



Educational Connections to Ongoing Research Projects (E-CORP)

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Abstract

The field of environmental education is challenged to look for new ways to develop relationships, partnerships, funding and strategies to further support our role to continuously develop an environmentally literate citizenry. The FAU E-CORP (Palm Beach County, Florida, USA) program is a internationally replicable model that highlights the collaboration between research scientists and environmental education programs by providing curriculum and field experiences to K-12 students. Researchers benefit from education professionals in the field of environmental education developing and disseminating a high quality, mission-driven, standards-based curriculum relating to their research. Drawing on current research in one of the most important lagoons in the US, the E-CORP RESTORE program focuses on the issues concerning fisheries populations and how they are impacted by changes in our natural habitats. During the 2-year pilot, a total of 109 students from three area schools participated in classroom lessons as well as field experience. Through these experiences, students developed an understanding of populations in natural and disturbed areas, and the considerations and actions that must take place for an area to be restored for the benefit of the local environment. Pre- and Post-test data as well as survey data of program outcomes are presented, and the implications of student engagement are discussed.

Keywords: E-CORP; environmental research; collaborative partnerships;

1. Introduction

Many studies have demonstrated a lack of student interest in science [1]. Teachers often struggle to convey complicated science concepts to students in meaningful ways that lead to science literacy. However, traditional science teaching methods wherein the teacher presents science content within the confines of a classroom (transmission) can lead to student disengagement [2]. Research suggests that students disengage from school subjects because they fail to see a clear connection between their education and their lives [3] Thus, there is a need for students to see the relevance of science and make connections to the real world. In addition, there is an increasing demand for science, technology, engineering and mathematics (STEM) workers in the United States, yet US student performance in science ranks nineteenth out of thirty-five OECD countries [4]. Consequently, some analysts suggest that the U.S. is on track for a shortage of 1 million STEM workers [5]. In order to ameliorate this situation, various initiatives have been created to engage students in STEM education in the K-12 classroom. These initiatives are designed to familiarize students with the tenants of scientific practice so that they may learn the discipline-focused values of science (such as open-mindedness, objectivity, and accuracy) as well as the norms, values, beliefs, expectations, and actions of scientists [6]. In doing so, the hope is that students will be able to see themselves as the kind of person that could engage in scientific endeavors, think rationally and understand the world scientifically, and therefore be more likely to choose a STEM related career [6].

Shaner et al. [7] found that students who engaged with scientists had a more statistically significant increase in attitudes toward science. Conversely, there is developing requirement internationally for research scientists to develop educational outreach programs (also known as broader impacts) as part of their research proposals [8]. One such initiative that is connecting students and scientists is the FAU Pine Jog Environmental Education Center (FAU Pine Jog)'s ECORP. The objective of this paper is to fully describe this program and the impacts that it had on students.



2. The Program

The E-CORP Restore Program was developed in partnership with Dr. Scott Markwith, Professor in FAU's Department of Geosciences, as part of a 2-year grant with The Curtis & Edith Munson Foundation. Markwith's research focuses on analyzing the habitat use and migration patterns of two game fish, common snook (*Centropomus undecimalis*) and gray snapper (*Lutjanus griseus*), in Lake Worth Lagoon (LWL) and examine the effects of restoration efforts on adult game fish populations. In 2017-2018, 109 students from three schools (public and private) in Palm Beach County, Florida participated in the program. Classes ranged from 8th-12th grade with approximately 40 students from each school. Participating schools were identified through our existing network of science teachers. FAU Pine Jog developed a series of in-class lessons and field experiences utilizing the BSCS 5E Instructional Model (2006) as a framework. The program included two teacher-led classroom lessons, a field experience with the grant PI and other professional scientists, and the preparation and presentation of their findings. See Table 1 for an overview of the lessons.

5 E's	Lessons and Field Experience	Lesson Objective
ENGAGE	Faux seining activity & Internet Scavenger Hunt	To introduce students to recent restoration efforts in the Lake Worth Lagoon, some of the fish species found and techniques for calculating the species diversity index.
EXPLORE	Field Experience in the Lake Worth Lagoon (LWL)	Connecting students with the scientists and learning how they conduct research in the lagoon.
EXPLAIN & EXTEND	Preparing PowerPoint Presentation of Research Findings	Analyze the data collected and synthesize the information learned on the field experience
EVALUATE	Final Presentation	Presenting what they learned to their peers.

Table 1. Overview of the 5 E's Lessons developed for ECORP Restore Program.

The initial classroom lessons were designed to orient students and introduce them to the concepts they would encounter in the field experience. In the faux seining activity, students learned about fish diversity. Using a large net fixed with magnets would collect laminated photos of fish which students would identify and then calculate the species diversity index. This activity was followed by an internet scavenger hunt wherein students would learn about the various restoration projects within the LWL.

For the field component, students worked with the scientists to collect data to compare the recently restored area of the lagoon with the degraded and unrestored areas. Data collected included water quality, turbidity, water temperature, and fish species diversity. Fish data were collected using two different sizes of seine nets (70 ft and 600 ft) with different net mesh sizes that are designed to sample different communities and populations of fish. In addition to the PI, Florida Fish and Wildlife Conservation Commission's (FWC) Fish and Wildlife Research Institute provided three scientists for each trip.

After the field portion of the program, students continued back in their classroom to synthesize what they learned by creating a PowerPoint presentation analyzing the field collected data, which was then presented to their peers.

3. Results

The results of this program were evaluated by looking at student knowledge gains from a pre-/post-test comparison, as well as from feedback from a Google Survey. The pre-/post-test was given to the students by their teachers at the start and end of the program in year 2 only. The survey was distributed to students with 102 of the 109 students completing the survey.

The pre- and post-test with 10 questions was implemented to evaluate the learning outcomes for the students who participated in the program. The following chart summarizes the average improvement in test scores between pre-program and post-program delivery. Students who answered the least



number of questions correctly prior to the program showed the greatest improvement, averaging an increase of more than 5 correct answers after program delivery.

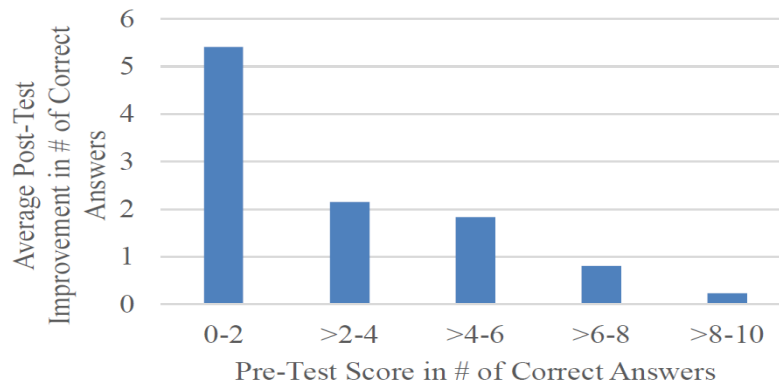


Figure 1. Average number of correct answers between the Pre- and Post-test.

Survey results suggest that students valued the program as shown by their responses to the survey items listed in Table 2. In addition to the pre-/post-test, students were asked what they like best about the program and what their “light bulb” moments were. One of the most common responses was interacting with and learning from the scientists (16). Students had the opportunity to learn from FAU scientists as well as FWC scientists. One student said that they enjoyed talking about potential research opportunities and indicated that they wished to explore them further. Two students also mentioned that they enjoyed hearing about the scientists’ career paths. One of those students commented that she really liked sitting with scientists after the large seine to discuss her career and journey in science. Learning about various restoration projects and why they are important was also highlighted by several students (17). Students also enjoyed the hand’s-on field aspect of the experience (20) and liked that they could make the connection between what was learned in the classroom with the activities that they did on the field trip (5). One student said that they liked “being able to see things in the real world rather than just a textbook.” Another commented that all of the students were really involved in handling the fish, analyzing the data, etc. “instead of just sitting back and listening to lectures.” One student even said, “I loved it so much, I might even consider going into environmental science.”

Item	1	2	3	4	5	6
I learned valuable information from the in-class lessons.				15	27	60
I learned valuable information from the field experiences.				3	10	89
The field activities were implemented in an interesting and stimulating manner.				3	14	85
The lessons increased my content knowledge about restoration ecology.				4	22	76
The program provided me with useful information about future career opportunities in science.		1	3	14	17	67
I enjoyed interacting with the scientists.				5	19	78

Table 2. Student feedback from survey regarding the program (n = 102) where 1 is strongly disagree and 5 is strongly agree.



4. Discussion and Conclusion

The ECORP Restore Program was intended to increase student engagement and interest in science by participating in an authentic science activity, rather than the usual theorized experience that is typical of the science classroom. Through this program, students drew upon their scientific knowledge to ask scientifically oriented questions, collect and analyze evidence, develop explanations, and communicate those explanations with their peers as well as professional researchers.

By partnering with scientists from local agencies, we were able to provide students access to people that are working in the field on local environmental issues, and enable them to perform tasks as professional scientists would. Their participation and their willingness to work with the students at no cost to our facility increased our capacity to provide this experience to more students. Students benefited from working alongside the scientists and talking to them about their experiences. Students were exposed to a variety of different types of STEM related careers as the students were able to have informal, candid conversations with the scientists as they discussed their job descriptions and career pathways.

While, many schools have expressed interest in participation in the future, the limitation is the availability of the researchers to interact with the students. Steps are being taken to reach out to other FAU departments that are doing scientific research for potential partnerships. In addition, several large government granting agencies are beginning to require educational components that reach K-12 students as part of their educational outreach (broader impacts). We anticipate that as this trend progresses, there will be more of a need for partnerships such as this one.

Although the first two years of this program was grant-funded, with the proven class-tested curriculum that required minimal management from Pine Jog, the program was able to move to a fee based model in its third year. The program now operates fully supported through fee collection from each school that covers all direct and indirect costs.

This easily replicable model provides opportunities for students that rarely exist in the traditional classroom, yet is called for by numerous studies in student engagement. The outcomes of this program indicate that the objectives of increasing student content knowledge and engagement in the scientific process were achieved.

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