PROJECT REPORT

Combining Cross-Disciplinary STEM Collaborations and Academic Service Learning to Help a Community in Need

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Abstract

This project report presents a multidisciplinary Faculty Learning Community model to foster civic engagement in STEM classes. It focused on first-year Chemistry, Math, and Scientific Inquiry courses and incorporated Academic Service Learning in a project to build solar cell phone chargers for a school in Puerto Rico recovering from the effects of Hurricane Maria in 2017. The project provided hands-on experiences for the students, with the tangible outcome of building the solar chargers for people in need. Student engagement was measured through surveys and reflective assignments; the students responded positively to their work and their sense of fulfilling the St. John's University mission. The members of the Faculty Learning Community have engaged in ongoing collaborative relationships.

KeyWords: Student Peer Mentoring, Knowledge Transfer, Academic Service Learning

Introduction

Faculty members from four different departments, Chemistry, Physics, Math, and Core Studies, were brought together as a Faculty Learning Community (FLC) under a St. John's University grant to improve undergraduate STEM education at St. John's (Cox, 2004; Baker, 1999). Expectations for the cohort were to attend the 2017 Association of American Colleges and Universities (AAC&U) Transforming STEM Higher Education conference, to disseminate their learning experiences to the wider St. John's faculty, and to develop their own STEM project (Association of American Colleges & Universities, 2017). Inspired by an introductory talk at the AAC&U meeting, the cohort developed a multidisciplinary Academic Service Learning (ASL) project in which St. John's students constructed solar cell phone chargers for students at a Puerto Rican school impacted by Hurricane Maria (Escuela Segunda Unidad Botijas #1 in Orocovis). ASL is a known high-impact practice that provides the potential for applied learning and civic engagement (Strage, 2000; Kuh, O'Donnell, & Reed, 2013). In our project, students in first-year Chemistry, Mathematics, and Scientific Inquiry (a required class for non-science majors) used their scientific knowledge and skills to help others by building 100 solar phone chargers for students who were without power in a mountainous region in Puerto Rico. The participants in this ASL project met outside of their scheduled class times to collaborate on assembling the chargers, participate in discussions with our Puerto Rican partners, and create videos on the construction process and the use of the chargers. Additional videos were produced by the St. John's students in which they reflected on their involvement in the project.

Our FLC illustrates the power of this structure to encourage interdisciplinary cooperation and to build stronger ties among faculty members, which benefits the faculty, students, and the community beyond the university (O'Neil, Yamagata, Yamagata, & Togioka, 2012). This project, with its focus on civic engagement, integrated STEM learning and real life applications and excited the students about the tangible and practical impacts of STEM (Turrini, Dörler, Richter, Heigl, & Bonn, 2018; Strage, 2000). Furthermore, current research on learning acknowledges the many factors beyond classroom pedagogy and specific content—including individual, social, cultural, and institutional influences—that affect learning, for both faculty and students (Pandya, Dibner, & Committee on Designing Citizen Science to Support Science Learning, 2018).

Faculty Learning Communities

Faculty Learning Communities typically involve voluntary groups of teachers, students, and administrators with a clear sense of membership, common goals, and extensive face-to-face interaction (Baker, 1999). Our FLC differed in some ways from that model in that it was a closed group, and the members were invited to join by the Dean and a faculty leader who acted as a group facilitator. The goals of the FLC were to develop a project and to share knowledge with STEM colleagues within a one-year time frame. Following best practices, the participants represented faculty from diverse disciplines (Sonnenwald, 2007; Hunt, Layton, & Prince, 2015; Ferrini-Mundy, 2013). Even though the members were largely unacquainted with one another at the outset, the FLC provided an opportunity for increased engagement across the disciplines.

The FLC was sent to the AAC&U conference to learn about new pedagogies and tools that they could bring back to the wider university STEM community. Most of the members of this FLC had not been exposed previously to some of these newer pedagogies. During the opening welcome, the Conference director challenged the attendees to consider projects that would help the people of Puerto Rico impacted by Hurricane Maria. Having decided to address this challenge by developing a project that built on our strengths in ASL, the group designed a project that would provide students with an applied-science-related activity that would also benefit people in Puerto Rico.

As a result of attending the conference, the FLC became a more coherent unit that provided a foundation from which to learn about each person's discipline and personality. Exposure to our various disciplines, approaches to research, and our professional trajectories led to creative collaborations and problem-solving (Olson, Labov, & National Research Council (U.S.), 2014). This in turn led to a greater understanding of the strengths

of each member and ultimately to a successful working relationship that is ongoing.

Project Overview

In response to the charge to create projects to help the victims of the hurricane, the FLC decided to focus on a STEM-centered ASL project that would aid this population. Realizing that many of the communities of Puerto Rico remained without electricity, the idea for a solar powered project emerged. Our ASL office identified Nuestro Ideal (Nuestroideal.org, n.d.), a local, non-governmental organization, as an effective collaborator. Nuestro Ideal selected a school without electricity in Puerto Rico. With funds provided by St. John's University, the FLC acquired materials and organized classroom opportunities to bring together the different classes taught by the members of the FLC. Upper-level students from the Society of Physics provided assistance by preparing materials as well as acting as coaches during the assembly process. Two out-of-class sessions were scheduled for the project, one to learn the skills needed to build the chargers, and one to assemble them. An online repository was established for students to post video reflections on their work and to tie their experience to what they were learning in their individual classes.

The goals for the project were to:

- Provide a STEM-based project with a civic engagement focus for a community in need in Puerto Rico.
- Create a STEM experiential learning environment for STEM and non-STEM students.
- Ensure that the hands-on applied project was accessible for students with different experiences and academic backgrounds.
- Foster collaborations among these students in a multi-disciplinary project.
- Create an opportunity for the upper-class students to share their expertise and enthusiasm for science.

Project Process

Upon receipt of the solar cell phone charger components, the Society of Physics students helped design and test the prototypes, pre-assembled the wiring harnesses with blocking diode housings, and fastened the connector housings to the solar cell frames (Fortmann, Lazrus, Rosso, Catrina, & Hyslop, 2019). At the initial ASL session, the students learned to solder and make reliable electrical connections, skills necessary for making the final products. They also learned about the school in Puerto Rico and the students who would receive the chargers. At the second session, the wires from the solar panels were soldered and attached to the USB connectors. All soldered connections were covered with silicon to prevent rust or disconnections. The entire assembly process was livestreamed via WebEx to the teachers and students in PR. The student groups were also asked to create two videos, one in which they described what they were doing and how to use the chargers and the other a reflective piece on their experiences. Two instructional videos were made by students for our partners, one in English, the other in Spanish, explaining the process of using the final product. A local TV station, upon hearing about the project, sent a news team to interview students about the impact of their experience (Fox 5 News, 2018). The solar cells were then packed and shipped to the school. We received pictures, videos, and thank you notes from the faculty and students in Puerto Rico.

Outcomes

We worked with Nuestro Ideal to provide a civic engagement focus with the community in Puerto Rico. With their help it was possible to set up a weblink during the assembly process, which fostered a greater sense of connection between our students and the recipients. Our students were able to see the environment in which the chargers would be used and gain a sense of purpose for their activity.

The project needed to be suitable for students with different academic backgrounds, experiences, and motivations. It became clear to the faculty that the students would need assistance in learning to solder and in understanding how solar cells work. We addressed this by having the Society of Physics students work with the groups learning to assemble the solar chargers. This also gave the upper-class students an opportunity to share their

expertise and excitement for science. Students come to their classes with different motivations; when an opportunity for real-world applications of scientific skills is provided, the incentive to learn increases as students perceive the usefulness of their work (Committee on How People Learn II, 2018; see also student comments below).

In order to foster collaborations among the students in the different classes, they worked in groups of three to five on each charger and video. Just as the FLC worked across disciplines, an effort was made to form groups across the different classes. St. John's University is one of the most diverse institutions in the country, and many of our students related to the recipients and the needs of the project, sharing their knowledge with their peers.

Evaluation

A survey was sent to all St. John's students involved in the project. The results showed positive responses in evaluating scientific information and in their connection to the University and its mission. The results were strongest for the math and chemistry cohorts, with more than 60% of the students responding positively. In particular, the written responses from the math students indicated a new understanding of practical applications for STEM and a realization of the impacts of STEM on people's lives. This was also the case in Strage's work with ASL and lecture classes (Strage, 2000). A popular response noted that the experience "opened me up to the global aspects of STEM." One possible improvement would have been the provision of more scaffolding for the ASL project within each individual class. This would have allowed the students to feel a greater ownership of the activity. In addition to the reflection and instruction videos, the use of process summaries might also have helped students integrate the new skills they were learning and reflect on their applications in the real world to a greater degree (Smith, n.d.; Keranen & Kolvoord, 2014). These types of activities expand the classroom learning experience, and, furthermore, expose students to the different types of knowledge that their peers bring to the project (Committee on How People Learn II, 2018; Olson et al., 2014).

The FLC experience has had a lasting impact on the participating faculty members, developing new cross-disciplinary relationships and leading to a desire to explore additional outreach projects together. The results of this initial project led to poster presentations at the 2018 AAC&U Transforming STEM Higher Education conference and at the 2019 New York City SENCER meeting. The project also had an impact on the Society of Physics students, and importantly, a large number of Society of Physics students in the 2018 graduating class intended to continue their education in engineering graduate school. Several student participants in this ASL project went on to engage in undergraduate research as second-year students.

Conclusions

The collaborations within the FLC, between the faculty members and administration, and between St. John's and Nuestro Ideal created an opportunity for civic engagement within the STEM disciplines. In the short term, the group has applied for a small internal St. John's grant to continue collaborating with Nuestro Ideal to identify new projects, including providing larger solar cell systems for water pumps in isolated farmhouses and transferring upkeep knowledge to the recipients. It also led to an additional ASL project in the fall of 2019 wherein students provided a handbook of seed bank best practices based on research to Nuestra Ideal for dissemination to a local farm project. Beyond that, the success of this project and the FLC led this group to apply for an NSF Ethical and Responsible Research grant. In this future project the group intends to assess methods of exposing students through mentoring, ASL, and personal interactions to ethical behavior in STEM fields, especially with regard to research choices and dissemination.

Authors

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Charles Fortmann is currently an associate professor in the Department of Physics. Before joining the faculty at St. John's, he was the vice president for research at Idalia Solar Technologies. He serves as the faculty advisor for the Society of Physics and Sigma Pi Sigma physics honor society.

Alison G. Hyslop, an associate professor of chemistry, has been at St. John's University since 2000. She has served as the faculty coordinator for STEM Faculty Learning Communities at St. John's for three years, is active in the Women in Science program, and was the chair of the Department of Chemistry from 2012 to 2018 and the coordinator for Scientific Inquiry from 2006 to 2012.

Paula Kay Lazrus is an associate professor in the Institute for Core Studies and Department of Sociology and Anthropology at St. John's University, and has been at St. John's since 2003. She is active in the Reacting to the Past community and has served on its Board of Directors since 2016. As an archeologist, she has participated in the Bova Marina Archaeological Project and is active in the Archaeological Institute of America and the Society for American Archaeology.

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