Reading Nonfiction Science Literature with and without Arts Integration

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Abstract
This study explores the integration of the arts into the teaching of science nonfiction texts during literacy instruction. Sixty-one elementary students (15 second graders, 25 third graders, and 21 fifth graders) attending schools of differing socio-economic levels participated in this study. The study examined the effects of arts-integration on student content knowledge, engagement level, and attitudes toward learning regarding science nonfiction texts. Throughout the eight-week study, students experienced both the traditional no-arts control condition and the experimental arts-integration condition in two-week segments for different science topics. Both conditions employed literacy strategies to teach comprehension of science nonfiction texts. The resulting pretests, posttests, and distal posttests, attitude surveys, and teacher observations indicated that students learned and retained content knowledge taught through both ways of teaching. The fifth-grade students evidenced greater learning during the experimental condition with very large effect sizes. Students' overall attitudes and engagement were better when the arts were incorporated into daily instruction. The excitement for learning and academic abilities of the participants throughout the study supports the idea that different ways of creative teaching positively impact the way students learn in the classroom.

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Introduction

Very few research studies that provide evidence of literacy strategies for student learning through nonfiction texts are available. Effective examples of using nonfiction texts to support student growth are needed, especially regarding how teachers can integrate the arts and science content into their literacy instruction. The first three authors of this study were classroom teachers desiring to integrate multiple standards and subject areas, but who wondered what strategies might successfully guide this enterprise, positioning students as active participants in their learning. In many testing-focused schools, student engagement has declined because of the overly structured content and unreasonable expectations that students will remain positive in a strongly teacher-centered environment. This situation has led to non-proficient test scores that hurt schools not only academically, but also financially.

A recent study explored the integration of art, literacy, and science in a second-grade classroom, showing that an integrative approach has a positive and lasting influence on student achievement in all of these subject areas (Poldberg, Trainin, & Andrzejczak, 2013). Art is a unique domain worthy of study alone, but research (Poldberg et al., 2013) demonstrated how integration of visual art, literacy, and science content created an effective curriculum benefiting all students. The teacher-researchers of this study have observed their students' declining attention and engagement levels under direct instruction at the schools. Support for student autonomy in learning (Ryan & Deci, 2009), minimizing controlling pressures while providing opportunities for choice and self-direction, has been found motivating and to increase student engagement (Shih, 2008), as has arts-integration (Wilson, Corbett & Noblit, 2001).

There are studies that focus primarily on arts-integration, science, or literacy, however, there is limited research of the integration of arts, science, and literacy and their effects on student learning. For example, art-integration is more than just creating an arts-related end product, instead, the integration allows students to consider the deeper meanings of content, assisting students in reaching the goals of the instructional unit (LaJevic, 2013). A more sophisticated understanding of how to systematically engage young students with science texts can help elementary teachers effectively integrate reading with science instruction, meet literacy requirements of current science education policies, and recognize that science reading transcends passive reception of facts (Oliveria, 2016). For example, the cumulative effects of exposing students to multiple texts while focusing on science and literacy concepts has been found to be more beneficial than having discussions after the reading (Heisey & Kucan, 2010). While these subject areas studied separately provide evidence of student learning, putting them together provides students and teachers with a variety of effective learning strategies that incorporate the arts, literacy, and science simultaneously.

The primary purpose of the current study was to test whether the use of arts integration into reading nonfiction books with science content would increase comprehension and recall of science content along with reading concepts. The study provided students accustomed to learning subjects separately a different way of learning information and of exploring different perspectives through the arts while addressing science and engineering standards of the Next Generation Science Standards (NGSS; NGSS Lead States, 2013). Student engagement and attitudes during art integration or typical literacy instruction were compared. The study had a counterbalanced, repeated measures pretest-posttest design with control (typical reading strategy instruction) and experimental (arts-integrated) conditions in which three classrooms of students at different grade levels participated. Student responses to items tied to lessons under different conditions and responses to attitude surveys revealed the effects of arts-integrated nonfiction science reading lessons.

Literature Review

This literature review addresses the three main areas this study incorporates into the elementary classroom: arts-integration, literacy strategies, and the Next Generation Science Standards (NGSS Lead States, 2013). Integration of subjects occurs in STEM (Science, Technology, Engineering, and Mathematics) learning; the addition of the arts (Daugherty, 2013) produces STEAM education (Science, Technology, Engineering, Art, and Mathematics). Adding Reading, a subject that can enhance student experiences, transforms STEAM into STREAM (Froschauer & Mayes, 2016), although this acronym has not received the attention that STEAM education has. The results of the current study will add to the mounting research that demonstrates how effective STEAM (and STREAM) can be for students not only academically, but regarding their level of engagement in classroom activities as well.

Arts-Integration

The arts have eight inherent mechanisms that facilitate long-term learning of content: rehearsal, elaboration, generation, enactment, oral production, effort after meaning, emotional arousal, and pictorial representation (Rinne, Gregory, Yarmolinskaya, & Hardiman, 2011). Rehearsal occurs as students mentally, verbally, or visually repeat important content as part of an arts activity. Elaboration happens when students add details to ideas, representations, or stories, processing the information more deeply. Generation means creating information in response to a cue or question; self-generated information often contains unusual ideas that make it more memorable. Enactment is physically acting out or dramatizing an event or idea, causing greater mental processing. Oral production involves reading or speaking aloud, shown to be more effective for memory than silent reading. Effort after or to determine meaning occurs when a student puzzles over the significance of something, causing those ideas to be committed to memory. Emotional arousal causes ideas to be better remembered than neutral ideas. Finally, the use or generation of images are part of the picture superiority effect; such visual information is better retained. These eight ideas were applied to a science study (Hardiman, Rinne, & Yarmolinskaya, 2014) with fifth graders learning about astronomy and ecology. The study (Hardiman et al., 2014) had a counterbalanced design with students learning one topic in the control condition of typical science instruction and the other in the arts-integrated experimental condition. The results of their study showed much greater long-term retention of science content for topics learned through arts-integration.

Classroom arts-integration often has been implemented ineffectively in the past (LaJevic, 2013); recent research has shown that arts-integration accomplished well shows a positive outcome in student achievement (Sorensen, 2010). Arts-integration is a pedagogical approach that merges art goals and practices with those of another discipline to produce work that addresses goals and processes of both. A problem identified by LaJevic (2013), an art teacher turned college faculty member who investigated arts-integration at elementary schools, was that teachers may engage students in art projects that match the curriculum topic, but do not allow students to think on their own (LaJevic, 2013). Effective arts-integration involves students in relating deep meaning of content to artistic messages to help students reach the goals of an instructional unit. This process requires students to review the content and to make connections between it and the arts to communicate a message. For arts-integration to be optimal, the teacher must take time to incorporate open-ended, meaningful projects that students can work on together to build and express understandings in a creative open environment.

A team of middle school content teachers, the art teacher, and administration (Sorensen, 2010) worked together to bring art integration in the classroom finding positive effects on learning. The author (Sorensen, 2010) provided in-depth examples of how arts-integration through literacy benefited students. The benefits included: connecting the art and content area learning goals, providing students with critical thinking opportunities, offering different pathways to communicate knowledge of the learning targets, and allowing students to explore self-reflection and expression. The struggles and challenges teachers faced to bring art integration into the classroom such as lack of experience and no professional development were documented. The author concluded that arts integration is a positive aspect of learning, but not often used because of teacher inexperience or lack of knowledge (Sorensen, 2010). Teachers who are provided with the necessary professional development better engage students and continue to work on their academic achievements.

A study (Fagan, 2015) conducted to determine how arts- integration into the curriculum affected teachers' instruction focused on elementary teachers who were accountable for student achievement on standardized testing. Teachers used art as a way to make their lessons meaningful and enjoyable to students through hands-on activities, real life connections, document-based inquiry, and collaborative learning. The researcher found that through art integration, there were increased levels of learning because of the high level of engagement of students (Fagan, 2015). Arts-integration allowed information to be conveyed to students in a more meaningful way and provided opportunities for students to use critical thinking skills in open ended activities. Arts-integration has been shown to benefit students in learning science content knowledge in a study of fourth and fifth graders reading information texts about what elementary students can do to help the environment and using thinking skills to discuss and write about this content (Gray, Elser, Klein, & Rule, 2016). This study examined students' attitudes towards environmental issues using literacy and arts-integrated science lessons to improve writing skills and content knowledge. Students used pop-up constructions to creatively convey the environmental messages in their essays. The lessons conducted in this study used critical and creative thinking skills to help students open their minds to new perspectives concerning environmental issues. The study demonstrated that through the use of literacy and arts-integration students concerns for environmental issues increased, as well as writing skills and overall content knowledge (Gray, et al., 2016).

The number of research investigations conducted to determine if arts-integration is beneficial for students in the classroom is limited. Some teachers who have incorporated arts in the curriculum have used it ineffectively, not allowing students to critically think through open ended questions. For arts-integration to engage and show academic achievement in literacy strategies with science nonfiction texts, instruction needs to be done with purpose. Meaningful instruction and planning produces positive outcomes that come with incorporating arts into literacy strategies with science related texts.

Literacy Strategies

While the National Science Teachers Association (NSTA; 2002) recommends a focus on inquiry-based, discovery-focused instructional approaches to science, this approach is not the only recommended method. Teachers can use a range of materials and strategies to teach the skills, knowledge, and abilities addressed in the science standards. Using hands-on learning in science does not guarantee inquiry and discovery outcomes; using literature such as nonfiction and narrative books with science information is not incompatible with inquiry and discovery learning and may support these objectives. Ideally, a teacher would use both approaches, combining observations of the real world, recordkeeping, experiments, and other hands-on science activities with literature, to introduce a science topic and for continued research on the topic in the classroom. Both are necessary to build the foundation of a good science program. In a study of the pedagogical content knowledge of experienced high school science teachers (Loughran, Mulhall, & Berry, 2004), teachers were observed to use many strategies in their teaching. These strategies included predict-observe-explain, hands-on activities, role-play, modeling, drawing, creative writing, model-making, and selected readings.

The current study was designed to incorporate both hands-on science experiences and nonfiction science texts to facilitate student science learning. The following sections first discuss the efficacy of a literacy-science integrative approach, then, highlight different integrative approaches such as attention-getting literacy techniques, transactional reading of science texts, thematic read-alouds to introduce a topic, and integration of reading and writing with science.

Efficacy of an integrative approach. In a study of participating students using both science observations and engaging books, Anderson (1998) found that the students acquired more conceptual knowledge than other students not using the combined approach. The NSTA (2002) also suggested that students learn science best when it is integrated with other areas of the curriculum such as reading, language arts, and mathematics. This approach includes reading textbooks, newspapers, magazines, online information, and children's and young adult literature, both fiction and nonfiction.

A study that explored the integration of art, literacy, and science in a second-grade classroom (Poldberg, Trainin, Andrzejczak, 2013), showed how an integrative approach has a positive and lasting influence on student achievement in art, literacy, and science. Analyzed ways in which art, science, language arts, and cognition intersected included the products of a lesson on drawing a rock, matching its color and texture with watercolor-crayon resist materials and then writing an "I am ___" poem about the rock's natural history. While the importance of art as a unique domain was recognized, this research demonstrated how integration of visual art, literacy, and science content created an effective learning environment. While some teachers and administrators regard the subjects that appear on standardized tests as most important, both students and teachers can benefit from integration of the arts into other core subjects. Learning in, through, or with the arts, has been found to be motivational, involving more students in a broader perspective, enriched vocabulary, and a variety of ways of thinking to meet content area standards (Poldberg, et al., 2013). Similar to this study, the current study incorporates various arts processes and media.

Attention-gaining and other strategies. Another study reported promising teacher practices that students viewed as supporting science learning, improving attitudes, and raising test scores (Moeed & Easterbrook, 2016). The teacher had effective strategies in place for gaining attention: he began lessons by explaining the expected outcomes and provided crossword puzzles and other problem-solving word games related to the content to pique student interest. The teacher used effective strategies such as graphic organizers to help students organize their ideas; asking and answering questions to a text they were reading as well as summarizing what they had read and had learned in their own words (Moeed, et al., 2016). Hands-on science investigation activities were used and students drew pictures of their results to help them remember and analyze their work. In the current study, teachers implemented several of these strategies, explaining expected outcomes, focusing some problem-solving activities on vocabulary, and using graphic organizers.

Transactional reading of science texts. Student reading engagement with children's science books in three first or second grade classrooms was the focus for another researcher (Oliveria, 2016). A more sophisticated transactional understanding of how to systematically engage young students with science texts can help elementary teachers effectively integrate reading with science instruction, meet literacy requirements of current science education policies, and recognize that science reading transcends passive reception of facts (Oliveria, 2016). In transactional reading of a science text, the teacher and the students collaborate to determine the meanings of scientific words by examining book covers, titles, other books, different genres, and critical commentaries. This study speaks directly to recent developments in educational policy which have promoted a shift toward text emphasis in elementary science. Teachers are required to teach the Iowa Common Core Reading Standards (Iowa Department of Education. 2009), mandated by the state in which the current study occurs. In the current study, teachers followed a transactional approach to reading texts, involving students in thinking and responding during the reading.

Thematic read-aloud to introduce a science topic. Research in introducing science concepts through read-aloud was conducted through the use of thematic read alouds to first and second-grade students (Heisey, et al., 2010). The books each involved a scientist and science investigation. The two groups of students had engaging conversations about text features but one discussion was done during the reading for one group while the other discussion was done at the conclusion of the read aloud for the other group. Students that had authentic discussions during the reading scored higher on posttests. The authors concluded that the cumulative effects of exposing students to the same concept at several times during the book was more beneficial than having discussions after the reading (Heisey et al., 2010).

Reading and writing about science. By using in-depth science instruction to accelerate the development of science content, another study (Vitale & Romance, 2012) was designed to enhance reading comprehension of first and second grade students. Science was integrated with reading and writing for a year-long, daily 45-minute instructional period to demonstrate the comprehensive effects on student learning, such as cumulative learning of science core concepts with integrated science and literacy (Vitale & Romance, 2012). The research provided data showing increased achievement on reading and science content on the Iowa Test of Basic Skills Assessments. The authors of that study suggested that reading nonfiction science texts results in meaningful cumulative learning compared to the non-content basal readers currently used in schools.

Next Generation Science Standards (NGSS)

The Next Generation Science Standards (NGSS Lead States, 2013) offers a new vision for K-12 students in science education that reflects how scientists and engineers practice their craft. This student-centered approach fits beautifully with teaching science, technology, engineering, and math (STEM) through hands on learning. The three-dimensional science learning model of disciplinary core ideas (content), cross cutting concepts (big ideas) and scientific and engineering practices (process) was used as a format for all subject areas in the curriculum (Houseal, Gillis, Helmsing, & Hutchison 2016). The benefits of using the NGSS as a multi-discipline framework included skills such as asking questions; developing models; constructing explanations; engaging in argument; obtaining, evaluating, and communicating information; including patterns and cause and effect critical thinking, examining social problems and issues, and analyzing and interpreting data. The authors argued that standards for literacy abilities in all content areas are being met through application of the NGSS to multiple disciplines (Houseal, et al., 2016).

A study that focused on student understanding of scientific practices and crosscutting themes (Yoon, et al., 2015) presented a high school biology curriculum that was intentionally designed to align with the NGSS. The authors used five curricular units which included: developing and using models, analyzing and interpreting data, cause and effect, and systems and system models. Students were found to have increased understanding and skills in all NGSS scientific practices and crosscutting themes addressed (Yoon, et al., 2015). The results of this study indicate that the NGSS practices and crosscutting themes can be taught to students through appropriate curriculum.

The intent of integrating NGSS in all grade levels is that all students, upon graduation, will be able to apply the processes of science and engineering to daily life, become critical consumers of STEM information within the world, and have the ability to go into the career of their choice. The current study integrated NGSS engineering design standard 3-5 ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. In the experimental condition, students made an arts-integrated product related to the science topic, which included criteria for success and constraints on time and materials. In the control condition, students made a science product or conducted a science investigation without integrated art.

Methods

Students in second, third, and fifth grade were given classroom instruction through nonfiction science literature, both with and without arts-integration to see how the combination of arts integration affected student academic ability. The study has a counterbalanced, repeated measures pretest-posttest design with control and experimental (arts-integrated) conditions in which students were assessed on reading comprehension skills, science content, and vocabulary from various nonfiction texts.

Research Questions

This nonfiction science unit encompassed these research questions:

1. Does integrating the arts into a nonfiction science book-study produce greater comprehension and recall of science content and reading concepts? Scores on a pretest, posttest, and distal science and reading content/concept assessment with questions directly tied to each book answered this question.
2. Are students more engaged in their reading and work in the control or experimental condition? Teacher observations using a daily observation form were used to determine this.
3. How did students feel about the arts integration compared to the typical book instruction? Results of an attitude survey determined the answer to this question.

Research Design

The study had a pretest-posttest-distal posttest design in which participants alternated for two-week periods in arts integrated (experimental) or non-arts conditions (control) as shown in Table 1. Questions on the identical assessments corresponded to the content of the nonfiction texts being studied during each of the two-week periods and could therefore be directly tied to the conditions under which the information was taught. Each day, teachers observed student behavior and engagement level during the lesson. Artifacts were collected through the use of photographs to document student work. At the end of each week, students participated in an attitude survey to help the teacher understand the students' feelings in regards to the learning targets during that week. At the conclusion of the eight weeks a posttest was administered to the students to determine the outcome of student learning. A distal test was then provided three weeks later to compare student retention.

Table 1. *Study Design*

Science Topic	Week	Second Grade Class	Third Grade Class	Fifth Grade Class
All	Pretest	Pretest to provide a baseline	Pretest to provide a baseline	Pretest to provide a baseline
Plants	Week 1 Book 1	Control Condition	Experimental Condition	Control Condition
	Week 2 Book 2	Control Condition	Experimental Condition	Control Condition
Animals	Week 3 Book 3	Experimental Condition	Control Condition	Experimental Condition
	Week 4 Book 4	Experimental Condition	Control Condition	Experimental Condition
Landforms	Week 5 Book 5	Experimental Condition	Control Condition	Experimental Condition
	Week 6 Book 6	Experimental Condition	Control Condition	Experimental Condition
Weather	Week 7 Book 7	Control Condition	Experimental Condition	Control Condition
	Week 8 Book 8	Control Condition	Experimental Condition	Control Condition
All	End of Week 8	Posttest	Posttest	Posttest
All	Week 11	Distal Posttest	Distal Posttest	Distal Posttest

Each week, the nonfiction book was introduced and studied using the following general, well-accepted steps: preview, text features, addressing science content, reviewing the book, and making a product related to the book's content. See Table 2. In the control condition, the arts were not used; students wrote responses to the teacher's questions or responded orally. In the experimental condition, the arts were incorporated into each of these steps of reading and analyzing the book. For example, in the experimental condition, students acted out their prediction of what the book addressed instead of providing oral or written predictions in the control condition. More information is provided in Table 2.

Table 2. *Lesson Procedures*

Condition	Day 1	Day 2	Day 3	Day 4	Day 5 of *second* week of topic
Main Concept of the Literature being taught	Preview of Book and Prediction of what is in the book. Begin reading the book	Text features such as bolded words or headings or sidebars	Summarizing Important Science Content of the book	Review of the Book	NGSS Engineering Standard Students make an invention or product with given materials that fits with the book theme.
Control Condition	Groups tell their predictions orally or writes them. Begin reading the book.	Write words and definitions Make an outline of the book using the headings What about sidebars?	Write in graphic organizer that expresses main ideas and important details.	Opinion paragraph with sentences providing 4 lines of evidence for opinions	Science-focused invention (no art)
Experimental Condition	Have small groups *act out* their prediction of what will happen or what will be in the book	Create a flipbook glossary with sketches that show what words mean. Headings made into a collage conveying a larger book-themed image.	Create poster using visuals to display main ideas and important details.	Pop-up card that tells review opinion on front with adjectives. Inside there are four emotion-provoking pop-up images with supporting statements	Art is part of the invention (such as a mobile with paper art items that hang from it; or a piece of jewelry (badge or pin) related to the theme).
Arts Mechanism from (Hardiman, et al., 2011)	Enactment	Pictorial Representation	Generation	Emotional Impact	Rehearsal of visual and performing arts

Setting and Participants

The three schools that were involved in this study were located in the Midwestern state of Iowa in the United States. The study was approved by the Human Subjects Committee of the overseeing university associated with the three teachers who were completing their master's research projects. All school principals, parents, and students gave fully informed written consent to participate in the study.

The second grade consisted of a class of 15 participants (8 female, 7 male; 5 White, 6 African American, and 4 Hispanic) at a Title 1 school with 72% of the students qualifying for free lunch. Four students qualified for special education services and 80% of students scored below grade level in reading.

The third-grade classroom consisted of 25 participants (14 male, 11 female; 10 White, 8 African American, 6 Hispanic, and 1 Pacific Islander). Of the study participants, seven students were English language learners, none qualified for special education services, and 42% of students scored below grade level in reading. The school was classified as a School in Need of Assistance (SINA) school, providing additional funding to provide students with the necessary skills to meet academic tasks. The school served a very low socioeconomic population with of 91% of students receiving free lunch or reduced-cost lunches.

The fifth-grade classroom consisted of 21 participants (11 female, 10 male; 18 White, 3 Hispanic). Three students qualified for special education services and two were English language learners. The school was upper middle class with only 5.5% of students receiving free or reduced-cost lunches.

Data Collection

The study included three different sources of data to determine if arts-integration in the classroom improved student content knowledge, engagement, and attitude towards academic activities. The first source of data, shown in Table 3, included identical teacher-made pretests, posttests, and distal tests designed for each grade level to see overarching progression in student learning. This information allowed for student data to be collected on student content knowledge and understanding of different literacy strategies before and after the study was conducted. The second source of data consisted of daily teacher observations and collection of artifacts through photographs that allowed teachers to scan the room to see which students were on and off task. Teachers filled out daily observation forms, shown in Figure 1, to maintain consistency in what students were doing. Students were also able to display their personal work and documented accordingly. The third source of data, seen in Figure 2 and Figure 3, allowed teachers to measure student attitude towards their work (Mills, 2014) in regards to the learning targets activities. Students took a weekly attitude survey where they were asked about how they felt in regards to the daily activities conducted in the experimental and control condition.

Table 3: *Format for Pretest, Posttest, and Distal Test Questions*

Topic	Week	Book	Question Types	
Plants	Week 1	Book 1	Vocabulary Question	Content Question- Text Features
Plants	Week 2	Book 2	Vocabulary Question	Content Question- Main Idea/ Details
Animals	Week 3	Book 3	Vocabulary Question	Content Question- Opinion
Animals	Week 4	Book 4	Vocabulary Question	Content Question- Summarizing
Landforms	Week 5	Book 5	Vocabulary Question	Content Question- Text Features
Landforms	Week 6	Book 6	Vocabulary Question	Content Question- Main Idea/ Details
Weather	Week 7	Book 7	Vocabulary Question	Content Question- Opinion
Weather	Week 8	Book 8	Vocabulary Question	Content Question- Summarizing

Instruments

Content and skill assessments. Each pretest, posttest, and distal test was short answer and followed the outline presented in Table 4. The test for each grade level was different to adjust for student proficiency level, but had the same general components. For each grade level, the pretest, posttest, and distal posttest were identical. The assessment questions with bolded correct responses, are shown in Table 4.

Table 4. *Assessments for Each Grade Level*

No.	2nd Grade	3rd Grade	5th Grade
1.	When a bug slides off a leaf, this means that the leaf surface is ______. **smooth**	What is a seedling? **A young plant**	What is a **nucleus** and its function? **Is like the brain of the cells and tells the cell what to do.**
2.	A text feature that is colorful and helps a reader understand the words on a page is a_________. **picture**	A text feature that points to each part of the plant is called a _______. **label**	Name a text feature that can be found at the end of one of the books we studied on plants. **Glossary or Index**
3.	A Redwood tree has _______ bark to protect it from fires. **thick**	The giant _________ redwood pines are the largest trees in the world. **Sequoia**	How does **photosynthesis** work? **The process in which plants make their own food from sunlight.**
4.	Redwood Trees grow well by the sea. What is another detail about how Redwood Trees grow? **Redwood trees grow well in rain and fog.**	If plants can survive in the cold mountains, dry deserts, and murky swamps, what is the main idea of all three of these places? **Plants can survive in many different types of environments.**	If the main idea is people use many plants, what would be three details that go along with this? **You can make medicine, furniture, and food from plants.**
5.	If a spider creeps, it moves _______. **slowly**	An animal that hunts and eats other animals is called a **predator**.	How does **mutualism** work? **When two organisms work together, each benefiting from the relationship.**
6.	_______ help animals swim in the water. **Flippers**	Why do you think a kangaroo could be deadly to a human? **Kangaroos can kick hard when threatened. A kick in the may break ribs and collapse lungs.**	Name three different ways animals protect themselves from their predators. **Run, hide, fight**
7.	Do you think that spiders are scary? Explain using 2 types of evidence. **Answers vary using textual evidence.**	List three types of mammals we read about in this unit of study. **Answers will vary- but must all be a mammal.**	How and why do animals migrate? **Fly/walk to find food and better living conditions.**
8.	Summarize why it is important for animals to have wings using facts by writing three sentences. **Answers vary using textual information.**	Summarize why it is important for camels to have humps on their backs. **Camels store fat in their humps and this fat can help the camel survive in the desert. Answers will vary.**	Summarize where and when animals migrate. **South and during the winter months.**
9.	When a volcano is dormant, it is like it is _________. **sleeping**	Explain what an **eruption** is. **Lava, gas, and /or rocks come out of a vent.**	What does a **plateau** look like? **Raised area of land with a flat top.**

Table 4 Continued. *Assessments for Each Grade Level*

No.	2nd Grade	3rd Grade	5th Grade
10.	A text feature that can show where a volcano is located in the world is a ______. **map**	Explain what a **glossary** is used for. **A glossary is like a min-dictionary at the back of a book. If you don't know what a word means, you can look in the glossary.**	Name a text feature you can find in the beginning of one of the nonfiction books we read about geography. **Table of Contents**
11.	Frozen rivers of ice, called _________ can be found all over the Rocky Mountains. **glaciers**	Explain what a cavern is and how it forms. **A large cave formed by groundwater or an underground river that dissolves the limestone rock.**	Describe and draw what a **cape** looks like. **A headland of large size extending into a body of water.**
12.	If the Rocky Mountains are cold, it snows at this time, and water freezes, what could the main idea of these details be? **The Rocky Mountains are cold during the winter months.**	What are three details if the main idea is a stalactite cave**? Stalactites are formed from dripping water that leaves behind a deposit of minerals. Stalactites start as sods straws. Stalactites form on the ceiling; stalagmites form on the floor. Answers will vary.**	If earth has mountains, deserts, and forests what could you say was the main idea from these details? **Earth has many different landforms.**
13.	A long line of storms on the outside of a hurricane is called a _________. **feeder band**	Water that falls as rain or snow to the Earth's surface is known as **precipitation.**	What does a **storm surge** do? **An abnormal rise of water generated by a storm greater than the high tide that floods the shore, causing destruction.**
14.	Do you think people should fly into the middle of a hurricane? Explain. **Answers vary using textual information.**	What is your opinion about blizzards? Support with evidence. **Blizzards are exciting because they have driving wind and falling snow that forms white-outs**. **Answers will vary.**	State your opinion on hurricanes, supporting it with three facts. **Hurricanes are interesting because of the high winds, massive amounts of rainfall, and damage they can cause.**
15.	A _________ is what forms a cone in the sky, which is called a tornado. **funnel cloud**	What are **wind turbines**? **Machines that produce energy from the wind blowing on them and moving their blades.**	Describe what the **greenhouse effect** is and how it works. **The process by which sunlight entering the atmosphere warms the planet's surface by the heat being reflected back to the surface by gasses instead of being radiated into space.**
16.	Summarize how a thunderstorm can be dangerous to humans using facts by writing three sentences. **Answers vary using textual evidence.**	Give a summary of a tornado or a hurricane. **Answers will vary. Tornado: a twisting updraft of very fast wind that moves along the ground, destroying structures.**	Summarize different ways to measure temperature. **Infrared, probes, thermistor, thermocouple.**

Teacher observation form. The teachers used the form shown in Table 5 to record daily observations about student engagement. Teachers determined whether students were on or off task by observing them during each condition. If a student was considered to be on task for the majority of the time during the activity, they scored a four for the day. If the student was slightly off task for one minute, they received a three. If the student was off task for two minutes or two times during the activity they were scored a two. Students who were considered to be off task for more than two minutes received a one.

Table 5. *Teacher Observation Form*

Teaching Strategies Observation Notes	
Circle: Control or Experimental	Main Concept of Literature Being Taught:
Day ___	Teacher Observations of Students
# of Students Engaged (Students on Task for majority- 20 minutes of Lesson)	___ Students participating in activity ___ Students answering questions ___ Students writing or drawing answers to express information
	Other Notes or Comments:

Note: Scoring was as follows: On task almost all time = 4; one time off task for 1 minute = 3; 2 times off task = 2 = Almost always off task = 1 Absent = blank

Attitude survey. Each week, students were given a student attitude survey to express how they felt about the week's' activities. Each condition had a different survey. These surveys are shown in Table 6 and Table 7. The surveys allowed students to reflect on the lesson activities. Scoring was as follows: Awesome= 4 Okay = 3 Boring = 2 Dislike= 1.

Table 6. *Control Condition Attitude Survey*

Circle a response for each question.	What are you Feeling?			
Did you like the book choice?	Awesome!	It's okay	Boring	Dislike
How did you feel about the preview and prediction activities on Day 1?	Awesome!	It's okay	Boring	Dislike
How did you feel about finding definitions to understand words and the outline of the book on Day 2?	Awesome!	It's okay	Boring	Dislike
How did you feel about making a graphic organizer to express main ideas and important details of the book on Day 3?	Awesome!	It's okay	Boring	Dislike
How did you feel about writing an opinion paragraph about the book on Day 4?	Awesome!	It's okay	Boring	Dislike
How did you feel about the science-focused activity related to the book on Day 5?	Awesome!	It's okay	Boring	Dislike
How did you feel about reading *this* book?	Awesome!	It's okay	Boring	Dislike

Note: Scoring was as follows: Awesome= 4 Okay = 3 Boring = 2 Dislike= 1

Table 7. *Experimental Arts-Integration Condition Attitude Survey*

Circle a response for each question.	What are you Feeling?			
Did you like the book choice?	Awesome!	It's okay	Boring	Dislike
How did you feel about acting out the preview on Day 1?	Awesome!	It's okay	Boring	Dislike
How did you feel about making a flipbook glossary to understand words and/or the collage of book topics on Day 2?	Awesome!	It's okay	Boring	Dislike
How did you feel about making a poster with visuals to tell main ideas and important details of the book on Day 3?	Awesome!	It's okay	Boring	Dislike
How did you feel about making the popup book review on Day 4?	Awesome!	It's okay	Boring	Dislike
How did you feel about science and art-combined activity on Day 5?	Awesome!	It's okay	Boring	Dislike
How did you feel about reading *this* book?	Awesome!	It's okay	Boring	Dislike

Score: Awesome= 4 Okay = 3 Boring = 2 Dislike= 1

Data Analysis

Student data were recorded using spreadsheets to compare students' content knowledge, participation and observation, and overall attitude of learning. Means, standard deviations, *t*-tests, and Cohen's *d* effect size (if scores from different conditions were significantly different) were used to compare these scores across conditions. The pretest, posttest, and distal test scores were scored with a "1" for a correct response and "0" for an incorrect response. A four-point value system was used for the attitude surveys with "Awesome" = "4" and "Dislike = "1". Student behavior was documented daily and recorded to compare engagement levels based on tasks completed during the control and experimental conditions with a four-point value system with "On task" = "4" and "Off task" = "1".

Results and Discussion

The assessments for this study included: pretests, posttests, distal posttests, attitude surveys, and teacher observations. Resulting data are discussed in the following sections. Overall, students who participated in this study enjoyed both conditions regarding the content taught, but throughout the study, students expressed favor for the experimental condition arts-integration approach compared to typical instruction in the control condition.

Pretests, Posttests, and Distal Tests Scores

Findings indicated that the second and third grade classes did not show much difference between conditions in gain scores on the posttest or the distal posttests. This means that for these two classes, students learned the content knowledge to a similar degree under both conditions and also retained that knowledge to a similar degree in the long-term. See Table 8. At the time of the pretest, there were no significant differences between second and third grade students' prior knowledge on topics later taught during the control and experimental conditions and this situation continued through the posttest and distal posttest. This means that second and third grade students learned approximately equally well under both conditions.

The fifth-grade results contrast with the results of the younger students. See Table 8. Before the interventions began, fifth graders scored differently on the content knowledge pretest of the information taught during the two conditions. Therefore, gain scores which take the pretest differences into account were used. At the time of the posttest, the content scores of information students had learned under the experimental condition showed much larger gains than the content scores concerning material students had learned under the control condition with a very large effect size. Similarly, students exhibited higher gains at the time of the distal posttest for information they had learned under the experimental condition with a medium effect size. This indicates that fifth graders not only learned content initially better in the experimental condition, but they retained that knowledge better in the long run.

This discrepancy in the effect of integrated arts on the second and third graders, compared to the fifth graders, may be explained as follows. In primary grades, students have more arts-integration in weekly lessons, and this approach feels normal to them in their learning, whereas, in upper grades, arts-integration tends to be set aside in favor of direct content instruction. Therefore, the arts integrated lessons seemed novel, exciting, and more meaningful to fifth graders and more commonplace to students in primary grades.

The second and third grade results indicated students can learn content from either approach of arts-integration or more traditional ways of teaching. The study by Poldbery, Trainin, and Andrezejczek (2013) showed that a combined approach can have a positive influence on student achievement. As students grow in their education, arts-integration may be ignored because of other curricular expectations. In second and third grade, teachers still integrate art into different aspects of the day and this practice might be one of the reasons why there was not a significant difference in content knowledge gain between the control and experimental conditions. The fifth graders in the current study were more removed from such practices like the upper elementary students in the investigation of Hardiman, Rinne, and Yarmolinskaya (2014), in which there were significant differences in content knowledge at the time of the distal posttest. In Hardiman et al.'s study and in the current study, fifth grade students remembered the content taught in arts-integrated lessons better.

Table 8. *Mean Scores (out of 16 total possible point) on Assessments for All Three Classes*

Mean Score	2nd Grade Class		3rd Grade Class		5th Grade Class	
	Control Condition	Experimental Condition	Control Condition	Experimental Condition	Control Condition	Experimental Condition
Pretest	0.40 (0.6)	0.53 (0.5)	1.76 (1.3)	2.52 (1.9)	1.71 (1.7)	3.14 (2.1)
Pretest paired *t*-test results	*p* = 0.27; No significant difference between conditions on pretest		*p* = .007; significant difference; gain scores should be used		*p* = .0006; significant difference; gain scores should be used	
Posttest	6.07 (1.5)	6.27 (1.7)	5.70 (2.0)	6.00 (2.0)	3.19 (1.5)	7.05 (1.3)
Posttest paired *t*-test results	*p* = 0.22; No significant difference between conditions on posttest		*p* = 0.06; No significant difference between conditions on posttest		*p* <.0001; Significant difference favoring experimental condition; Cohen's *d* = 2.75; very large effect size	
Pretest to Posttest Gain	5.31 (2.1)	5.38 (2.3)	3.66 (1.7)	3.60 (1.9)	1.48 (1.5)	3.90 (2.1)
Gain paired *t*-test results	*p* = 0.41; No significant difference between conditions on posttest gain scores		*p* = 0.40; No significant difference between conditions on posttest		*p* <.0001; Significant difference favoring experimental condition; Cohen's *d* = 1.33; very large effect size	
Distal Posttest	5.60 (1.4)	5.60 (1.4)	4.60 (2.4)	5.32 (2.6)	3.76 (1.9)	6.33 (1.9)
Distal Posttest paired *t*-test results	*p* = 0.50; No significant difference between conditions on distal posttest		*p* = 0.01; Significant difference favoring experimental condition; Cohen's *d* = 0.29; small effect size		*p* <.0001; Significant difference favoring experimental condition; Cohen's *d* = 1.35; very large effect size	
Pretest to Distal Posttest Gain	4.88 (2.0)	4.75 (1.8)	2.92 (1.6)	3.00 (2.1)	2.15 (1.6)	3.35 (2.0)
Gain paired *t*-test results	*p* = 0.36; No significant difference between conditions on distal posttest gain scores		*p* = 0.43; No significant difference between conditions on distal posttest gain scores		*p* = 0.02; Significant difference favoring experimental condition; Cohen's *d* = 0.66; medium effect size	

Note: Standard deviations in parentheses

Student Attitudes

Student ratings of items on the attitude survey are shown in Table 9. The attitude survey was completed by the students each week. The results are provided here by grade level. Overall, students in all three classes displayed more positive attitudes during the experimental condition in 20 out of 21 instances with the one exception showing no statistically significant differences. Sixteen of these 20 instances were statistically significant with effect sizes ranging from small to very large favoring the experimental condition. These results are discussed in the following sections, class by class.

Table 9. *Mean Scores on Attitude Survey for All Three Classes*

Mean Score	2nd Grade Class		3rd Grade Class		5th Grade Class	
	Control Condition	Experimental Condition	Control Condition	Experimental Condition	Control Condition	Experimental Condition
1. Liking of book choice	3.32 (0.7)	3.55 (0.6)	3.53 (0.4)	3.46 (0.6)	2.89 (0.7)	3.19 (0.7)
Paired *t*-test results	*p* = 0.04; significant difference between conditions favoring experimental condition; Cohen's *d* = 0.35; small effect size		*p* = 0.30; No significant difference between conditions		*p* = 02; significant difference favoring experimental condition; Cohen's *d* = 0.43; small effect size	
2. Attitude toward preview /prediction activities	2.87 (1.1)	3.36 (0.7)	3.16 (0.6)	3.73 (0.3)	2.14 (0.5)	2.90 (0.8)
Paired *t*-test results	*p* = 0.03; significant difference between conditions favoring experimental condition; Cohen's *d* = 0.53; medium effect size		*p* <.0001; significant difference favoring experimental condition; Cohen's *d* = 1.20; very large effect size		*p* <.001; significant difference favoring experimental condition; Cohen's *d* = 1.14; large effect size	
3. Attitude toward definition and outline activities	2.90 (0.8)	3.48 (0.7)	2.95 (1.0)	3.28 (0.7)	1.98 (0.5)	2.88 (0.7)
Paired *t*-test results	*p* = 0.009 significant difference between conditions favoring experimental condition; Cohen's *d* = 0.77; medium effect size		*p* = 0.07; No significant difference between conditions		*p* <.0001; significant difference favoring experimental condition; Cohen's *d* = 1.48; very large effect size	
4. Attitude toward making graphic organizer	3.37 (0.6)	3.49 (0.6)	3.17 (0.7)	3.56 (0.5)	1.85 (0.6)	2.82 (0.7)
Paired *t*-test results	*p* = 0.41; No significant difference between conditions		*p* =.006; significant difference favoring experimental condition; Cohen's *d* = 0.64; medium		*p* <.0001; significant difference favoring experimental condition; Cohen's *d* = 1.49; very large effect size	
5. Attitude toward opinion paragraph writing	3.05 (1.0)	3.79 (0.3)	3.09 (0.8)	3.52 (0.5)	2.32 (0.6)	2.95 (0.7)
Paired *t*-test results	*p* = 0.001 significant difference between conditions favoring experimental condition; Cohen's *d* = 1.00; large effect size		*p* =.006; significant difference favoring experimental condition; Cohen's *d* = 0.64; medium		*p* <.001; significant difference favoring experimental condition; Cohen's *d* = 0.97; large effect size	
6. Attitude toward science activity	3.50 (0.6)	3.87 (0.2)	3.40 (0.5)	3.66 (0.3)	3.32 (0.7)	3.75 (0.3)
Paired *t*-test results	*p* = 0.008 significant difference between conditions favoring experimental condition; Cohen's *d* = 0.83; large effect size		*p* =.01; significant difference favoring experimental condition; Cohen's *d* = 0.63; medium		*p* <.01; significant difference favoring experimental condition; Cohen's *d* = 0.80; large effect size	
7. Attitude toward reading the book	3.35 (0.5)	3.60 (0.5)	3.43 (0.7)	3.46 (0.6)	2.91 (0.7)	3.10 (0.8)
Paired *t*-test results	*p* = 0.01 significant difference between conditions favoring experimental condition; Cohen's *d* = 0.50; medium effect size		*p* = 0.41; No significant difference between conditions		*p* = 0.414; no significant difference between conditions	

Second grade attitude survey results. The second-grade attitude survey results indicated that, in general, students favored the experimental condition. The first item of liking of book choice showed a significant difference favoring the experimental condition with a small effect size. This situation also occurred with fifth graders, indicating that approaching a book through the arts may increase student enjoyment of the book.

The level of excitement from the students during the arts-integrated activities allowed them to take what they were learning from the nonfiction texts through artistic pathways to show what they were learning. Figure 1 shows students dramatizing the text *Rocky Mountains* (Madder, 2004), which was part of the experimental condition. They were acting out the part of the text that tells wildflowers grow in the Rocky Mountains. The right and left students were pretending to be the sun and the mountain, and the student in the middle was demonstrating how a flower grows. As they were watching these dramatizations, the students in the audience made predictions of what they thought they were going to learn in the text. There was a medium effect size favoring the experimental condition concerning making predictions and learning vocabulary skills. In Figure 1, students acted out the text instead of just looking at the book's pages to guide their predictions. Students also preferred drawing or creating a word art picture, shown in Figure 2, to show what they knew regarding vocabulary and creating the pictures themselves as shown in item 3 of Table 9.

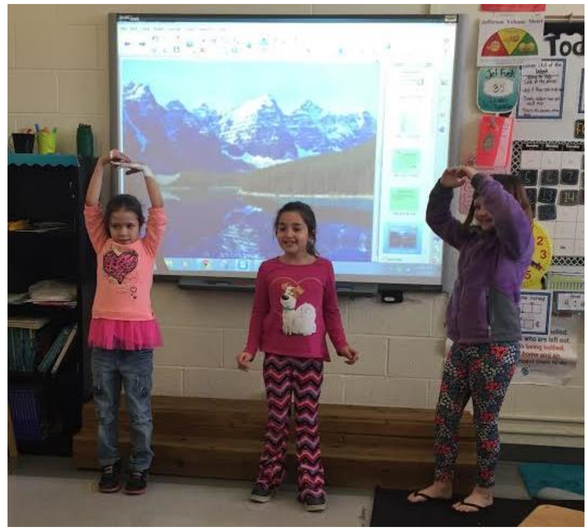

Figure 1. Students dramatizing a flower growing on a mountain in the sun.

Figure 2. A student's word art picture including vocabulary and headings from the volcano text, *All About Volcanoes* by Kirk, J. (2009).

A large effect size favoring the experimental condition occurred for opinion writing activities, see item 5 on Table 9. During the experimental condition, students not only expressed their opinions through art pop-up scene construction, but they avoided the typical writing process that often resulted in a loss of student engagement.

One area in which students' attitude ratings did not show a significant difference between the control and experimental conditions was identification of the main idea and details from the text. Students enjoyed the graphic organizer shown in Figure 3 and used during the control condition. This was a new graphic organizer for these nonfiction texts, and was easy for the students to complete on their own, making this activity a good match for the enjoyable arts-integration activities. Students assumed ownership when finding details to support their main ideas.

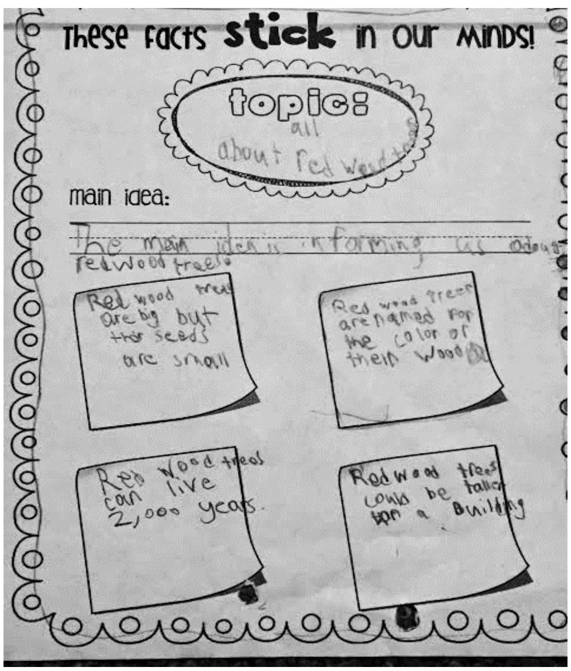

Figure 3. Graphic organizer showing the main ideas and details about Redwood trees.

Overall, students in the second-grade classroom enjoyed the science activities (Item 6 in Table 9) that incorporated the arts as seen in Figure 4 in which students came together as a class and shared their art-integrated projects that focused on the ways scientists study the books' topic. This particular activity was based on the text, *All about Volcanoes* (Kirk, 2009), in which students designed their own homes using milk cartons and tissue paper to see how it could withstand the volcanic ash and debris that was described in the text. Students were talking about these activities for days. When arts- integrated activities were used alongside nonfiction texts, students tended to like the texts more. This information is similar to the findings of Gray, Elser, Klein, and Rule (2016) who identified that students had more emotions and ideas regarding the texts and information used in environmental studies when doing arts- integrated projects alongside the texts. This indicates that arts-integration positively impacts student attitudes towards their own learning.

Figure 4. Students are working together on a science activity

Third grade attitude survey results. There were several significant differences in student ratings on the attitude survey that favored the experimental condition. These differences occurred regarding preview activities, the graphic organizer, the opinion paragraph, and the science activity. The third-grade students were excited to be able to act out the book and to predict the events that would happen next. There was a very large effect size (Cohen's d = 1.20) favoring the experimental condition on the item referring to these prediction activities. When students were learning in the control condition, they were unmotivated at times and were disappointed they could not dramatize book events.

No significant difference was found between conditions regarding the definition and outline activities. Students had completed several flips books before this project began, so this activity was not new. At first students were excited to start another flip book but then they soon lost interest.

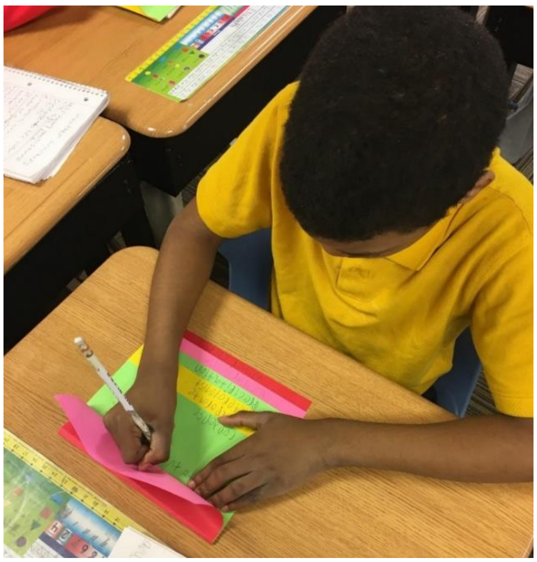

Figure 5. A student creates a flip book with vocabulary and definitions.

The fourth attitude survey item evaluated the making of graphic organizers and resulted in a medium effect size favoring the experimental condition. Students became very confident in these literacy skills as they are part of the school success grade-level criteria and practiced many times during third grade. Similarly, student ratings of the opinion writing activities had a medium effect size. Students loved to write and any chance they could write and voice their opinions, they were highly engaged and motivated. Some activities were favored more in the experimental phases because this was something new and exciting that they have not had the chance to participate in before.

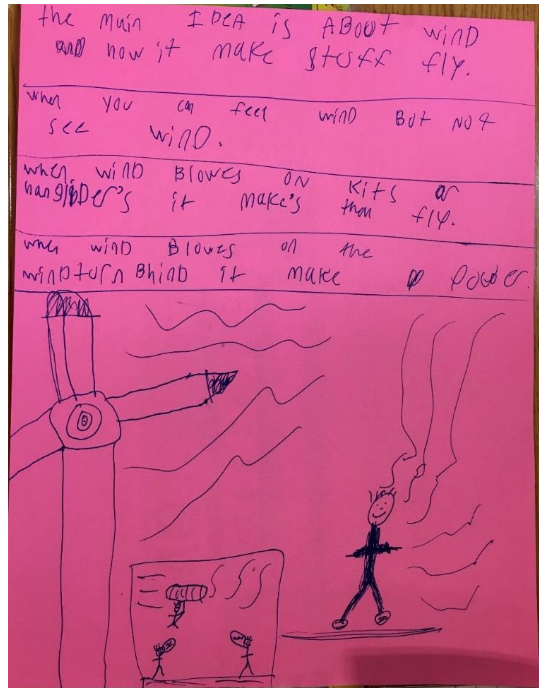

Figure 6. An example of a main idea poster with pictures.

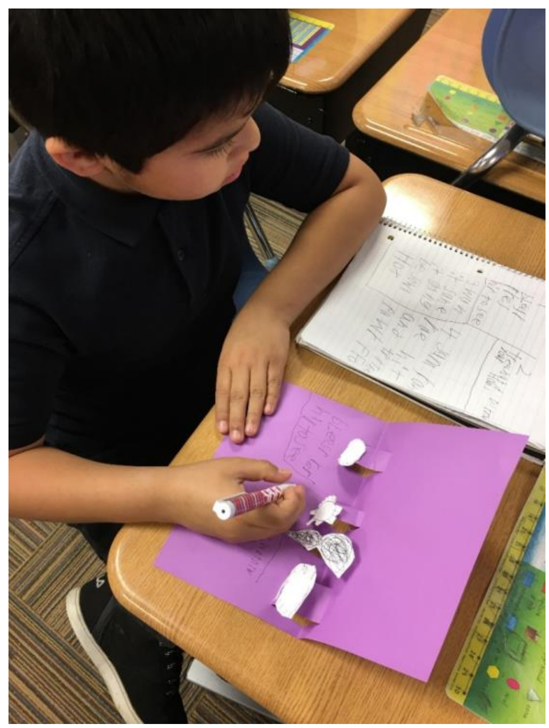

Figure 7. A pop-up book about weather is being created.

A medium effect favoring the experimental condition was observed in the student ratings of the science activity. The opportunities they had to create things on their own during the experimental condition were much more engaging than those in which there was no creative art activity.

Figure 8. Pinwheels are being created to show how wind works with a hairdryer.

No significant difference was found in students attitudes between conditions toward reading the books. For the control condition, students studied animals. These books were highly engaging to the students no matter the condition because of the fascinating topic. The students were very interested in animals and therefore it did not make a difference to them if they were in the control or experimental phase.

Fifth grade attitude survey results. The fifth-grade results indicated that on six out of the seven questions asked, students significantly favored the experimental condition activities with effect sizes ranging from small to very large. For the last question, which asked the students' attitudes toward reading the nonfiction book that was selected for that week, only a slight favoring towards the experimental condition existed, with the mean score of 3.10, compared to the control mean score of 2.91. This difference was not statistically significant. However, overall, student responses indicated that teachers desiring students to like books should present book comprehension and analysis activities through the arts. Figure 9 and Figure 10 show students engaged in art-integrated activities and a landform model on a plate.

Figure 9. Students created a diorama of the landforms they studied during the experimental condition and showcasing their understanding through art.

Figure 10. Landform model created by students.

Behavior Assessments Concerning Time on Task

Behavior observations were tallied to determine the time students were on task during each condition. When a student was observed to be on task for the majority of the time during the activity, that student scored a "4" for the day. If the student was slightly off task for one minute, the student received a “3.” If the student was off task for two minutes or two times during the activity the student scored a “2.” Students who were considered to be off task for the majority of the time received a “1”.

The experimental condition was favored with better observed student behaviors in the second grade with a large effect size and in the fifth grade with a medium effect size. The third- grade results indicated that the control condition was favored with a small effect size. See Table 10. Each class is described in more detail in the following sections.

Table 10. *Mean Scores on Behavior Assessments of Time on Task*

Mean Score	2nd Grade Class		3rd Grade Class		5th Grade Class	
	Control Condition	Experimental Condition	Control Condition	Experimental Condition	Control Condition	Experimental Condition
Time on Task	3.28 (0.7)	3.87 (0.2)	3.99 (0.03)	3.94 (0.17)	3.63 (0.4)	3.82 (0.1)
Paired *t*-test results	$p < 0.001$; significant difference between conditions favoring the experimental condition; Cohen’s $d = 1.15$; large effect size.		$p = 0.04$; significant difference between conditions favoring the control condition; Cohen’s $d = 0.41$; small effect size.		$p = .02$; significant difference between conditions favoring the experimental condition; Cohen’s $d = 0.60$; medium effect size.	

Second grade behavior scores. In the second grade, there was a large effect size favoring the experimental condition regarding student engagement. Students behaved better for the experimental condition than the control possibly because students were more involved and excited to accomplish the experimental condition lessons. This situation of the experimental condition favoring better student behavior was found in another study (Fagan, 2015) in which participating classrooms had students who were more engaged when art activities were involved. Students were allowed to express their own reflections and insights about the content during the different art activities. As seen in this Figure 11, a student who struggled in reading was able to create a beautiful poster of the Rocky Mountains, displaying main idea and details through art instead of having to describe it in words. His behavior during the arts-integrated lessons improved because he was successful in expressing his ideas.

Figure 11. Work by student who typically struggled with reading and who demonstrated his main idea and details by creating a poster.

Third grade behavior scores. The mean scores on the behavior assessment show that third graders behaved somewhat better during the control condition with a small effect size. However, under both conditions, the mean time-on-task scores were nearly 4.00, indicating very good behavior at both times. A few students found too much freedom in the experimental condition and they either complained it was too hard or were more prone to overexcitement during this condition.

Fifth grade behavior scores. The student behavior data for fifth grade students showed that there was a significant difference between the two conditions concerning the students' behaviors, favoring the experimental condition of a mean score of 3.82 compared to the control score of 3.63 out of a possible 4 points. This result indicates that although most students were on-task most of the time during both conditions, they exhibited significantly better attention to their work during the experimental condition. Figure 12 and Figure 13 show non-posed photographs of fifth grade students under both conditions. Their facial expressions indicate more excitement during the experimental condition.

Figure 12. Students reading the nonfiction book and filling out the graphic organizer as part of the control condition.

Figure 13. Students reading and acting out parts of the book.

Additional Teacher Observations

During the control condition, students sat at their desks, quietly working independently, book in one hand and a pencil in the other. During the experimental condition, students were out of their seats, discussing the content with their group mates, working collaboratively on the assigned project, laughing, smiling, and creating models of learning. Research shows that purposeful, carefully implemented integration of arts, science, and language arts can lead to positive outcomes and demonstrated an increase in performance across the three content domains. Students of all ability levels were also able to discuss the content using descriptive vocabulary correctly (Poldberg 2013).

A trend in solving today's overcrowded school curriculum is to implement subject integration addressing several concept areas in the same lesson, while highlighting connections (Gray et al., 2016). In the current study, environmental science was integrated with crafts, reading of trade books, and self-guided discussions. Critical-thinking lessons, in which students are encouraged to think scientifically, allow students to be more active participants in their learning (Gray et al., 2016). In a study in which students were assigned to use pop-up constructions to create a scene, students were reluctant to stop work for lunch, even suggesting that lunch be skipped while they continued to work (Gray et al., 2016). In that same study, students had reported that they spent time at home looking for additional images to enhance their current projects made in the classroom. Students within our study complained that they seldom had the opportunity to be creative and create works of art outside of their formal art class; they especially enjoyed the engineering projects creating scenes with clay, cotton balls, Popsicle sticks, toothpicks, and paper.

Conclusion

Overall, in all three grade levels in the study, content knowledge was learned both in the control and experimental conditions. Second and third grade students learned content in a similar manner through both typical and arts-integrated instruction, but a significant difference between conditions was found in fifth grade students' content knowledge favoring learning through arts-integrated lessons with a very large effect size. In general, students of all grade levels had more positive attitudes towards the arts-integration lessons when they rated the different types of activities that they had participated in over the course of the eight weeks. Teachers observed that positive student behaviors usually favored the experimental condition; this finding supports the idea that arts-integration strongly engages students in learning science content during literacy lessons.

Implications for Practice

The authors of this study recommend bringing arts-integration into the classroom in literacy and science because it has shown a positive impact at multiple grade levels with no significant negative effects. Incorporation of students' opinions and thoughts through the arts allows students to process and express their feelings in connection to other ideas as they learn. Based on the findings of the current study, next steps would be for teachers to examine the scope and sequence of curricula and plan how to incorporate more hands-on arts approach in future content area lessons. The teachers involved in this study found that conducting an arts-integrated-to-typical lesson comparison study positively impacted their thought processes and willingness to try new ways in teaching. Hopefully, the results of this study will assist other educators, administrators, and/or policy makers in understanding the importance of arts in the classroom, rather than only using traditional ways of teaching. A way to implement these instructional strategies would be to provide educators with more professional development opportunities to improve student achievement as suggested by the results of this study.

Suggestions for Future Research

The recommendations for future research would be to allow more time, beyond eight weeks, for conducting the experiment. In the current study, both conditions had equal amounts of time for each activity. Art projects can take longer than standard graphic organizers and paragraph writing. Consider a different research design that will allow more time for the arts integration part so students can really relax and enjoy the arts processes. Alternatively, if another subject were integrated into the lessons, that might provide more time for students to unwind more during the art activities. Allowing students time to be creative and to put their ideas together in different ways may boost the positive results.

This arts-integration approach could be beneficial to students and educators and encouraged by showcasing students' hard work in and out of the classroom to inspire schoolwide conversations of how arts integration can be a powerful instructional tool. Educators need to generate a variety of art integrated lessons to avoid students doing the same activities repeatedly to practice skills, which leads to boredom. Future studies should consider incorporating arts-integration into technology to further enhance student retention of content knowledge and their engagement in learning. Extending this type of arts-integration investigation into high school and college level classes would reveal whether older students find arts integration effective.

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