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TEACHING PHOTOSYNTHESIS:

A Graduate Service-Learning Experience in an Eighth Grade Science Class

Cecilia Espinoza, *College of Agriculture*

ABSTRACT

The purpose of this service-learning experience was to provide a graduate student from a land-grant university with a teaching experience at a local public school. Through a GK–12 program, author assisted a middle school science teacher in the development of class activities and engaged eighth graders in active learning. In this program, 132 eighth grade students participated in a series of active learning activities developed by the author in collaboration with the teacher. These activities aimed to enhance students' understanding of the process of photosynthesis.

KEYWORDS

service-learning, teaching, photosynthesis, eighth grade, middle school, science

INTRODUCTION

Many middle school students are finalizing their decisions to pursue a STEM (science, technology, engineering, and mathematics) career before they enter high school. Therefore, middle school may be the last chance to influence students toward a STEM pathway. For that reason, instructional methods that increase students' abilities and interests in science should occur at the middle school level (Honey, Pearson, & Schweingruber, 2014).

One of the learning outcomes for eighth graders in life sciences involves photosynthesis (National Research Council, 2012). The curriculum for middle school science students states that lessons about photosynthesis should include facts on plant structure and the role of plants in taking in carbon dioxide (CO_2) from the environment and releasing oxygen (O_2) for human consumption (Indiana Department of Education, 2016). In addition, the Next Generation Science Standards (NGSS) for the life sciences (LS1.C) states that plants use the

energy from sunlight, water, and CO_2 to synthesize carbohydrates and to release O_2 through photosynthesis (NGSS, n.d.).

In fall 2016, I engaged in the GRAD 590 GK–12 program at Purdue as a result of my positive experience with the program while obtaining my master's degree. In 2012, I was part of the same educational program at Tecumseh Junior High School. At that time, all students were taken to Fair Oak Farms as part of a student grant program for community service. The goal of visiting Fair Oak Farms was to provide eighth graders with a place-based learning experience to enhance their knowledge of agricultural sciences. The Community Service Grant Program was facilitated by Purdue's Office of Engagement through the GK–12 program (Purdue University, n.d.a).

Overall, the GK–12 program provided me the opportunity to enhance my teaching and communication skills and learn teaching strategies from a science teacher in a local public school. In addition, engaging middle school

Figure 1. Participants. Courtesy of Dr. Faith Weeks.

students in science activities using agricultural concepts such as photosynthesis could influence them to pursue an agricultural-related science career.

The student grant I received in fall 2016 from the Purdue Service-Learning Grant Program for my service-learning initiative was fundamental in acquiring the materials middle school students need to develop learning activities. These activities were planting, watching educational videos, a laboratory experience, and class discussions regarding photosynthesis. The planting activity aimed to promote the importance of light into photosynthesis for plant survival, and the laboratory experience engaged students in the visualization of a product of photosynthesis (a carbohydrate) in leaves by using a dying compound. All activities were supported by handouts developed in collaboration with the science teacher. The learning objectives for these experiences included the abilities to:

1. identify basic vocabulary of the photosynthesis process: reactants (light, carbon dioxide, and water), plant parts (leaves) and molecules (chlorophyll) involved in photosynthesis, and products (carbohydrates and oxygen);
2. determine through experimentation that plants produce carbohydrates (e.g., starch) as a consequence of photosynthesis; and
3. determine through experimentation that light from the sun gives energy to plants for their growth.

DESCRIPTION

A middle school science teacher from Tecumseh Junior High School in Lafayette, Indiana, agreed to participate in the GK–12 program as part of her standard curriculum. Participants included 120 eighth grade students, 62 girls and 58 boys, distributed across six classes

(Figure 1). Seventy percent of the students at the school received either free or reduced lunch (Graphiq, n.d.).

The Purdue GK–12 educational program is a graduate school initiative directed by Dr. Jon Harbor and currently coordinated by graduate student Mohan Yang. Purdue graduate students, post docs, and visiting scholars interested in this program apply through the graduate school website. Purdue students are part of the GK–12 program by either volunteering or enrolling in a two-credit class (GRAD 590). The GK–12 program is modeled on a successful program funded by the National Science Foundation (NSF). In this program, participants serve as visiting scholars at Tecumseh Junior High School. Teachers and participants work together to integrate research and new approaches into classrooms. They observe the classroom first, and then gradually assist teachers, working up to teaching a lesson as the primary teacher (Purdue University, n.d.b).

CLASSROOM ACTIVITIES

I implemented a five-day lesson in a science class over the course of a month, once per week. First, eighth graders were engaged in a class discussion about what photosynthesis meant and how the process was connected to their daily lives. Second, they watched an educational video about photosynthesis to become familiar with the vocabulary of the process. Third, they worked first individually on a handout about photosynthesis and then as a team in the completion and checking of the handout (Figure 2). Fourth, students participated in an experimental activity that involved growing a plant under light and dark conditions (Figure 3). Students defined their hypotheses and tested them with the experience. The goal of this activity was that students determined through experimentation that light energy promotes plant growth.

Figure 2. A student working on a handout. Courtesy of Dr. Faith Weeks.

(a)

(b)

(c)

Figure 3. Experimental activity (a) newly planted seeds, (b) a student measuring the length of a seven-day seedling, and (c) seven-day seedlings.

COMMUNITY IMPACT

Positive impacts occur from a relationship between middle school students, their teacher, and a graduate student. I enhanced my teaching and communication skills and learned teaching strategies from the science teacher. Middle school students gained scientific knowledge, performed experiments, and reported results. They also learned more about what students do at a university and their options to pursue a degree at Purdue.

Classroom handouts were provided to students during the lessons to help them recall and recognize vocabulary on photosynthesis. Students completed handouts individually and then as teams of four students. Students' knowledge was checked through class discussions. The handouts were developed based on the learning

outcomes for the experiences, supported by the standards (Indiana Department of Education, 2016; NGSS, 2013).

Challenges and Barriers

Students were clustered in different class periods. In each class, there were students who were able to focus and follow instructions for a task, as well as others who had a difficult time with instructions. I conducted all of the lessons with the teacher's support to help manage classroom behavior and logistics.

GRADUATE STUDENT IMPACT

The GK-12 program provided me with training on middle school students' vocabulary, content, amount of information, their emotions at that age, as well as

lesson planning. This experience also taught me how to communicate about my field of study to non-experts. I learned that it is important to simplify the language and use analogies related to their age—using their vocabulary while including scientific and academic words. The GK–12 program at Purdue University supported my potential future career goals to be a faculty member in the field of education.

Given my experience with the GK–12 program, my view of teaching has changed since beginning the program. Prior to my experience at Tecumseh Junior High School, I learned from research that classroom integration at school is positive for all. After teaching in an integrated classroom for some months, however, I see limitations of classroom integration as effective for all students. These limitations were visible when a teacher has 29 students in a classroom. For example, students with learning, language, and emotional disabilities received the majority of the teacher's attention. It was assumed that students who performed better were able to work successfully with limited guidance.

CONCLUSIONS

In conclusion, I learned that (1) a smaller class size (12–15 students) is better when it comes to teaching; (2) middle school students enjoy hand-on activities; and (3) developing activities in collaboration with the teacher made the lessons more beneficial for the students. My advice for fellow graduate students who develop and teach lessons for a middle school classroom is to work together with the teacher. The success in bringing research into the teacher's curriculum depends on this relationship. This means adapting the lesson to the teacher's needs and incorporating the teacher's feedback into the dynamic of the lesson.

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REFERENCES

Graphiq. (n.d.). StartClass: Lafayette Tecumseh Jr High School in Lafayette, Indiana. Retrieved from <http://public-schools.startclass.com/1/32067/Lafayette-Tecumseh-Jr-High-School>

Honey, M., Pearson, G., & Schweingruber, H. (2014). *STEM integration in K–12 education: Status, prospects, and an agenda for research*. Washington, DC: Committee on Integrated STEM Education, National Research Council, National Academies Press. <https://doi.org/10.17226/18612>

Indiana Department of Education. (2016). *Indiana Academic Standards: Biology Standard 2*. Retrieved from <http://www.doe.in.gov/standards/biology-resources>

National Research Council. (2012). *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: National Academies Press. <https://doi.org/10.17226/13165>

NGSS. (2013). HS-LS1 from molecules to organisms: Structures and processes. *Next Generation Science Standards*. Retrieved from <http://www.nextgenscience.org/dci-arrangement/hs-ls1-molecules-organisms-structures-and-processes>

NGSS. (n.d.). LS1.C: Organization for matter and energy flow in organisms. San Diego, CA: San Diego County Office of Education, Next Generation Science Standards. Retrieved from <https://ngss.sdcoc.net/Disciplinary-Core-Ideas/DCI-Life-Sciences/LS1C-Organization-for-Matter-and-Energy-Flow-in-Organisms>

Purdue University. (n.d.a). Community Service/Service Learning Grant Program. *Office of Engagement*. Retrieved from <https://slg.engagement.purdue.edu/>

Purdue University. (n.d.b). Graduate School Professional Development. (2017). Retrieved from <https://www.purdue.edu/gradschool/gspd/gk-12/index.html>

AUTHOR BIO SKETCH

Cecilia Espinoza is a Fulbright fellow from Chile. She earned a double bachelor degree in agronomy and biochemistry from the P. Catholic University of Chile, and she earned her master's degree in horticulture from Purdue University in 2012. She is currently a doctoral candidate in the Department of Youth Development & Agricultural Education (YDAE) at Purdue, which she expects to complete this fall. She then plans to work as a P–12 professor at her local university in Chile. Espinoza has been involved in several professional activities since the beginning of her graduate program at Purdue. She was a participant of the international program in agriculture (IPIA) Latin American initiative series promoted by the College of Agriculture (2011); an officer of the MANRRS association in the College of Agriculture (2013); the YDAE senator for the Purdue Graduate Student Government (PGSG) (2013–2014); the secretary of the graduate women student organization of the College of Agriculture (WCOA) (2015); the treasurer of the discipline-based educational research graduate student organization (DBER-GS) (2015–2016); and a teaching volunteer at the Lafayette adult resource academy (LARA) (2015).

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