progress.	Work is incomplete.
Understanding of concepts	Superior understanding of concepts. Awareness of plant parts.	Understanding of concepts evident in work. Most plant parts are identified.	Minimal understanding of plant parts.	No understanding of plant parts.
Leaf physical properties	Identify 5-6 properties.	Identify 3-4 properties.	Identify 2 properties.	Identify 0-1 properties.
Leaf rubbing	2 leaf rubbings	1 leaf rubbing	Partial leaf rubbing	No leaf rubbing
Drawing	3 art techniques, labels, and observations.	3 art techniques and labels.	2 art techniques, labels, and observations.	1 art technique and no labels or observations.

APPENDIX M

PLAY-DOH SCULPTURE RUBRIC

Play-Doh Sculpture Rubric

Criteria	Exceeds Expectations	Meets Expectations	Approaches Expectations	Needs Improvement
Completion	Work is complete and finished to an outstanding degree.	Work is complete and finished.	Work is in progress.	Work is incomplete.
Understanding of concepts	Superior understanding of concepts. Awareness of steps to plant a seed.	Understanding of concepts evident in work. Most planting steps are mentioned.	Minimal understanding of concepts.	No understanding of concept.
Shadow drawing	Drawing shows accurate observation skills.	Finished work that shows good observation skills.	Finished work that shows observation skills are lacking.	Unfinished work

APPENDIX N

LIGHT BOX RUBRIC

Light Box Rubric

Criteria	Exceeds Expectations	Meets Expectations	Approaches Expectations	Needs Improvement
Completion	Work is complete and finished to an outstanding degree.	Work is complete and finished.	Work is in progress.	Work is incomplete.
Understanding of concepts	Superior understanding of concepts. Awareness of steps to plant a seed.	Understanding of concepts evident in work. Most planting steps are mentioned.	Minimal understanding of concepts.	No understanding of concept.
Presentation	Able to explain all science and art concepts used in the project.	Able to explain most science and art concepts used in the project.	Able to explain half of the science and art concepts used in the project.	Able to explain less than half of the science and art concepts used in the project.

APPENDIX O

AWARENESS INTERVIEW

Awareness Interview Questions

1. Where have you observed science in your community? Explain.
2. Name different animals that live in Shanghai.
3. Which animals have you observed living near your house? Explain.
4. How does a botanist identify plants?
5. How are leaves different? Explain.
6. How does the tree in the school's courtyard change during the year? Explain.
7. How do artists use the world around them in their work? Explain.
8. Where have you seen a shadow? Explain.
9. Where does light come from?
10. Where do artists work in Shanghai?
11. Is there anything you wish I would have asked you? Explain.

APPENDIX P

AWARENESS SURVEY

Awareness survey questions

	Strongly agree	Agree	Undecided	Disagree	Strongly Disagree
1. I can list 5 science jobs in Shanghai.	5	4	3	2	1
2. I know where animals live in Shanghai.	5	4	3	2	1
3. I think trees are important.	5	4	3	2	1
4. Science is found in many places in a city.	5	4	3	2	1
5. I am aware of light sources.	5	4	3	2	1

Did you pass any science related environments on the way to school?

What role does life and physical science play in the school's environment?

When do you see art in your environment?

Additional comments:

APPENDIX Q

TIMELINE

Overall Timeline

Start Project Implementation: January 9, 2012

January 9, 2012: Nontreatment Unit, 2 weeks – Plant parts and plant life cycle

January 9, 2012 Nontreatmentpreunit 4th grade assessment and interviews

January 10, 2012 - Different plant life cycle card pictures discussion PK

January 11, 2012 –Different plant life cycle card pictures discussion, note taking, and sequencing cards 4th

January 12, 2012 – Sequence plant life cycle cards PK

January 16 – Label plant parts on a plant PK and first colleague observation

January 17, 2011 – Match plant parts to a picture of a plant PK and 4th

January 18 – Label plant parts on a plant 4th grade

January 19 –Plant a seed PK orally describes how to plant a seed while being taped and 4th grade writes a how to.

January 20, 2012 – Collect student surveys and nontreatment postunit assessment

January 23, 2012: Chinese New Year Holidays

January 30, 2012: Treatment Unit 1, 2 weeks –Botany and Art Study

January 31, 2012 – George Seurat painting to discuss color, shape, and line.

February 1, 2012 – Pointillism plant picture focusing on color, shape, and line

February 2, 2011 Label the plant picture with important data, which was tape inside their science journal

February 6, 2012 – Basic shapes and lines mini-lessons and practice drawing shapes and

linesFebruary 8, 2012 - Vincent Van Gogh shapes and line discussion and plant shapes and lines observation and rubbings. 2nd colleague observation

February 10, 2012 - Sum it up using color, line, and shape in a plant drawing and questionnaire

February 13, 2012: Treatment Unit 2, 2 Weeks –Light and Art Integration Study

February 15, 2012 Monet painting shadows and light mini-lesson

February 16, 2012 – Opaque, transparent, and translucent activity

February 20, 2012 – Draw plant and shadow at different times of day

February 22, 2012 – Draw plant and the shadow outside, in the classroom with the lights off and blinds closed, and then in a dark room with no windows

February 23, 2012 - Pictures of Francois Pompon's animal statues discussion and begin sculpture

February 24, 2012 - Student art gallery ended the second treatment unit.

February 24, 2012 - Questionnaire

February 27, 2012: Treatment Unit 3, 2 weeks – Critical Thinking and Design

February 28, 2012 – Light box plant drawing

March 1, 2012 – Group light box and third colleague observation

March 2, 2012 – Design light box

March 6, 2012 – Test light box

March 7, 2012 – Modify light box

March 8, 2012 – Poster and presentation

March 9, 2012 – Questionnaire and interviews

End Project Implementation: Approximately March 9, 2012

