Board 212: An Engineering/Computer Science Project with Community Service Focus

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Abstract:

This conference paper informs about a S-STEM (Scholarships in STEM) project awarded to the University of New Mexico (UNM) School of Engineering (SOE). This NSF project is focused on providing scholarships to students with merit who also demonstrate financial need. This particular NSF project was focused on professional development activities as well as community service projects. The community service projects were enabled by the S-STEM Scholars taking credit hours or performing paid internships. Although the NSF project is in its first two years, it has had many successful community service projects. This paper focuses on surveys and other data from the scholars' participation in this NSF project. The survey data and testimonials show that the NSF project is progressing in the right direction to achieving its original stated goals.

Background:

The University of New Mexico (UNM) was awarded, by the National Science Foundation (NSF), a project titled "Scholarships, Service Learning, and Community Engagement to Improve Student Success in Engineering and Computer Science". This is a multi-year project that started in early 2021. It was awarded from NSF's DUE (Division of Undergraduate Education). This particular paper reports on the details of this NSF project and some of its results to-date. The results exhibited are centered on surveys and student testimonials related to student participants/scholars. The paper is a first attempt to disseminate information on the NSF project and share with the at-large engineering education community.

The main goal of this NSF project is to support meritorious students (above 3.00 GPA with strong recommendations) who have financial need (as determined by their FAFSA report for unmet need) with a scholarship to enable them to continue their STEM studies. In the case of this NSF project, focus was on engineering and computer science students. In addition to providing scholarship support for the students, the NSF project also provides career development activities (e.g. resume critique, interview tips, etc.), opportunity to join a learning community (LC) in a strategic area for the UNM School of Engineering (SOE) (e.g. bioengineering or aerospace engineering), and last but not least, an opportunity to participate in service learning (SL) or community-engagement (CE). The community engagement is presented to the students in the form of a bigger concept or umbrella: Peace Engineering (PE). PE encompasses engineering activities that generally promotes world peace. The students learn throughout a scholarship year about PE through SL/CE. There are two main ways for the students to participate in SL/CE: paid internships or through taking credit hours that counts towards their degree.

Literature Review:

Although there are not a lot of journal papers on the topics of SL/CE, there are many conference papers, especially published in ASEE conference, that address these topics. For example, Koh (2020) [1], developed a "Community Engaged Design" course as a senior design capstone in a small liberal arts college. Students were able to address pedestrian safety in their community by coming up with a prototype for a system which detected and warned drivers of the presence of bicyclists. Jordan (2014) [2] took their service learning all the way to Haiti by working with the locals there to establish a solar project that can offer sustainability for them. Schneider (2017) [3] presented a paper that discussed several research and capstone projects aimed at improving efficiency and reducing operational costs at a local food bank. Then they extended that to interdisciplinary collaborations centered on the use of sustainable urban agriculture as a means to increase access to fresh produce within the emergency food network. Frey & Atwood (2013) [4] used a Strength of Materials course to engage students in a local middle school in hands-on activities related to concepts like buoyancy, electricity, strength of materials, and mechanics. Jordan-Bloch & Cohen (2018) [5] used service learning to motivate girls into STEM education/careers. Che (2018) [6] used students in a computer-aided engineering (CAE) course to construct a CAD model via ANSYS for an old truss bridge. The motivation for this project was for students to help determine the load-carrying capacity (or reverse engineer it) of the bridge for safety purposes going forward. Krishnan & Nilsson (2015) [7] discuss a course titled "Engineering Projects for the Community" at their institution to engage students in community projects. Projects cover a wide variety of engineering majors including civil, mechanical, electrical, bio and computer. This course also emphasizes the need to interact with civic bodies or public organizations which is a new soft skill set for the students involved. Nagel et al. (2019) [8] discuss in their paper design courses at James Madison University intended to help the local community through student engagement in projects benefiting the locals. The paper is particularly focused on second-year course for the design, development, and delivery of human-powered vehicles for individuals with disabilities. The course incorporates experiential, problem-based learning and active learning pedagogies to teach sophomore engineering students engineering design fundamentals. Lu et al. (2018) [9] presented a paper involving their land-grant university and a created course encompassing three majors (distribution logistics, sociology, and technology management) who work together on a distance service-learning project to address food disparities. Canney et al. (2018) [10] presented results from a CAD course (or drafting course) which engaged its students with local community partners through the university's own Center for Community Engagement. Oakes et al. (2018) [11] presented a long-standing program at their institution that has had a great impact on education and community engagement, as recognized by ASEE, IEEE, NAE, and others. Over 400 projects have been delivered ranging from software that allows agencies to coordinate services and protect privacy, to a constructed wetland that purifies agricultural runoff, to an iPad app that helps children with autism communicate, to a new school in rural Ecuador, or an accessible camp for children with disabilities.

Although there are more older references dealing with SE and CE, it suffices to say that ASEE is in particular interested in these topics and studies that address them. The current study, with its own unique flavors, is one of them.

Methods:

For this NSF project, its different activities were studied by several researchers. One of them is a project evaluator reporting on the overall execution of the NSF projects in accordance to proposed activities and student/team feedback. Others are community-engagement experts at UNM (3 of them), who work to place students in community service/engagement projects. Yet another is a communication expert who is evaluating the student scholars and any noticeable changes in their communication levels. Moreover, for this particular paper, reliance was mainly on survey tools (questionnaires and online surveys) to collect useful information that helps provide feedback for the management team of this NSF project. Surveys are conducted pre- and post an academic semester. In addition to the utilization of surveys, statistical metrics (mean and standard deviation) were utilized to study the correlation between the direct student data and their activity involvement (pre- and post-semester contrasts). Lastly, student testimonials were collected as another way to gauge the progress and interest of the students in the NSF project activities.

Results and Discussion:

One of the surveys conducted with the students was in regard to their experience working in a service-learning project (or community-based engagement). Table 1 shows the results of this survey for the 2022 cohort. There were five community service projects for this cohort all with non-profits: energy efficiency project, solar trailer project, ditch mapping project, IT improvement project, and computer data query project. As can be seen in the survey, the students overall responded positively about their experiences. Only one student out of 8 had some negative experience to report on. For the team managing this NSF project, the survey results show promising and indeed pleasant results as it can be seen from the results that overall students value the benefits that engineers bring to the greater community at-large and they see the value in-return that the community service brings back to them as technical individuals.

	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
I enjoyed working on a team with fellow S-STEM scholars.	37%	50%	12%	0%	0%
My team worked well together.	50%	37%	0%	12%	0%
The number of hours I was required to work with the community site seemed appropriate.	37%	37%	12%	12%	0%
I gained valuable experience through my participation on this project.	62%	12%	12%	0%	12%
The project I was assigned to matched my interests.	37%	37%	12%	0%	12%

The project I was assigned to matched my abilities.	50%	37%	12%	0%	0%
I communicated effectively with non-engineer team members.	37%	62%	0%	0%	0%
I learned from the non-engineer partners on my team.	50%	37%	12%	0%	0%
I enjoyed working with community members.	50%	37%	0%	0%	12%
I think engineering can benefit society.	75%	12%	0%	0%	12%
The work I did as part of this project was meaningful.	50%	37%	0%	0%	12%
As a result of this experience, I want to work on more projects like this in the future.	50%	26%	25%	0%	0%
This part of the S-STEM scholars program was well organized.	25%	37%	12%	12%	12%

Table 1. Survey regarding participation in community service or service learning. *Note:* N=8. Due to rounding, the percentages above may not sum to exactly 100 percent.

Student testimonials were collected at the end of the community projects/semester to gather their evaluation of the NSF project. Overall, students were positive about the NSF project and its importance. One student said: "People need help. We can use our skills to help them and gain a better sense of understating of what our community needs and how our knowledge can support." Another stated: "I got to see the intersection of engineering and community engagement. There was lots of learning involved from both sides that I didn't expect going in to the program initially." Moreover, the student scholars could develop their technical and practical skills out of their community engagement experience. One respondent said that "I acquired proficiency in mapping skills by doing this project. I learned how to fly a drone and use this ability to respond to the goals of this project." Another student said that "It was nice to do some hands-on work." Lastly, one student noted that it was a valuable experience to get familiar with "different communities across Albuquerque, specifically, in the South Valley area."

Another survey conducted to the students was in regard to their future interests as they are affected by their participation in this NSF project. Table 2 shows results from this survey for the 2022 cohort. It is clear that the almost all students now exhibit interest in doing community engagement and in engaging in activities that revolve around the utilization of engineering skills for peace purposes or general welfare. This type of data in the presented surveys is lacking from the literature and hence represent important knowledge generation for future studies and researchers.

	Strongly Agree	Agree	Disagree	Strongly Disagree	N

I will pursue a career that involves peace engineering.	37%	25%	25%	12%	8
I will volunteer for community service work.	28%	42%	14%	14%	7

Table 2. Survey on future interests of students. Due to rounding, the percentages above may not sum to exactly 100 percent.

At the end of the academic year, a mini-conference or colloquium, which brought together all the student scholars from the year and the NSF project personnel (PIs and other team members), was held. The goal of this colloquium is for student scholars to share with the attendees what they have been engaged in as part of this NSF project during the finishing academic year, and to also share with the attendees their future goals and aspirations (especially the ones who are graduating at the end of the Spring semester). The last survey presented here asks students about their take on the colloquium. As demonstrated in Table 3, the students overall enjoyed participating in the colloquium and have found it informative as a venue to share personal experiences (past ones and future aspirations).

	Strongly Agree	Agree	Disagree	Strongly Disagree
This session was informative.	28%	71%	0%	0%
I enjoyed hearing about fellow scholars' experiences during the colloquium.	57%	42%	0%	0%
I enjoyed sharing my experiences with fellow S-STEM scholars.	57%	28%	14%	0%
Hearing about fellow scholars' future career plans was helpful for thinking about my own career plans.	42%	57%	0%	0%
I liked having the opportunity to share my future career plans with others.	42%	42%	14%	0%

Table 3. Colloquium survey responses. Note: N=7. Due to rounding, the percentages above may not sum to exactly 100 percent.

Lastly, it is interesting that the participant students' concept of PE has evolved during the academic year as they were exposed more to community engagement, service learning and human welfare concepts and practice. In fact, at the end of the year, here is how some students explained what PE is all about:

- "An effort to improve community through engineering."
- "The holistic balance between technical and scientific skills and community engagement."
- "A larger look at human's processes that are completed on earth to emphasize a more earth friendly way to usher in our next stage of evolution."

Conclusions:

As can be seen from the results presented above, the NSF Project at UNM revolving on community engagement or service learning is perceived to have been a success in its first two years of execution. Overall, the student participants' or scholars' view of community engagement grew positive over time to the extent that many are thinking to do more engagement in their future. In addition, these technically-oriented projects to serve groups in need in our community, have had a positive technical return on the participating students as they tackled open-ended problems which naturally characterize real human issues. As the NSF project undergoes more years of execution, it is predicted that it will have an even bigger impact on the local community in which the University resides/serves. The bigger impact will come naturally as more community partners get involved in the community projects. Also, once the communication data is available, it is expected to see an uptick in the students' overall communication skills as a result of participating in this NSF project.

References:

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