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Impact of Engineering Ambassador Programs on Student Development

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Abstract

This study highlights the positive impact of participation in an engineering ambassador program on students from two universities: Oregon State University, which is a large public university in a college town with a 13% minority student body, and Howard University, a medium-sized private university with a relatively small engineering program in an urban setting and enrolling a primarily minority population. Although these ambassador programs were designed with a primary goal of service to the engineering program and university, they serve an equally important goal of developing the skills and attitudes of the ambassadors themselves. Ambassadors from both universities were surveyed, and though the universities and the ambassador programs are different, results show that both programs have a similar positive impact on student goals, attitudes, leadership skills, and engineering self-efficacy.

Introduction

Increasingly, engineering ambassador programs are used by departments and colleges at universities across the country (http://engineeringambassadors.org/index.php) for several purposes: providing outreach to younger students to encourage them to consider STEM careers; exposing high-performing undergraduates to the larger university community, college donors, and industry representatives; recruiting students to specific programs; and providing leadership and labor for in-house publicity and outreach events (Talbot et al., 2013; Hartzell et al., 2013). Outcomes from the first *Engineering Ambassador Network Workshop* (Thole et al. 2013) at Penn State University indicate that universities develop engineering ambassador programs with three major goals: enhancing recruitment/outreach strategies, improving relations with industry supporters and university alumni, and developing a cadre of engineering student leaders with strong communication skills.

Ambassadors can provide a vital connection between schools of engineering and the K-12, general public, and practicing engineering communities through visiting programs, outreach events, and open houses. Myriad models exist for staffing these programs with volunteers, hourly paid students, scholarship recipients, or a blend of these. Generally, engineering ambassador programs are designed for the students to provide service to the university in some form.

This paper focuses on how these programs *serve the participating ambassadors* by developing "soft" or "professional" skills, such as teamwork, communication, management, and leadership. The focus on professional skills in engineering education has progressively increased since the early 1990s in response to the rapidly changing needs of the engineering workforce that have resulted from new technology, globalization, increased use of interdisciplinary problem-solving approaches, and a shift from defense to commercial engineering applications (Shuman et al., 2005). In 1999, ABET introduced the EC2000 criteria to provide a framework for universities to respond to these needs. The current ABET accreditation criteria define five technical outcomes and six professional outcomes that students must satisfy if a program is to be accredited (ABET, 2012). The professional outcomes are communication, teamwork, understanding of professional and ethical responsibility, understanding engineering in the context of global and social factors, knowledge of contemporary issues, and the ability to engage in lifelong learning (ABET, 2012). Ambassador programs are an excellent mechanism for reinforcing these outcomes.

To a lesser extent, this study looks at self-efficacy as a potential outcome of ambassador programs. Here self-efficacy, consistent with Bandura (1977) and Zimmerman (2000), describes students' perceptions of their own capabilities to successfully complete certain tasks required to achieve their goals. For example, measures of self-efficacy might include a student's confidence in her ability to graduate with a degree in engineering or give an oral presentation to a large audience. Numerous research studies have focused on the correlation of self-efficacy and success in STEM (Rittmayer & Beier, 2009), particularly with respect to females (Zeldin & Pajares, 2000; Zeldin et al., 2008) and minorities (Chemers et al., 2011; MacPhee et al., 2013). The studies examine various influences (e.g., family, mentors, role models, research experience, community involvement, mastery of tasks, social persuasion, etc.) and distinct areas (e.g., academic, math, science, career, leadership) of self-efficacy. In general, though, the studies agree that "individuals with high STEM self-efficacy perform better and persist longer in STEM disciplines relative to those lower in STEM self-efficacy" (Rittmayer & Beier, 2009, p. 1). Ambassador programs include many of the components that have been shown to support increased STEM self-efficacy such as mastery, mentoring, and social persuasion and thus have the potential to have a positive effect.

This study highlights the positive impact of participation in an engineering ambassador program on students from two universities: a large public university in a college town with a 13% minority stu-

dent body (Oregon State University, OSU), and a medium-sized private university with a relatively small engineering program in an urban setting enrolling a primarily minority population (Howard University, HU). The first program is well developed and has been in existence for eight years, while the second is a newer program in its third year when this study was completed. The authors demonstrate that for both universities, participation in these programs has a similar positive impact on student goals, attitudes, leadership skills, and engineering self-efficacy.

Ambassador Programs Overview

The ambassador programs at these two universities engage undergraduate engineering students in outreach to K-12 and the general public and promotion of careers in engineering. At OSU students serve as tour leaders for an active research laboratory that receives approximately 5,000 visitors per year, lead daily tours of the College of Engineering for about 5,600 visitors per year, and meet with engineering professionals when they visit campus. Ambassadors at both schools make presentations and run activities at K-12 schools throughout the region, serve as facilitators for hands-on engineering challenges at large-scale public outreach events with attendance of several thousand visitors in a day, manage the programs, and train incoming ambassadors. To deliver the activities, the students complete a training program that includes leadership and communication skills as well as some technical content that they typically would not get in their undergraduate curriculum. Table 1 summarizes the similarities and differences in these two programs.

Oregon State University (OSU) Ambassadors

OSU implemented an Engineering Ambassador Program in the fall of 2004 as a diversity recruiting program. It was developed and managed from the Women and Minorities in Engineering (WME) Program and designed as a *student-to-student* recruitment/education effort using "near peers," women and underrepresented minority engineering students just one to four years out of high school. Initially, the sole duty of ambassadors was to visit high school classrooms and deliver engaging presentations to introduce engineering as a career that helps people and benefits society. Today the 23 paid ambassadors collectively average more than 80 school visits each year, but their duties and responsibilities have expanded greatly as summarized in Table 1. The director of the WME program supervises the CoE ambassadors, but the program is managed by students who are responsible for specific components of the program, with a CoE ambassador student manager who oversees all groups. Each spring, new ambassadors are recruited for the following academic year to replace graduating seniors, so the program begins each fall with about two-thirds experienced and one-third new ambassadors. Students apply to be ambassadors and go through a rigorous selection process that includes group meetings and interviews, along with a written application. Much of the training of new ambassadors is managed by returning students.

	Oregon State University	Howard University
Established	Fall 2004	Fall 2011
Original Purpose	Diversity recruitment (women and underrepresented minorities in engineering)	Diversity recruitment (underrepresented students into earthquake engineering)
Founder	Women and Minorities in Engineering (WME) Program	George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)
Original Format	Women Ambassadors student-to-student recruitment using near peers through high school visits	Select set of students staffing one annual large-scale outreach activity during Engineering Week
Current Format	All OSU engineering students	All HU civil engineering students
Activities	Research laboratory tours, College of Engineering tours, K-12 school visits, staff large-scale outreach events, alumni and industry relations, new student recruitment and orientation, managing mentor program for first year women and URM, manage Ambassador program	K-12 school visits, staff large-scale outreach events, manage Ambassador program

Table 1: Ambassador Programs at Oregon State and Howard Universities

The two-day training session prior to fall term, required of all ambassadors, focuses on activities to promote team bonding and leadership development, as well as understanding diversity issues and learning to communicate to wide variety of audiences with the goal of increasing interest and esteem in the profession of engineering. During the academic year, the entire group meets just once per term. The ambassadors are divided into action groups, which meet on a regular basis and report to the ambassador manager and the WME director. Each action group has specific functions and duties with recruitment retention and outreach. Communication with the entire ambassador group is through an email listserv and the WIKI event site.

Howard University (HU) Ambassadors

The ambassador program at HU started in 2011 in collaboration with the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) and OSU. It is supported by a grant from National Science Foundation through NEES, which allows participants to be paid hourly. The student coordinator is paid a fixed monthly stipend. The original objective of this ambassador program was to lead an outreach activity at National Engineering Week Family Day in Washington, D.C., that typically hosts more than 9,000 children and their families. Outreach consists of a hands-on activity that utilizes a 16-foot-long mini-wave flume developed at OSU (Lyman-Holt & Robichaux, 2013). The ambassadors are in charge of the logistics for transporting and setting up the flume, organizing materials, interacting with the activity's participants, and introducing concepts related to tsunami hazard mitigation and the role of engineers in society. In response to the enthusiasm that the engineering ambassadors manifested for the one-day hands-on outreach activity in Year 1, the objectives of the program were expanded as summarized in Table 1. In addition to organizing and operating the flume activity at these large events, ambassadors supported the training of volunteers from other organizations including the National Science Foundation and ran several educational activities at elementary and middle schools.

A faculty mentor administers the ambassador program at HU. The faculty mentor provides general guidance, communicates with NEES, manages resources, defines general objectives, and serves as an advisor; however, the ambassador program functions as a self-managed team with characteristics of a student organization under the lead of a student coordinator. Due to the small pool of engineering students, selection of ambassadors is based on dedication to the team and ability to commit necessary time. The student coordinator responsibilities include planning and scheduling of activities. The ambassadors' responsibilities include: 1) recruiting team members, organizing training sessions, and training new ambassadors, 2) defining program purposes and helping to generate ideas, 3) committing to decision making and being fully in charge of activity logistics and organization,

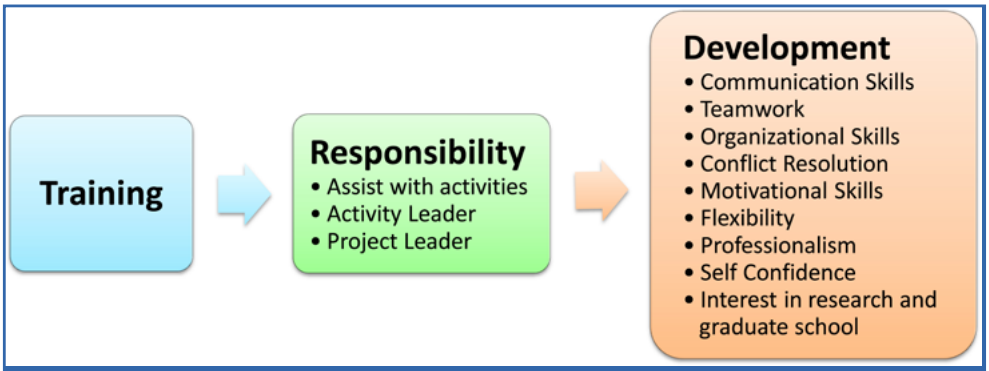

Fig. 1. Training is an essential element in the progression of skill and attitude development.

4) identifying skills and responsibilities of ambassadors for each activity, and 5) participating in assessments after events to identify potential improvements.

From the faculty perspective, this program provides the opportunity to interact with the students outside of the classroom and in different environments, identify students' skills, use out-of-classroom activities to develop students' communication and teamwork skills, provide experience in public relations (meeting people, public speaking, representing the university, etc., which enables ambassadors to feel more connected to their role in society as engineers), and identify potential students for undergraduate research activities.

Ambassador training

Training is essential for successful student development in the ambassador program. Students progress from training through increasing responsibility for activities and the program, which in turn develops and reinforces professional skills and goals (Fig. 1).

OSU has a training program both for ambassador *development* and for *management* of specific activities. The development training program takes place at the beginning of the academic year over two days. Because ambassadors represent all disciplines in the college, prior to training they generally do not know each other. Therefore, the first day focuses on team building to develop trust and camaraderie between students with the goal of promoting effective collaboration. The second day focuses on diversity, presentation skills, and preparation for the new student orientation, which takes place the following two days.

The new student orientation, which serves 1,000+ new engineering students, reinforces the leadership and communication skills learned in the training. Ambassadors present an overview of the college to the entire group and then escort groups of students to departmental meetings where the ambassadors assist department faculty in major-specific presentations. This intense four-day on-the-job training prepares ambassadors for the rest of their duties, which have topic-specific modules with an apprenticeship model. The topic-specific training covers protocols and best practices for university tours, College of Engineering tours, the laboratory tour, and school visits. Each training module consists of a training manual and observation of an experienced tour guide, followed by co-leading tours before advancing to individually leading tours. Each program has program-specific feedback and mentoring for the ambassadors to encourage development and self-confidence.

HU's ambassador program training focuses on the mini-flume activity, and students attend several training sessions where they work on specifics about the activities and their roles as ambassadors. The ambassadors must read specified materials about tsunamis prior to training sessions. They also practice the introductory talk and how to answer potential questions. The ambassadors do run-throughs of the activity so they can anticipate issues they might encounter on the actual day of the activity. The more experienced ambassadors take leadership roles in the training sessions.

The faculty mentor offers guidance on all activities, management, program planning, problem solving, and activities evaluation and meets regularly with ambassadors and the coordinator to keep current on events. The faculty mentor also serves as a resource person via continued open interaction and makes sure students maintain a balance between academic and co-curricular activities.

Study Methodology and Objectives

While the primary objective of these ambassador programs was originally to promote the research laboratory, the universities, and STEM careers, anecdotal evidence suggested that student development occurs as a result of participation and therefore additional objectives could be identified and formalized. This IRB-approved study was designed to examine the extent to which the *ambassadors themselves* benefit from the program through gains in self efficacy; interest in pursuing undergraduate research and graduate school; and skills that promote leadership such as communication, delegation, teamwork, flexibility, time management, decision making, and problem solving. In addition, the study aimed to examine how the level of involvement, leadership roles, and length of time in the program correlates with impact on the ambassadors.

A survey was sent to all current and former ambassadors at both schools to evaluate the impact of the program on ambassadors; however, completing the survey was voluntary. The survey explored why students chose to participate in the program and how their attitudes, goals, and academic choices were impacted by participating in the program. The Ambassador Evaluation Survey (Anagnos et al., 2012) was founded on work done by the NSF-funded *Assessing Women and Men in Engineering Project* (https://www.engr.psu.edu/awe/). The AWE project has developed assessment instruments for K-16 educators involved

		Number	%
Gender	Male	19	37
	Female	30	59
	Unknown	2	4
Length of Service	In Training	4	8
	Less than 6 month	16	31
	6-12 Months	9	18
	More than 1 year	22	43
Level of Participation	At least twice/month (Very Active)	18	35
	At least once/month (Active)	10	20
	At least once/semester (Somewhat Active)	16	31
	Less than once/semester (Minimally Active)	2	4
	N/A – In training	5	10
Role (not mutually exclusive)	Assisted with activities	41	80
	Activity Leader	17	33
	Project Coordinator	11	22
	N/A – In training	6	12
University	Oregon State University	28	55
	Howard University	23	45

Table 2 - Survey Respondent Characteristics

Goal	Responses
Have fun	78%
Make a difference in my community	76%
Build my resume	73%
Meet other engineering students	65%
Feel more part of the College of Engineering	63%
Meet engineering faculty	57%
Have a paying job	49%
Make friends	47%
Help me with career and job search skills	47%
Learn about engineering	39%
Get/seek advice from upper division engineering students	24%
Help me to do well in my engineering studies	20%
Meet other women engineering students	24%
Meet other students of my race/ethnicity	8%
Find other engineering students to study with	6%
Help me decide on an engineering major	6%

Table 3 - Goals for Becoming an Ambassador (ambassadors were asked to check all possibilities that applied to them)

Strongly Agree/Agree	Neutral	Disagree/Strongly Disagree	N/A - Still in Training
43 (84%)	4 (8%)	1 (2%)	3 (6%)

Table 4 - Goals for Participating in the Ambassador Program Were Met

in formal and informal educational outreach activities. Specific questions from the *AWE Undergraduate STEM Mentor Post-Participation Survey* and the *PDQ Leadership Survey* were used. Additional questions specific to this ambassador program were also developed by the authors. Although the AWE project has developed a survey aimed specifically at evaluating engineering self-efficacy (Longitudinal Assessment of Engineering Self-Efficacy, or LAESE), this study did not draw from that instrument because it is designed to be used in longitudinal studies to compare changes from one year to the next.

Results

Fifty-one students responded to the survey (28 from OSU and 23 from HU). Table 2 summarizes the characteristics of the respondents. Students were asked about their goals for joining the Ambassador Program and whether their goals were met. As indicated in Table 3, a large majority of students joined the program for three primary goals: to have fun, to make a difference in their community, and to build their resumes. The concept of community was not defined in the survey, but it could be defined as the university, the department, or the community in which they live. Based on open-ended comments, students felt a strong need to encourage younger students to consider STEM careers, so perhaps they are thinking of K-12 students as the community they are trying to help.

A second highly ranked cluster of goals centers on creating a stronger connection with the engineering program through meeting other students and faculty. Also highly ranked was having a paying job, but less than 50% of the students selected this as a goal. A large majority (84%) agreed or strongly agreed that they program met their goals (Table 4).

Although less than half of students indicated that they joined the program with specific personal or professional development goals (e.g. career and job search skills, learn about engineering, do well in studies), a significant percentage of the students indicated that they made gains in professional skills and attitudes. Skills development explored in the survey—such as teamwork, communication, conflict resolution, time management, flexibility, and motivation of others—are important elements of leadership development. They can also improve students' academic performance. Attitude changes such as willingness to consider research or graduate school and participation in engineering clubs can be instrumental in changing a student's professional trajectory. Self confidence is an important factor in student persistence and retention, particularly for women (Cech et al., 2011).

Being a leader means knowing what is out there and how to work with all types of people.
–Former Ambassador

Figures 2 and 3 summarize students' perceptions of the impact of the program on their skill development as a function of their role in the program (Assist with Activities, Activity Leader, Project Leader) and the length of time they participated. Generally the data trend toward greater development gains with increasing time in the program and with increasing responsibility. For example, 85% of students who only assisted with activities reported gains in their ability to speak in front of an audience compared to 100% of project coordinators. Similarly 79% of students who participated for less than 6 months in the program reported gains in their ability to speak in front of an audience compared to 95% of those who participated for more than 1 year. The trends are more pronounced with time in the program than with ambassador role. It should be noted that the samples are small (9 to 22 students in a category), and there are other factors in play. For example, students reported their level of participation ranging from once per semester to at least twice per month. The data show that a student who has been in the program for more than 1 year but participated infrequently did not experience the same gains. Also, in several cases students reported that when they joined the program they had

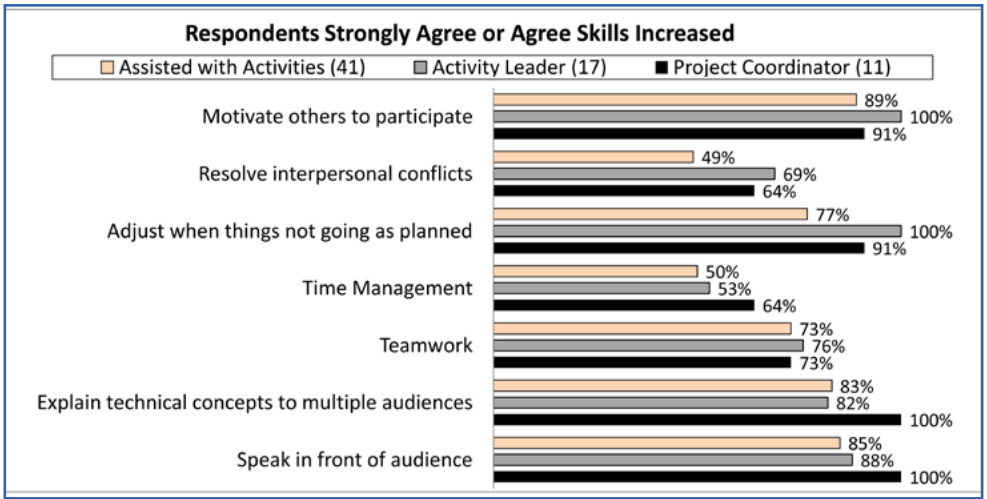

Fig. 2 – Percent of respondents that agreed or strongly agreed that their skill levels had increased as a result of participating in the ambassador program as a function of their role.

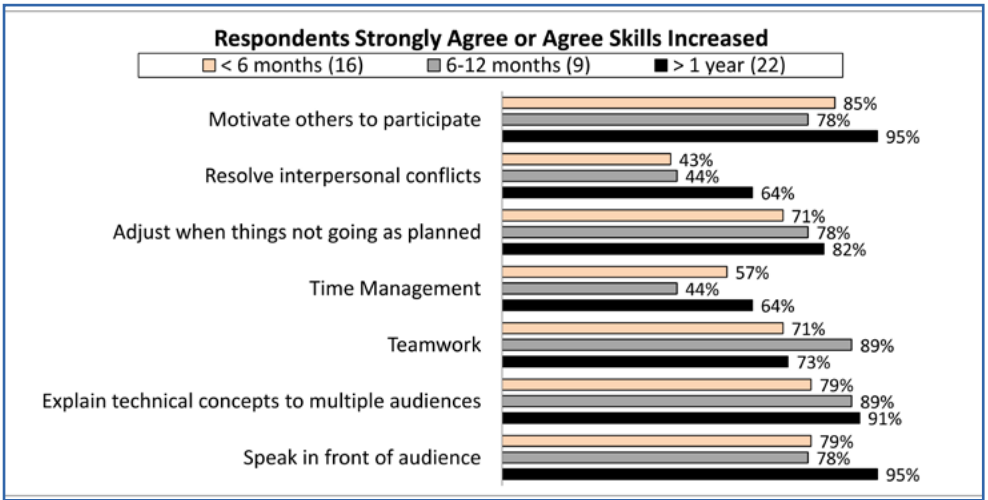

Fig. 3 – Percent of respondents that agreed or strongly agreed that their skill levels had increased as a result of participating in the ambassador program as a function of length of service.

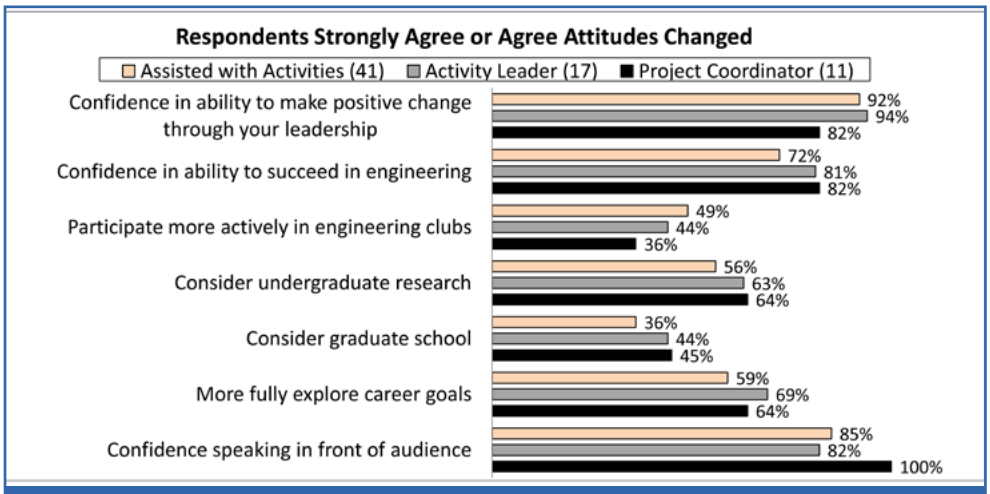

Fig. 4 – Percent of respondents that agreed or strongly agreed participating in the ambassador program changed their attitudes as a function of their role.

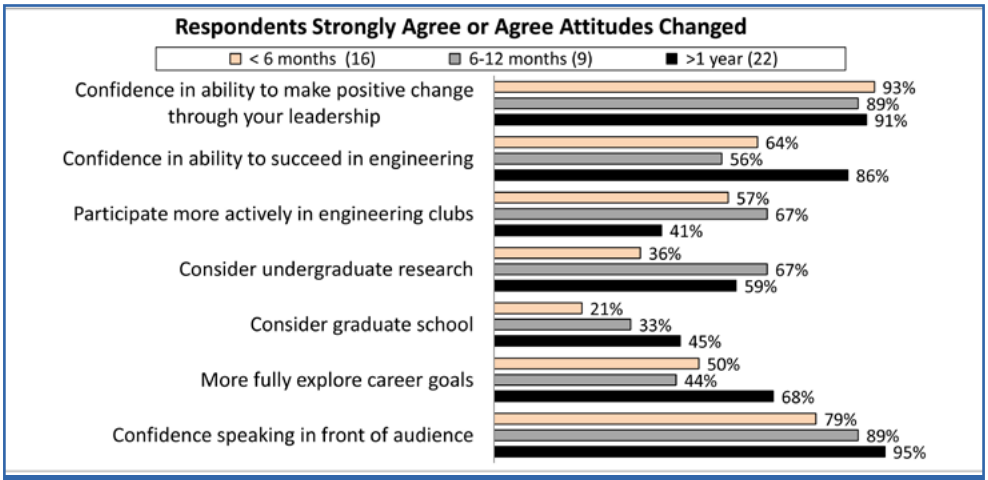

Fig. 5 – Percent of respondents that agreed or strongly agreed participating in the ambassador program changed their attitudes as a function of how long they participated in the program.

high skill levels so they felt that their skills levels remained about the same.

Figures 4 and 5 summarize students' perceptions of the impact of the program on their attitude development as a function of their role in the program and the length of time they participated. As with skills, the data trend toward increased positive impact with increased role responsibility and increased time in the program. The distribution of impact is consistent with the emphasis of the training and activities in the ambassador program, with the smallest impact on attitudes related to graduate school, research, and student clubs, which are not explicitly addressed.

These data indicate that the majority of students (82% to 94%) experienced gains in *confidence in ability to make positive change through leadership*. Even students with the lowest level of responsibility (assisted with activities) reported gains in this area. Further, a large majority of students reported gains in *confidence in public speaking* (79% to 100%), with largest impact being on the project coordinators and ambassadors with longer involvement in the program. Similarly, a large majority of project coordinators and ambassadors with longer involvement in the program reported more confidence in ability to succeed in engineering (engineering self-efficacy). While study was not able to longitudinally track the success of these students, the literature is consistent in concluding that increased STEM self-efficacy leads to improved persistence and success in STEM (Rittmayer et al., 2009).

The Ambassador Program puts you in a leadership position all the time because you are a representative of the college.
–Former Ambassador

Overall, serving as an ambassador had a positive impact on students' perception of their leadership abilities with 89% of students indicating that they feel they are better leaders after participating in the program. As with skills and attitudes, the perception increases with length of time in the program and with increasing responsibility, although all students showed significant gains. As shown in Fig. 6, 85% of students who spent less than 6 months in the program felt they were better leaders compared to 90% of students who spent more than 1 year in the program. Similarly, 100% of project coordinators felt they were better leaders compared to 86% of those who only assisted with activities. When asked about gains in leadership, open-ended responses clustered around communication skills, teamwork, organization, decision-making, and working with all types of people.

The study also explored whether gains were similar at the two universities. For some skills and attitudes the reported gains were very similar, but generally a slightly larger percentage of students at OSU than HU agree or strongly agreed that their skills had increased and attitudes had changed. This could be due to more extensive training at OSU, longer participation in the program, or the nature of ambassador duties. Only the issue of length of participation was explored.

Discussion

While engineering ambassador programs generally define service to the university and engineering program as a primary goal, they serve an equally important but often unstated goal of developing the skills and attitudes of the ambassadors themselves. Ambassador programs also provide an avenue for networking with faculty, stu-

Fig. 6 – Percent of respondents that felt they were better leaders because of participation in the ambassador program.

dents, and other professionals. Through this networking students were encouraged and successful in gaining internships and research opportunities, presenting their work at professional meetings, and learning more about graduate programs. Overall the data from this study show clearly that most students participating in the ambassador programs had large gains in important professional or "soft skills," an increase in their self-perception as skilled leaders, and increased confidence in their ability to succeed in engineering. Students reported gains even if they completed training but only participated for a short time or infrequently.

While many aspects of the programs at OSU and HU are different, one similarity is the outreach component in which undergraduates work with K-12 and the general public. These groups afford students a "safe" audience for practicing their soft skills. Another similarity of these programs is the student leadership and advisor mentorship model. In both programs students are encouraged to take on progressively larger responsibilities and eventually, with guidance of faculty, contribute to the training and mentorship of novice ambassadors. Again, this provides a safe space for students to practice their skills as they develop them. When ambassadors struggle, their peers and the program director provide the needed support, whereas if they were practicing these skills in a work environment there might not be the same safety net or level of understanding.

The authors feel that the training and mentorship model used in both programs, though implemented somewhat differently, is critical to the success of the programs and the growth of the students. Training should target the needs of the students for the program (e.g., particular communication styles and elements or content knowledge) and should allow ambassadors to practice their talks and help them anticipate questions and prepare answers. Shadowing a more experienced ambassador is also very helpful. All of these practices lead to improved self confidence as well as, of course, improved performance. Furthermore, an important contributor to student development is requiring the students to be responsible for the management of activities and the program itself rather than management being done solely by a paid staff member. As stakeholders in the management of the program ambassadors practice the organizational, conflict resolution, teamwork, time management, and motivational skills of future leaders.

It is notable that while HU's program is smaller with fewer activities, students reported gains in all categories nonetheless. It is an important finding that smaller programs still will benefit students at all levels of participation. It also is useful to note that the OSU program started small and focused on only one activity and grew incrementally over time as opportunities arose. It takes time and resources to build such a large program. This study does not sufficiently probe the difference between the two programs to understand how the size and complexity of the program may affect the student outcomes.

Findings reported here can have important implications for the restructuring of the engineering undergraduate experience so that an increased number of undergraduates have an opportunity to gain experience in program development and leadership. One approach might be to integrate portions of University Outreach with the Engineering Undergraduate Programs Office, offering an increased number of outreach opportunities for engineering students with explicit goals related to STEM self-efficacy and leadership development. In such programs additional attention could and should be placed on the multi-dimensional influences on self-efficacy. For example, more formal pathways from the ambassador program to undergraduate research could be built into the program, or ambassadors could be guided through self-reflections on how they are growing as a result of participating in the program. Future studies are needed to assess in more detail the best practices for training and supporting ambassadors to maximize their personal growth and to study the longitudinal impact of ambassador experiences on undergraduate retention and on the career trajectories of graduates.

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References

ABET. (2012). *Criteria for Accrediting Engineering Programs 2013-2014*. Engineering Accreditation Commission. Baltimore, Md. Retrieved Nov. 11, 2012 from http://www.abet.org/accreditation-criteria-policies-documents/

Anagnos, T., Lyman-Holt, A., Marin, C. & Momsen, E. (2012). *Engineering Ambassador Survey.* http://nees.org/education/assessment-and-evaluation

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavior change. *Psychological Review, 84,* 191–215.

Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011) Professional role confidence and gendered persistence in engineering. *American Sociological Review, 76*(5), 641–666. doi: 10.1177/0003122411420815

Chemers, M. M., Zurbriggen, E. L., Syed, M., Goza, B. K., & Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *J. Social Issues, 67*(3), 469-491.

Hartzell, J.G., Marshall, M., Alley, M., Thole, K.A., Haas, C., Engel, R. S., & Garner, J. K. (2013). Engineering Ambassador Network: Professional development programs with an outreach focus, *120th ASEE Annual Conf.*, Atlanta, GA.

Lyman-Holt, A. L. & Robichaux, L. C. (2013). Waves of engineering: Using a mini-wave flume to foster engineering literacy, *120th ASEE Annual Conf.*, Atlanta, GA.

MacPhee, D., Farro, S., & Canetto, S. S. (2013). Academic self-efficacy and performance of underrepresented STEM majors: Gender, ethnic, and social class patterns. *Analyses of Social Issues and Public Policy, 13*(1), 347-369.

Marra, R. M., Rodgers, K. A., Shen, D. and Bogue, B. (2009), Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *J. Engineering Education,* 98:1, 27–38. doi: 10.1002/j.2168-9830.2009.tb01003.x

Rittmayer, M.A. & Beier, M.E. (2009). Self-efficacy in STEM. In B. Bogue & E. Cady (Eds.). *Applying Research to Practice (ARP) Resources.* Retrieved <March 1, 2014> from http://www.engr.psu.edu/AWE/ARPresources.aspx

Shuman, L. J., Besterfield-Sacre, M., & McGourty, J. (2005). The ABET "Professional Skills" – Can they be taught? Can they be assessed? *J. Engineering Education*, 94:1, 41-55.

Talbot, C., Alley, M., Marshall, M., Haas, C., Zappe, S. E., & Garner, J. K. (2013). Engineering Ambassador Network: Professional development of the Engineering Ambassadors, *120th ASEE Annual Conf.*, Atlanta, GA.

Thole, K. A., Zappe, S. E., Marshall, M., Alley, M., & Engel, R. S. (2013). Engineering Ambassador Network: Dissemination through an inaugural national workshop, *120th ASEE Annual Conf.*, Atlanta, GA.

Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal*, 37, 215–246.

Zeldin, A. L., Britner, S. L., & Pajares, F. (2008). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *J. Research in Science Teaching, 45*(9), 1036-1058.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology,* 25(1), 82-91.

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Alicia Lyman-Holt has served since 2005 as the Outreach and Education Coordinator for the O.H. Hinsdale Wave Research Laboratory at Oregon State University, one of the largest near shore and tsunami research facilities in the world. Under Ms. Lyman-Holt's guidance the laboratory hosts over 5000 visitors per year, including 3500 K-12 students; most of these tours are provide by ambassador tour guides. Additionally Ms. Lyman-Holt coordinates a large Research Experience for Undergraduate program for the George E. Brown, Jr., Network for Earthquake Engineering Simulation (NEES). Her interests include undergraduate student development, informal science and engineering education, public outreach and natural hazard mitigation.

Claudia Marin-Artieda is an Associate Professor in the Department of Civil and Environmental Engineering at Howard University where she joined in 2008 after her graduate studies at SUNY-Buffalo. Her research focuses on protective systems to offer high-performance solutions to structures and nonstructural systems and components under extreme loading. She has received several awards and scholarships, among others, the NSF-CAREER award for "Passive Seismic Protective Systems for Nonstructural Systems and Components in Multistory Building", and was a recipient of a Fulbright Scholarship. Before she pursued her graduate studies, she had seven years of professional experience working in Colombia for HMV Ingenieros.

Ellen Momsen is Director of the Women and Minorities in Engineering Program at Oregon State University, and OSU program manager of the Louis Stokes Alliance for Minority Participation in STEM. She developed and implemented the Engineering Ambassador Program at OSU as a way to reach underrepresented students in all geographic areas of the state. Her office manages an active undergraduate research program, mentor programs, and STEM Summer Bridge. Prior to joining OSU, she was a physics instructor, and mentor teacher.