Increasing Science Instruction In Elementary School Classrooms

Rosa Alexandria Leon

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A Capstone project for the Bachelor of Science in Human Development and Family Science
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**Introduction**

There is a lack of science instruction in elementary school classrooms, which results in science achievement gaps and a lack of scientific literacy skills. To address the lack of science instruction of school-age children, I have created a two-day interactive lesson on the life cycle of plants for first graders at Arroyo Seco Academy in Greenfield, California.

**Needs Statement**

Time devoted to science lesson plans in public elementary schools has become limited. On average, school-age children spend about two and a half hours a week on science instruction which is only twenty-eight minutes a day (Blank, 2013). Whereas students spend about twelve hours a week on language arts instruction and five and a half hours a week on math instruction (Blank, 2013). Elementary school-age children who spend less than three hours a week on science instruction are less likely to have positive science achievement scores (Blank, 2013). Students' academic achievement is dependent on the time they are given to learn and the time that they need to learn classroom material (Judson, 2013). When there is a lack of science being taught in the classroom, it results in science achievement gaps and a lack of scientific literacy skills.

An achievement gap is when a particular group of students, like females or African Americans, does significantly better than another group of students, like males or Latinos, and the scores are significantly larger than the margin of error (National Assessment of Educational Progress, 2020). Science achievement gaps grow when children attend low-resourced or low-quality schools in which science lesson plans are not implemented frequently and are of low quality when implemented (Morgan et al., 2016). Dual language learners are more vulnerable to
fall into the science achievement gap because of the difficulty to comprehend instructions in class (Morgan et al., 2016). However, when the science achievement gap decreases, dual language learners’ achievement growth greatly increases and is similar to their peers with higher academic levels (Morgan et al., 2016). Large science achievement gaps that develop in elementary school will typically continue to persist throughout middle school and high school (Byrnes et al., 2018). Long-term science achievement gaps decreases low-income Hispanic and African American students' ambition and chance to be able to succeed in science, technology engineering, and math education systems (Byrnes et al., 2018). The science achievement gap will only grow with the absence of science lesson plans (Morgan et al., 2016). To address the issue of science achievement gaps, science curricular intervention must begin early in elementary school.

Scientific literacy is understanding the laws and scientific methods of natural science, understanding scientific concepts and terms, and understanding the effect that technology and science have on society (Genci, 2015). Only eighteen percent of seniors in high school were considered scientifically literate (US National Assessment of Educational Progress as cited in Liu, 2009). Students make more intertextual connections through science books and score higher on standardized tests when science literacy is used in their science curriculums (Cervetti et al., 2012). Furthermore, when science literacy is integrated into science lesson plans students are more likely to understand scientific terms and use them while writing (Cervetti et al., 2012). However, when children develop inadequate scientific literacy skills they are unable to fully understand scientific text (Güçlüer & Kesercioğlu, 2012). Today, it is becoming more important for people to possess scientific literacy skills (Genci, 2015). When students possess science literacy skills they are better able to address public policy issues like hydraulic fracturing and
climate change in adulthood (Morgan et al., 2016). Children must develop scientific literacy skills early in elementary school for a successful educational career.

Young children gain many benefits when they learn science early in elementary school such as gaining science processing skills, gaining problem-solving skills, and having a better attitude towards science. Science processing skills are the ability to use mental skills and physical skills to process, organize, and collect information in different ways (Mulyeni et al., 2018). Two categories are part of the science processing skills. One of the categories is integrated science process skills which consist of interpreting data, hypothesizing, experimenting, and controlling variables (Martin, 2009 as cited in Mulyeni et al., 2018, p. 188). The second category of science processing skills is the basic science process which includes observing, predicting, classifying, and measuring (Mulyeni et al. 2018). Children who gain science processing skills early in their education are more likely to have a greater understanding of science literacy and a greater understanding of the contents of science (Durmaz & Mutlu, 2017). Observation is one of the first and most important skills children use to gain knowledge of the world around them (Mulyeni et al. 2018). Through observation, children are creating connections to what they are exploring (Martin, 2009 as cited in Mulyeni et al., 2018, p. 188). Children who partake in scientific observation in their early school years are also more likely to have the scientific information they learned stored in their long-term memory (Mulyeni et al. 2018). Furthermore, when students learn science early they have greater problem-solving skills and a better attitude towards science (Mulyeni et al. 2018). A benefit young students gain in possessing problem-solving skills early in their educational career is being able to apply this skill in their personal lives as well as in other subject areas in school (Durmaz & Mutlu, 2017). A benefit children gain from having a better attitude towards science is they are more likely to pursue a
career in science, technology, engineering, and math (Durmaz & Mutlu, 2017). The benefits associated with learning science early in elementary school have many positive impacts on the educational career of young students.

Given that a lack of science instruction in elementary school causes science achievement gaps and leads students to have poor scientific literacy skills, I have created a two-day interactive lesson on the life cycle of plants for first graders at Arroyo Seco Academy, Greenfield, California.

**Theory**

Jean Piaget’s theory of cognitive development focuses on how people gain, use, and construct knowledge and information from birth through adolescence (Santrock, 2016). When children learn new information they either accommodate or assimilate their schemas. A schema is a mental representation or action that organizes knowledge (Santrock, 2016). For example, when a young child's schema of squirrels is furry animals who climb trees. So when they see a cat climb a tree they say “squirrel” because of their existing schema of squirrels, which is assimilation. However, since squirrels and cats are completely different they accommodate this new information, by changing their current schema of squirrels or creating a different schema for cats.

Piaget found that this process of adding to or forming new schemas occurred in different ways during different stages of an individual’s life. Piaget’s theory consists of four stages which are the sensorimotor stage, the preoperational stage, the concrete operational stage, and the formal operational stage. Young school-age children are in the preoperational stage of cognitive development when children between the ages of two and seven develop symbolic functioning skills (Santrock, 2016). They also have a strong sense of egocentric thinking, have animism
ideas, exhibit centration, and cannot perform operations yet (Santrock, 2016). Egocentric thinking is the inability to think from another person's perspective (Santrock, 2016). Young children who have animism ideas give inanimate objects life-like abilities such as a preschooler stating their chair is angry (Santrock, 2016). Children who exhibit centration focus on one characteristic of an object and exclude all other characteristics (Santrock, 2016). Performing operations is the ability to mentally perform tasks that young children in Piaget's second stage cannot yet perform (Santrock, 2016).

Children who are four to seven years old are at the end of Piaget's second stage which is the intuitive thought substage. In this stage, children begin to seek answers to their “why” questions and begin to use primitive reasoning (Santrock, 2016). This questioning is due to them becoming aware they have a lot of knowledge but do not know how they acquired that knowledge (Santrock, 2016). The intuitive thought substage of Piaget’s theory applies to my project because the science activity will allow the first graders the opportunity to ask “why” questions about life science and have them answered, leading them to build upon their knowledge of life science.

Next, first-grade children are transitioning to Piaget's concrete operational stage of cognitive development. Throughout this third stage, children, between the ages of seven to eleven, begin to reason logically and become capable of conservation, seriation, reversibility, class inclusion, and transitivity (Santrock, 2016). Seven-year-old children move on from using intuitive reasoning and begin to use logical reasoning to further gain and construct knowledge and information. An example of this is learning about cause-and-effect relationships through observation, discussions, and experiments in the classroom. The third stage of Piaget’s theory
applies to my project because first-grade students will practice using logical reasoning skills by making connections on how parts of a plant help the plant function.

Overall, Piaget’s theory of cognitive development focuses on how a person's cognitive process develops from birth to adolescence. This project will further develop the first-grade student's cognitive process by aiding them in transitioning from Piaget’s second stage of cognitive development to Piaget's third stage of cognitive development in practicing using current and new cognitive skills and accommodating and assimilating their schemas of life science.

**Consideration of Diversity**

My project will be conducted in person with first-grade students in the after-school program at Arroyo Seco Academy in Greenfield, California. According to the School Accountability Report Card (SARC) in the 2019-2020 school year, Arroyo Seco Academy had 612 students enrolled with 98.4% of the population being Hispanic or Latino, 1% white, 0.2% African American, 0.2% American Indian or Alaskan Native, and 0.2% Filipino. The SARC in the 2019-2020 also reported that 94.9% of students were socioeconomically disadvantaged, 66% are English learners, 23.2% are homeless, and 10.9% have a disability. The SARC also states there were 87 first graders in the 2019-2020 school year. My project will be conducted with 10 first-grade students. Also, students at Arroyo Seco Academy attend the after school for free. Students either attend the program to get extra support with their homework or they attend the program because their parents do not get out of work until 5 pm. I would expect my participants to be reflective of the larger population of Arroyo Seco Academy in terms of race, ethnicity, and socioeconomic status.
For the students to participate in my project, they will need to be able to write and speak in English proficiently. Participants who do not speak English or are not literate in English may be excluded from the project. Since my project is aimed at lower-level elementary school students, it is too simple for students in a higher grade level. A change that needs to occur for the content to apply to older participants like middle school students is focusing more on the chemistry aspect of the life cycle of plants. A change that can be made is the project being based on the process of photosynthesis to better fit middle school students. I will also need to ensure that the information I provide to the participants is not too complicated or long so they can stay engaged throughout the project.

**Learning Outcomes**

I intend to provide two, forty-five-minute lessons to first-grade students in the after-school program at Arroyo Seco Academy.

By the end of my project, participants will:

1. Describe the function of two parts of a plant
2. Identify two ways plants help people and animals
3. Identify two things needed for photosynthesis to occur

**Method**

**Day 1**

I will first introduce myself to the first-grade students and explain the topic we will discuss. Then, I will inform the students that I will be reading a book to them about plants. I will then read *The Amazing Life Cycle of Plants* by Kay Barnham which covers the topics of the life cycle of a plant, the functions of a plant, how insects use plants, and what plants need to grow. See Appendix A. Throughout the reading, I will pause and talk about the important points made
in the book like how the stem carries water and nutrients from the roots. Afterward, we will have a ten-minute discussion about the book. I will ask questions like: What are some plants that have seeds? Which plants have a long life cycle? After the discussion, I will direct the students to sit at their desks and then I will pass out a worksheet. I will explain to them that they will be writing the functions of the parts of a plant on the worksheet. The first-grade students will then describe the function of two parts of a plant by completing the worksheet. See Appendix B. Afterwards, I will have the students sit on the rug and have them brainstorm how long it takes for a bean plant to grow. After they share their guesses they will watch the video: https://www.youtube.com/watch?v=w77zPAtVTuI. This video is a time-lapse of a bean plant growing from seed to plant. To end the day, I will inform the first-grade students that we will be learning about photosynthesis and why plants are important to humans and animals the next time we meet.

Day 2

I will begin by reminding the students about the parts of a plant and its functions. Then give a brief overview of the activities they will be doing that day. I will inform the students that plants are important to animals and humans because they depend on plants for many things. Next, I will present my PowerPoint presentation titled “Thank you plants.” See Appendix C. Throughout the presentation the first-grade students will identify two ways plants help people and animals. In the first part of my presentation, I will inform students of the different ways plants help animals. For instance, I will inform students that plants provide animals a habitat. Then I will have the students identify at least one way plants provide a habitat for animals and I will write their responses on the whiteboard. In the second part of the presentation, I will inform students of the different ways plants help people. For instance, I will inform students that plants
provide people with food. Then the students will identify at least one way plants provide people food and I will write their responses on the whiteboard. When we finish the Powerpoint activity, I will show students an aloe vera plant and how it is used to treat burns.

For the second segment, I will have students watch a music video about photosynthesis from https://www.youtube.com/watch?v=HYYeHyzOlc. Afterward, I will present a photosynthesis diagram to review the important aspects of photosynthesis like how chloroplast converts sunlight into energy for the plants. See Appendix D. Next, I will have students return to their desks and explain to them that they will be identifying the important elements that need to be present for photosynthesis to occur on a worksheet. The first-grade students will then identify two out of the five things needed for photosynthesis to occur by completing a cut and paste worksheet. See Appendix E. I will wrap up the project by giving students a sunflower growing kit to take home.

**Results**

Due to COVID-19, I was unable to execute my project.

**Discussion**

Due to COVID-19, I was unable to execute my project.
References


Appendices

Appendix A

The Amazing Life Cycle of Plants by Kay Barnham.
Appendix B

Functions of the Parts of a Plant Worksheet for learning outcome 1.
Appendix C

Powerpoint on how plants help people and animals.

Thank You Plants!

How do Plants help People?

- Plants provide medicine
- Plants give people food
- Plants provide wood for various needs
- Plants provide cotton for clothes
How do Plants help Animals?

- Provides animals a habitat
- Plants give animals food
- Plants give animals shelter from harsh weather
Appendix D

Photosynthesis Diagram.
Appendix E

Photosynthesis Cut and Paste Worksheet for learning outcome 3.
Appendix F

Capstone Presentation

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Need

- Science achievement gaps
- Lack of scientific literacy skills
- Benefits of learning science early
Jean Piaget’s Theory of Cognitive Development

- Preoperational Stage
- Intuitive Thought Substage
- Forming New Schemas
- Concrete Operational Stage
- Logical Reasoning

Learning Outcomes

By the end of my project, participants will be able to

1. Describe the function of two parts of a plant
2. Identify two ways plants help people and animals
3. Identify two things needed for photosynthesis to occur
Methods

- Two-Day Implementation
- 45 minutes each day
- 10 first grade students in the after school program
- Arroyo Seco Academy in Greenfield, CA

Methods Day 1

- Explain how we will be learning about plants
- Read *The Amazing Life Cycle of Plants* by Kay Barnham and have a discussion about it
- Describe the functions of two parts of a plant
- Watch “Bean Time-Lapse - 25 days”
The Amazing Life Cycle of Plants

Written by Kay Barnham
Illustrated by Maddie Frost
Methods Day 2

- Plants are important to humans and animals
- “Thank You Plants” Powerpoint
- How do plants help people and animals?
How do Plants help Animals?

- Provides animals a habitat
- Plants give animals food
- Plants give animals shelter from harsh weather

Methods Day 2

- “Photosynthesis SONG - How Does Photosynthesis Work?”
- Photosynthesis diagram
- Photosynthesis cut and paste worksheet
With energy from the sunlight (I simply can’t do it at night). I'll just soak up your CO2, And add water to make my food.

Key Words

Oxygen
Water
Chloroplast
Sunlight
Carbon Dioxide
Discussion
Not executed due to Covid-19

Thank You!
Any Questions?
Rosa Leon