WIP: Common Practices in Undergraduate Engineering Outreach

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Motivation

When undergraduate engineering students participate in various forms of community outreach through an ambassador-style group, the mission is often to promote engineering and engineering-related careers to K-12 students and their families, and increase interest in engineering among historically underserved populations. Yet, the preparation and delivery of outreach activities may also impact the undergraduate students. In this Work in Progress paper we present the early findings of a project seeking to identify common practices among university-based, ambassador programs, with a view to informing communities of researchers and practitioners. We explored three questions [1]: (1) What similarities and differences are apparent in the foci of college of engineering outreach programs? (2) How do programs train their undergraduate students to conduct engineering outreach? and (3) How do programs assess the impact of their efforts to train undergraduate students to conduct engineering outreach?

Background

For well over a decade, outreach to precollege audiences has been recognized as an important strategy for increasing the public's understanding of engineering and raising awareness about the importance of a diverse engineering workforce [4]. An explosion of literature has paralleled activities in this area. For example, an ASEE PEER search using the keywords "outreach" with "undergraduate" and "engineering" yielded 3,416 results. However, researchers have generally not surveyed the landscape of outreach program formats or explored the impact that participation may have on the undergraduate ambassadors themselves. The small number of studies that have been conducted have been able to connect outreach participation with social engagement and improved professional readiness including communication and leadership skills [5,6], but these studies have not examined impacts across different programs. As a first step towards a more comprehensive research agenda we employed various methods to survey common practices and features of ambassador programs and inform the interests of both researchers and practitioners.

Methods

Our initial task was identify universities across the country that have active outreach programs in which undergraduate engineering students perform in an ambassador role. From this point, our primary strategy was to conduct an online search of university websites of ABET accredited engineering programs. This search yielded information about 102 ambassador-type outreach programs[2]. The points of contact for all of the programs were then sent an invitation to complete a short survey describing the focus, composition, and core features of their program (Appendix A). Thirty programs reflecting universities in the north, mid-Atlantic, south, mid-west, south-west and north-west of the United States responded to this survey. From this group, representatives of 18 programs attended either one of two in-person workshops or an online

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[1] Please contact Dr. Joanna K. Garner at jkgarner@odu.edu for more information about this paper.
[2] To date, 40 of the largest and regionally diverse schools' websites have been analyzed [2], [3].

meeting. This smaller group also completed a second survey (Appendix B) about areas of perceived impact on the ambassadors and current methods of program evaluation.

Results

(1) What similarities and differences are apparent in the foci of college of engineering outreach programs?

The analyses of a representative sub-portion (40%) of ABET accredited engineering program websites revealed that most outreach programs engaged students via tours (75%), K-12 outreach (58%), and on-campus events (58%). Responses to the initial survey sent to advisors of student outreach groups within ABET accredited programs paralleled these findings. Of the thirty respondents, most (92%) reported that students engaged in presentations to K-12 audiences, and 96% also conducted hands-on classroom activities. The same percentage (96%) reported that undergraduate students conducted tours and participated in STEM events. Fewer respondents (50%) reported that their students engaged with alumni and industry partners. Less than half of the respondents (42%) reported that mentoring and tutoring was a component of their outreach program.

(2) How do programs train their undergraduate students to conduct engineering outreach?

From the analysis of a portion of the ABET accredited programs, more than half (58%) of programs indicated that some form of training was offered to or required for ambassadors. However, information about the type of training was most often not provided.

In their responses to the second survey, our workshop attendees indicated that programs differed in the nature and duration of the training offered to students. Some programs provided training at an initial meeting, while others required students to take a three credit course in communication. Many required attendance at weekly meetings.

(3) How do programs assess the impact of their efforts to train undergraduate students to conduct engineering outreach?

Of the 18 workshop attendees, less than half (44%) indicated that their programs routinely engage in systematic efforts to collect indicators of impact on the undergraduate engineering students that perform outreach. Of these efforts, the most common form was an end-of-year survey asking students to provide a self-assessment of the impact that outreach or ambassadorship might have impacted them. A very small number of respondents (11%) indicated that they used individual interviews with students.

However, despite finding that most programs did not engage in formal assessment efforts, program advisors and representatives offered clues as to the features of the programs that they felt were most impactful. The following summary presents emergent themes that emerged from an analysis of program leaders' open-ended survey responses.

Theme 1. Formal Training. In response to the question about features of the program that promote undergraduate students' professional development, a prominent theme was the presence of a formal training mechanism, which was mentioned by all but one program representative.

Respondents indicated that training was offered through a variety of means within and between their respective programs. Training took the form of weekly group meetings, on-campus or otherwise specially convened events and workshops, and credit-bearing courses. These formal training mechanisms were associated with several opportunities, the most frequent of which were opportunities to create and practice presentations, develop and practice outreach activities, or work on other career-enhancing skills such as interviewing.

Sub-theme: Creating and practicing the delivery of presentations. A sub-theme that emerged was respondents' indication that particular content within the formal training was impactful. Program leaders indicated that creating and delivering presentations, and having the opportunity to practice them and receive feedback, was associated with improved communication skills and confidence to present to a variety of audiences.

Theme 2. Delivery of presentations, programs, and activities to precollege audiences. Not surprisingly, program leaders felt that the practice of creating and delivering activities to younger students contributed to the professional development of the undergraduate students. Perceived benefits included being confident in front of an audience, being flexible, and being able to relate technical information in ways that can be understood by non-technical audiences.

Sub-theme: Acting in the role of mentor. Representatives of eight programs explicitly mentioned that their undergraduates acted in the role of mentor, whether to precollege students or other undergraduate students in the classroom, or within the organization. Mentoring was associated with improved teaching and leadership skills and the ability to give and receive advice from others. One program leader also connected mentorship to the idea of forming a sense of community.

Theme 3. Contributing to the governance and activities of the ambassador organization. Twelve of the eighteen program leaders cited leadership skill development as a major benefit to ambassadors. In these programs, students take on a variety of leadership positions, including committee leadership or other self-governance positions, as well as acting as the point of contact for various avenues of activity including precollege visit or tour planning. Program leaders relayed that the outcomes of leadership experience included confidence, interpersonal communication, problem-solving skills, and the development of professional identity.

Sub-theme: Civic and community engagement. Three program leaders explicitly mentioned that the opportunity to participate in the outreach program promoted students' readiness for civic and community engagement. Leaders acknowledged that some students may already be motivated by a socially aware agenda, but connected changes in students' civic identities to their programs' missions of reaching out to underrepresented and underserved students. One program leader called attention to the development of cultural awareness through participation in outreach.

Significance

To our knowledge, this research is the first of the engineering outreach landscape that deliberately sought to identify the existence of professional development practices for participating students. Our study revealed not only common activities among programs at

colleges of differing size and focus, but also a significant need to develop strategies that can examine the impact of the ambassadorship role. Our survey of ambassador program leaders generated substantial consensus about the features of an engineering outreach program that impact students' professional development, and about the areas in which students benefit the most. Formal training, opportunities to deliver messages and activities to a variety of audiences, and involvement in program leadership were unanimously linked to perceived changes in students' communication skills, confidence, and preparation for leadership roles. These might tentatively be considered as core strengths of ambassadorship as a co-curricular activity. Further research is needed to examine the degree to which program leaders' and undergraduate ambassadors' perceptions match, and the ways in which program components impact each type of outcome. Efforts to conduct consistent evaluations across programs will likely yield additional insights and may permit advisors to better advocate for resources at their home institutions.

References

[1] Garner, J.K., Alley, M., & Kaplan, A. (2016). From Undergraduates to Ambassadors: The Impact of EA Network Training. Presented at the Annual Conference and Exposition of the American Society for Engineering Education, New Orleans, LA.

[2] http://carnegieclassifications.iu.edu/listings.php

[3] Yoder, B. (2016). Engineering By the Numbers. Retrieved from https://www.asee.org/.../2017-Engineering-by-Numbers-Engineering-Statistics.pdf

[4] Moore, T. & Richards, L.G. (2012). P-12 Engineering Research and Practice. Advances in Engineering Education 3 (2), 1-9.

Appendix A (Contact information questions have been removed)

1. With which institution and school or college are you affiliated?
2. What is the name of your STEM outreach program? Please provide a link to its website, if one exists:
3. Are you the advisor for your outreach program?
4. Approximately how many STEM undergraduates do you currently have in your program?
5. What percentage of those undergraduates are female?
6. What percentage of those undergraduates identify with historically under-represented groups?
7. What types of activities do your undergraduates engage in as part of their official outreach role? Please check all that apply…
8. In no more than 150 words, please describe how you train your undergraduate students to conduct outreach activities. If you provide initial and ongoing training, please describe each method.
9. In no more than 150 words, please describe how you assess the effect of your program.

Appendix B

1. Which features of your program act as a vehicle for undergraduate students' professional development, and why?

2. Please describe areas in which participating students manifest change (such as knowledge, skills, attitudes, future aspirations), and which experiences seem to promote change.
3. How do you currently assess impact on the undergraduate students who perform outreach? Please describe all formal and informal means of assessment.