

Engagement in Practice: Lessons Learned in Finding Synergy between Student Organizations and the Recruitment of Underserved Populations

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Abstract:

In Engineering, the positive relationship of community engagement with college student persistence is known. In this case study, we reinforce this finding and present a strategy that utilizes a strong network of professional student organizations (e.g., the American Society of Civil Engineers, National Society of Black Engineers, Society of Women Engineers, Society of Hispanic Professional Engineers, etc.) to facilitate enrichment activities with K-12 students. Not only did these activities promote student success, but there were also signs that this work could attempt to repair the leaky pipeline of diverse talent. An unexpected apprehension to outreach by students prompted the research team to acquire hands-on models that professional student organizations could use as a tool to increase engagement. This factor was also studied to ascertain any insights into how the models enhanced the experiences of the event. College students wrote reflections after their interactions. This paper shares how community-engaged activities not only change attitudes and outreach self-efficacy in all students but also might be critical in self-efficacy and motivation for minority women engineering students.

I. Introduction

Kennesaw State University (KSU) is thriving with nearly 43,000 students on two metro Atlanta, Georgia campuses. The adoption of strategies like providing incentives, such as scholarships and financial aid, for minority students to attend the engineering program, as well as creating an environment that is welcoming and supportive of diversity, has caused our numbers to shift greatly from women accounting for only 14% of our engineering program population in 2020 to women making up 21% in 2022 [1]. With over 50% of our engineering students identifying as non-white, there is a lot to celebrate but there is still more work to do. When considering the intersectionality with race, we discovered that African American women engineering students comprised only 4% of the college and Hispanic women engineering students comprised just 3%. Further analysis revealed that out of the nearly 800 degrees awarded in 2022, not even 50 were awarded to these demographics. Women accounted for only 13% of these degrees. Nevertheless, it is important for us to share the activities and strategies we incorporate within our college to foster a sense of self-identity rooted in community impact for all engineering students.

Recruiting minorities to pursue engineering degrees is an important and necessary action for institutions to increase diversity and inclusion in engineering programs. Early recruitment of minorities for engineering programs has been long advocated to promote equity and inclusion in the field of engineering [1]. Researchers concluded that this practice could be beneficial in promoting diversity, increasing the number of minority students in engineering fields, and reducing the attrition rate of these students. Recent studies support this idea in nontraditional settings, noting the role of social support in enhancing agency and identity among minority groups [2]. The authors highlight the need to understand the role of social support in identity formation and a sense of agency. This is particularly important because minority engineering students have traditionally faced challenges in both the academic and social domains due to discrimination and other forms of marginalization.

Social support can come in many ways, including volunteerism. Volunteering can provide many social and cultural benefits that can have a lasting impact on a community. Researchers explain that volunteering can be used to create a sense of community and shared identity, as well as to promote social inclusion and intercultural understanding [3]. Additionally, studies have shown

that volunteering can help to create social networks, provide individuals with a sense of purpose and belonging, and can be used as a tool for education and civic engagement [4]. Furthermore, volunteering can help to foster feelings of trust, mutual respect, and understanding among people from different backgrounds, creating a more tolerant and cohesive community [3]. While the sense of belonging and community is critical to the engineering experience, self-efficacy and self-determination are also linked to community engagement activities.

The practice of community engagement has been connected to significant improvements in minority college engineering students' self-efficacy and self-determination [1]. Some studies focused on young women and found that students' participation in a community engagement program had a positive effect on women college engineering students' self-efficacy and self-determination [5]. While these studies have provided critical insights into overcoming the dissuasion minorities incur from opting into or persisting in the minority setting, little work is done to explore the role intersectionality plays in the impact community engagement might have on the sense of belonging for specific populations.

By clarifying the differences in lived experiences across various genders and ethnicities, researchers can gain further insights into motivations for not just participation in community-engaged activities but also motivations to progress in an engineering degree. Additionally, clarification of the current impacts of hands-on activities in a post-COVID-19 era is critical in understanding whether past outreach practices can be repeated or if new strategies should be developed to address a changing community and volunteer base.

II. Methods

A. Participants

The participants of this study were civil and environmental engineering (CEE) students who were enrolled in coursework during the Fall 2022 semester at KSU. Approximately, 300 students were requested to participate in the study. Participants were informed about the study and told that their participation was completely voluntary and that they could withdraw at any time without affecting their evaluation. Students were informed that they could receive extra credit for their participation upon successful completion of the activity. A total of 20 students responded to the call for participants. Of the participants that joined, 50% identified as men, and 50% identified as women. A total of 75% of the participants identified as non-white with much of that non-white population identifying as Black or African American. Most of the participants were between the ages of 18-24 and of note is that 40% of participants were first-generation college students.

B. Setting

KSU (Marietta Campus), the study site, is in the suburbs of metro Atlanta, Georgia. KSU is a large comprehensive institution with a population of over 40,000 students. In the Fall of 2022, over 5,000 students were enrolled in the Southern Polytechnic College of Engineering and Engineering Technology (SPCEET). Like KSU, SPCEET attracts a diverse student body related to race. Nearly 24% of students identify as African American and 15% as Hispanic. When gender is considered, 21% of SPCEET students identify as women. SPCEET comprises nine departments, including CEE, the study's target department. The CEE department enrollment was over 700 students during the Fall 2022 semester. Of these students, 21% were African American

and 20% were Hispanic. The department outperformed the college with women representation at just over 27%.

C. Community Engagement Event (Planning)

A planning effort was launched approximately 2 months prior to the event. The CEE department was contacted by a representative of the Atlanta Chapter of the American Society of Civil Engineers (ASCE). Through a separate initiative, this representative was involved in outreach work with elementary students at an Atlanta, GA public school with 82.1% of the population identifying as African American, 14.9% identifying as Hispanic, and 1% identifying as American Indian. Many of the students were described as never traveling outside of their local neighborhoods and 100% of the students were eligible to participate in the Free Lunch and Reduced-Price Lunch Programs under the *National School Lunch Act of 1946*. The ASCE representative also served as the industry advisor for the KSU student chapter of ASCE and requested the participation of students, faculty, and staff in a visit from the public school. Over the course of several planning meetings, the team outlined a rotation schedule that achieved 3 main objectives: (1) Provide exposure to the campus infrastructure; (2) Engage in hands-on activities related to civil and/or environmental engineering; and (3) Interact with college students that may have shared their identities and experiences. Table 1 presents an overview of the schedule outlined.

Table 1: Outreach Event Schedule

Time	Agenda Topic	Speaker(s)	Location
10:00 AM	Welcome and Introductions	CEE Chair ASCE	Architectural Building (The Pit)
10:15 AM	Campus Tour	ASCE Student Volunteers	Floors 1 & 2 of ET Center
10:45 AM	Competition Team Demonstrations	Steel Bridge, Technical Competition, and Concrete Canoe Competition Teams	Competition Team Building
11:15 AM	Hands-on Activity Block 1	ASCE Student Volunteers/CEE Faculty	Team Orange - Soils Lab (Cube) Team Black - Microplastics Lab (Enviroscape 1) Team Purple - Environmental Lab (Enviroscape 2)
11:45 AM	LUNCH	--	Team Orange - L125 Team Black - L120 Team Purple - L121
12:15 PM	Hands-on Activity Block 2	ASCE Student Volunteers/CEE Faculty	Team Orange - Microplastics Lab (Enviroscape 1) Team Black - Environmental Lab (Cube) Team Purple - Soils Lab (Cube)
12:45 PM	Departure/Goodbyes	--	--

To achieve Objectives 2 and 3, it was important to keep students in small groups, with the elementary students divided up into three teams. This provided ease in conducting activities as

well as a greater likelihood of interactions with college student volunteers. The schedule was not only approved by CEE department leadership and staff but was also approved by the elementary school. Volunteers from the public school were requested to attend alongside the elementary students and the *KSU Minors on Campus Policy* was followed, including the registration of the event with the appropriate University staff. Based on the expected number of attendees (50), the team planned for 3 college student volunteers per group ($n=9$) and 2 volunteers to lead each hands-on activity ($n=6$). As discussed earlier, a total of 20 participants answered the call, which allowed for additional assistance where needed.

D. Community Engagement Event (Execution)

During the Community Engagement Event, the participants worked with fifty-five (55), 5th Grade elementary students. This was a slight increase than what was expected, but participants adjusted accordingly. The participants led the students on an interactive tour of the campus, visiting various engineering labs and meeting faculty, students, and staff. One integral part of the event was the inclusion of hands-on activities designed not only to incorporate coursework that participants would encounter or had encountered during their studies but also provide easy-to-follow instructions to give participants confidence in leading activities with the students. Two of the hands-on activities involved the use of *EnviroScapes*, a molded plastic model of a watershed with various types of land use (e.g., residential, transportation, agricultural, construction, recreation, and forestry areas) used to demonstrate how water pollution can result from a variety of activities and sources. Recent studies tout the use of such models in combining the benefits of problem-based learning with place-based education [6]. In addition to the *EnviroScapes*, college students led elementary students in the making of concrete cubes typically developed for the *Compressive Strength Test of Concrete* (ASTM C39/C39M). Another activity, which involved the use of student competition teams, was a tour of the Steel Bridge and Concrete Canoe area. Elementary students had the opportunity to not only lift the 200lb concrete canoe but also had the opportunity to stand on the previous year's steel bridge. Food for lunch was donated by the Atlanta area ASCE chapter and to understand the impact of the community engagement event, the college student participants reflected on their experience through critical reflection. Figure 1 provides visuals of the activities conducted.



Figure 1: Photographs from CEE Outreach Event Hands-On Activities

E. Data Collection

Post the Community Engagement Event, KSU volunteer students received a six-question survey. Five of the six questions were demographical questions, and one question was an open-ended critical reflection question asking: *Reflect on your experience during this outreach activity, do you have the same attitude about volunteering at this event as you did beforehand? When did students engage the most about your field? Does this correlate to what you thought would be the most effective way?* Data collection and data analysis were conducted until theoretical saturation was reached. All 20 KSU volunteer students completed the survey.

F. Data Analysis

A thematic analysis using the six steps proposed by Braun and Clarke was conducted [7]. In the first step, researchers reviewed the critical reflection response to understand the content. In the second step, the researchers generated concise labels to identify important features of the data. Using open coding, the reflection data were divided into smaller units, and the codes were labeled based on the interpretations. Researchers first labeled the codes and then discussed them with each other to enhance reliability. Then, using axial coding, the relationships between the labeled codes were explored, organized, and grouped to generate concepts. In the third step, the relationships among the concepts were elaborated on and developed into themes. In the fourth step, the themes were reviewed and refined by the researchers. In the fifth step, each theme was defined and named. Lastly, the relationships between the themes were explored, and a report was generated upon which underlying concepts and themes were investigated. The research team used Atlas.ti, a computer-assisted qualitative data analysis software platform, to achieve the data analysis objectives.

III. Results

The analysis revealed three main themes: (1) community engagement in student identity; (2) community engagement as a tool to improve self-efficacy and motivation; and (3) the role of activity design in the quality of community engagement experiences. The first theme consisted of three concepts, namely, a sense of responsibility participants had in performing outreach and volunteer work, the need to make *engineering* a possibility for students from varying backgrounds, and the common practice of volunteerism in their lives. The second theme consisted of four concepts that centered on the ability of community engagement to change their perceptions of populations, its role in confidence building, the sense of contribution as a motivation factor, and the idea that community engagement is the only tool to receive such intangible and priceless benefits. The final theme entailed three concepts that focused primarily on sheer enjoyment and fun participants and students found in the event, the importance of hands-on experiences to promote such engagement, and the usage of hands-on activities to create curiosity and engage in problem-solving.

A. Community Engagement in Student Identity

Recent studies suggest that outreach as a context for developing retention-oriented identities has led many students to seek formal volunteer roles to bolster motivation toward degree completion and a career in the field, particularly, when it comes to women [8]. This finding was reinforced in this study with many of the reflection responses codes under this theme coming from participants who identify as women. Some of the statements of the participants are as follows:

“I have always thought volunteering was an amazing way to contribute to the community.” (Student 3 – Hispanic Woman)

“I always look for opportunities like this to volunteer. I feel like this is how I got connected to engineering so I should give back and do the same.” (Student 18 – African American Woman – 1st Generation)

“Giving back to the community is a part of our role as human beings.” (Student 19 – Hispanic Woman – 1st Generation)

While the sense of responsibility to do outreach concept was not found in responses from white women students, it should be noted that this demographic represented only 10% of participants ($n=2$). When looking at responses from men participants, a sense of responsibility was seen in one participant’s response, in which he noted, “I know there was 5% involved in the grade but it was more important to me that I had the chance to help guide kids who deserve a chance in the right direction.” This student identified as African American and shared an intimate story of how his family adopted a “troubled” child. While we might hypothesize that this participant’s unique experience was the motivation behind his sense of responsibility, with such a limited study population, conclusions cannot be drawn.

B. Improvement of Self-Efficacy and Motivation

As mentioned earlier, many of the college student participants expressed apprehension during the recruitment process. After the event, many expressed changing attitudes and perspectives related to their experiences with the students. Some of the statements are as follows:

“I really enjoyed volunteering. I was nervous about leading kids, but the kids were very sweet.” (Student 6 – white Woman)

“My attitude has shifted from when I initially first signed up. I now am more inclined to participate in these activities from the enjoyment that I have experienced with the students.” (Student 11 – white Man)

“This activity did change [my] perspective on volunteering due to the priceless impact that one could have on the future by looking out for children.” (Student 14 – African American Man)

C. The Role of Activity Design in Engagement

Most of the college student participant reflections made mention of the benefits obtained from using the hands-on models as well as allowing the students to actively engage in the experience. Some of the statements are as follows:

“They engaged when it came to hands-on things.” (Student 1 – African American Woman)

“My guess was that participating in hands-on activities encouraged them to pay attention.” (Student 5 – African American Woman)

“They seemed to engage the most when they were helping with the demonstrations.” (Student 7 – African American Man)

“The kids really liked seeing that the same concrete that can float is also very strong. I think showing what we do every day was more effective than talking about it.” (Student 8 – African American Woman)

IV. Discussion

Findings from this study suggest that amidst so many different changes in technology, educational environments, and even the global pandemic, college students not only regularly participate in volunteer activities, but have concluded that these opportunities are beneficial to them and to society. The connection of outreach to student identity is not a new concept, in fact, outreach activities have been linked to the development of professional engineering identity, which promotes college student persistence [9]. Of note though, is the response to the call for volunteers. Despite the prevailing demographics within the department, overwhelmingly, most of those that chose to participate were from underrepresented groups. While a weak conclusion could be drawn, most researchers explain such behaviors to be more likely than not correlated to how engineering students weighed the costs and benefits of volunteering and how they saw their professional obligation to help others [10]. We also found this to be true in the reflections that stated it was their responsibility to give back to their community.

Many students found the event to be enjoyable and fun and relished the opportunity to participate again in the future. While some studies suggest that volunteerism can be burdensome and taxing for marginalized students, a sentiment analysis revealed positive attributes from all college student participants who identified as belonging to historically marginalized groups in engineering [11]. Of note though, only the Faculty and Staff members who identify as belonging to historically marginalized groups in engineering participated for this outreach event. Anecdotally, these individuals traditionally lead and participate in such activities throughout the department and college.

The positive impact of hands-on activities on the engagement of elementary students and college student participants is the most definitive outcome of this study. Regardless of whether the activities provided real-world applications in a modeled setting (e.g., *EnviroScapes*) or actual practice-based lab procedures (e.g., Compressive Strength Test of Concrete), elementary students and college student participants found value in the exercises. In the development of outreach programs, researchers have long noted the positive impact of performing hands-on activities to engage students and promote interest [12, 13, 14]. Recent studies have found benefits in the practical application of virtual hands-on activities but based on this study’s results, engagement and interactions in a face-to-face environment were critical to the positive outcomes experienced [15]. Moreover, some studies have noted a decrease in engineering program readiness after the global pandemic, particularly for underrepresented minorities in engineering due to the virtual learning environment [16].

This study has several limitations. First, this study's participants were limited to civil and environmental engineering college students in suburban Atlanta, GA. However, since education is standardized according to the Accreditation Board for Engineering Technology, transferability was maintained. Second, there could be a problem with credibility; as the college students were awarded extra credit for participating. While one might believe that this was the likely driver for participation, there was no correlation found between students who needed the extra credit versus students who did not. In fact, one of the faculty members involved noted that the students who participated did not need the extra credit. Third, the surveys were sent by the faculty members who awarded the extra credit. This may have introduced bias into the participant's responses to a certain extent and may reduce confirmability because participants might have felt persuaded to provide positive feedback in the study. However, survey responses were anonymous, thereby allowing participants to express their views more comfortably and honestly in anonymity.

V. Conclusions

This study found that college students participate in volunteer activities and find them beneficial to themselves and society. Despite the demographics of the department, most of the volunteers were from underrepresented groups. The positive impact of hands-on activities on the engagement of elementary students and college student participants was the most definitive outcome of the study. Creating more hands-on outreach experiences for college students may be the key to changing attitudes and outreach self-efficacy in all students but also might be critical in self-efficacy and motivation for minority women engineering students.

VI. Works Cited

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