Engineering Ambassador Network: Professional Development Programs with an Outreach Focus

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Introduction

Among middle and high school students and teachers, many misconceptions exist regarding the profession of engineering. According to a study done by the National Academy of Engineers, the majority of students in grades K-12 were unable to identify what engineers do. Those students commonly labeled engineers as people who fix things or cars. Also, many students associated the term engineer with someone who drives a train. The lack of understanding about the profession of engineering has caused people to shy away from studying engineering or, worse yet, make a misinformed decision from studying engineering.

A lack of understanding especially appears to be the case for certain groups. For instance, only 18.4 percent of engineering bachelor’s degrees were awarded to women in 2011, which is near the lowest since 1995. Moreover, only 4.0 percent of engineering bachelor’s degrees in 2011 went to African-Americans and only 8.5 percent went to Hispanics. The lack of diversity in engineering fields is a cause for serious concern. In engineering, the most underrepresented groups are currently women, African Americans, and Hispanics.

Rectifying the retention and attraction of youth into engineering is an ongoing process. To combat the false perceptions about engineering, a network of universities, named the Engineering Ambassador Network, has developed a professional development program with an outreach mission. The Engineering Ambassador Network uses the report Changing the Conversation, published by the National Academy of Engineers, as a guide to provide outreach to middle and high school students. Specifically, the Engineering Ambassador Network emphasizes three messages from Changing the Conversation: (1) “Engineers make a world of difference,” (2) “Engineering encourages creativity,” and (3) “Engineers contribute to the health, happiness, and safety of our world.” In addition, the Engineering Ambassador Network focuses on the professional development of its ambassadors by providing them with formal training on advanced communication skills and on leadership skills, both of which are important skills in the liberal education of engineers.

The member programs of Engineering Ambassador Network (Penn State, University of Connecticut, Rensselaer Polytechnic Institute, and Worcester Polytechnic Institute) strive to change the conversation when speaking to middle school and high school students about engineering. All of these schools take part in collaborative training sessions; these sessions lead the student ambassadors to develop advanced communication, presentation, and leadership skills. The skills that the ambassadors develop are then applied when speaking with middle school and high school students.

For instance, as a partner school in the EAN, the University of Connecticut Ambassadors “strive to raise awareness of the value of engineering and the need to increase interest in the field.” The Engineering Ambassadors at Connecticut present off campus at middle school and high schools with the purpose of “educating students on the importance of engineering to the health, happiness, and safety of our world.” As with all of the Network schools, the basis of this outreach is centered on the principles found in Changing the Conversation. Outreach is not limited to off-campus visits. The ambassadors strive to inspire UConn engineering students by demonstrating the opportunities in engineering.
Similarly, the missions of the EA programs at Rensselaer Polytechnic Institute and Worcester Polytechnic Institute center on educating students on engineering and engineering in society. The mission of the EA program at Rensselaer Polytechnic Institute is to focus on inspiring younger generations to explore the roles of engineers in society. Likewise, the mission of the EA program at Worcester Polytechnic Institute is to engage younger generations in the STEM fields and make the engineering study seem more accessible and exciting, meanwhile still garnering leadership, presentation, and project management skills of their own.

This paper presents an overview of the Engineering Ambassador Network. Connected with this overview paper are four more specific papers that provide analysis about specific aspects of the Network. One such paper focuses on the outreach done by Engineering Ambassadors, a second paper focuses on the leadership development of the Engineering Ambassadors, a third focuses on the establishment of Engineering Ambassador programs at three additional schools, and the fourth assesses the effectiveness of a national conference that trained ambassadors for seventeen pilot programs at schools across the United States.

This paper first presents a review of other engineering ambassador programs around the country and shows how they differ from the Engineering Ambassador Network. Following that is a brief history of the Engineering Ambassador Network with an emphasis on what distinguishes this program from other programs bearing the same name.

Overview of Other Outreach Programs

Schools in the Engineering Ambassador Network (EAN) are not the only institutions that have programs with the label “Engineering Ambassadors.” Several other engineering colleges around the country have such programs. Presented in this literature review are descriptions of four of the largest: North Carolina State, Purdue University, Cornell University, and Texas Tech University. Although these organizations carry the same name as the programs in the Engineering Ambassador Network (EAN), this literature review will show that they vary significantly from the EAN in their missions, training of ambassadors, and outreach activities. Such an argument is important—otherwise, Engineering Colleges might assume that they already have an EAN program when in fact they do not.

North Carolina State University (NCSU) is one of the first programs to initiate an Engineering Ambassador program. Unofficially, the program started in 2006, but it achieved prominence in 2010. This program relies on the strong core of students to “support the College of Engineering by helping attract good students…by exposing our students to engineering departments and opportunities…[to] enrich the educational experience for first year and upper-class engineering students…[and by] developing collective leadership skills that will benefit our state, nation, and the world.” Carrying out the program’s mission occurs through series of informational sessions for prospective and current students. The focus of the NCSU Engineering Ambassador programs is on campus events. Additionally, to develop the skills necessary to provide outreach and guidance for the College of Engineering, ambassadors at NC State undergo two training sessions and are teaching assistants for an introduction to engineering class. Unclear, however, is the type of communication training that the NCSU ambassadors undergo. One other difference between this program and the EAN is the NCSU focus on campus outreach events. While the NCSU program wishes to bring the message of engineering to new
Engineering outreach is also seen in the form of an Engineering Ambassador program at Purdue University. This organization was developed to “enhance and expand student representation in College of Engineering alumni, development, and legislative efforts and recruitment and retention activities.” Similar to the ambassadors at NCSU, Purdue University ambassadors undergo training. The goal of Purdue’s training programs is to provide the students with leadership skills and information about the university. There are two main goals of the organization: (1) to recruit and offered outreach to prospective students, and (2) to orient and retain current engineering students. The outreach for prospective students done by Purdue is mostly limited to campus events, including tours and presentations. Purdue University does not mention participating in off-campus events. Like NCSU’s program, the Purdue program does not emphasize or even mention using the messages of *Changing the Conversation* when speaking with middle school and high school students.

Cornell University’s Engineering Ambassador program was created in the 2005-2006 school year, with the mission of being a “student led organization committed to providing an accurate and candid portrait of the College of Engineering.” The main difference seen with this organization compared with the previous two Engineering Ambassador organizations is that it is student run. Another key difference is that no class requirement or formal training requirement exists. The main purpose of the group is to become a “cohesive” group that improves College of Engineering tours and to create new services for prospective students. Similar to the programs of NCSU and Purdue, this program lacks an off-campus outreach component and does not emphasize or even mention the messages of *Changing the Conversation* to middle school and high school students.

The Engineering Ambassador program at Texas Tech University (TTU) is similar to the other three organizations mentioned in this literature review. The mission of Texas Tech is to “assist the Whitacre College of Engineering in promoting its programs to prospective students, industry, business, and alumni.” For this program, outreach is not the main priority. Similar to the other schools mentioned, TTU has its organization focus on tours to prospective students. Additionally, the TTU ambassadors assist at the Engineering Job Fair and escort alumni at the Distinguished Engineers' Luncheon. Therefore, the TTU Engineering Ambassador program is more similar to the Engineering Ambassador programs at Cornell, Purdue, and NCSU than it is to the programs in the EAN. In all four of these schools, the ambassador programs focus on campus events, and do not emphasize or even mention the messages of *Changing the Conversation* in their dealings with middle and high school students.

Table 1 presents a summary comparison of the Engineering Ambassador programs at North Carolina State University, Purdue University, Cornell University, and Texas Tech University, with the programs of the four member schools of the EAN (shown in gray): Penn State, Rensselaer Polytechnic Institute, the University of Connecticut, and Worcester Polytechnic Institute. As shown in the table, the EAN schools have a large effort to reach middle and high school students in off-campus events. In addition, the EAN schools use messages from *Changing the Conversation* (CTC) as the foundation for their outreach presentations. Finally, the EAN schools provide formal training to their ambassadors on advanced communication skills and leadership skills.
Table 1: Identifying Features of Engineering Ambassador Programs across the U.S.

<table>
<thead>
<tr>
<th>Source</th>
<th>Purpose</th>
<th>On-Campus Outreach</th>
<th>Off-Campus Outreach</th>
<th>Size</th>
<th>Training of Ambassadors</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carolina State Engineering Ambassadors</td>
<td>Support the College of Engineering by helping attract good students and by exposing our students to engineering departments and opportunities</td>
<td>Exposure to engineering is created by hosting on campus informational events to current and prospective students</td>
<td>Limited number of off-campus outreach events held—no mention of using CTC messages</td>
<td>38</td>
<td>Two days of training; also, service as TA for an engineering course</td>
</tr>
<tr>
<td>Purdue University Engineering Ambassadors</td>
<td>Enhance and expand student representation in College of Engineering alumni, development, and legislative efforts and recruitment and retention activities</td>
<td>Give on campus tours and presentations to prospective students</td>
<td>Limited number of off-campus outreach events held—no mention of using CTC messages</td>
<td>20</td>
<td>Attend Engineering Ambassador Leadership Seminar to develop as leaders and become knowledgeable about Purdue culture</td>
</tr>
<tr>
<td>Cornell University Engineering Ambassadors</td>
<td>Student led organization committed to providing an accurate and candid portrait of the College of Engineering</td>
<td>Student led tours for the College of Engineering</td>
<td>No off-campus outreach to students—no mention of using CTC messages</td>
<td>Unknown (no official designation)</td>
<td>Engineering Ambassador training and certification session required to all ambassadors</td>
</tr>
<tr>
<td>Texas Tech Engineering Ambassadors</td>
<td>To promote programs to prospective students, industry, business, and alumni</td>
<td>Tours to prospective students and interested parties</td>
<td>Limited number of off-campus outreach events held—no mention of using CTC messages</td>
<td>34</td>
<td>No formal training</td>
</tr>
<tr>
<td>Penn State University Ambassadors</td>
<td>To inspire middle and high school students to challenge conventional ideas about science and engineering</td>
<td>Tours to prospective students, VIPS, and information sessions</td>
<td>Middle and high school visits that use CTC messages</td>
<td>66</td>
<td>Effective Speaking course or 3-day Network workshop; Advanced Engineering communication class</td>
</tr>
<tr>
<td>University of Connecticut Engineering Ambassadors</td>
<td>Educate students on the importance of engineering to the health, happiness, and safety of our world</td>
<td>Campus outreach to prospective students</td>
<td>Middle and high school visits that use CTC messages</td>
<td>&gt; 20</td>
<td>3-day Network workshop on presentations</td>
</tr>
<tr>
<td>Rensselaer Polytechnic Institute Engineering Ambassadors</td>
<td>Has a focus on inspiring younger generations to explore the roles of engineers in society</td>
<td>Presentations to a younger audience promoting engineering</td>
<td>High school visits that use CTC messages</td>
<td>21</td>
<td>3-day Network workshop on presentations</td>
</tr>
<tr>
<td>Worcester Polytechnic Institute Engineering Ambassadors</td>
<td>To engage younger generations in the STEM fields and make it more accessible and exciting, meanwhile still garnering leadership, presentation, and project management skills on their own</td>
<td>Reaches out to prospective students, specifically women and underrepresented minorities, to make engineering as a discipline more visible</td>
<td>Middle and high school visits that use CTC messages</td>
<td>&gt; 20</td>
<td>3-day network workshop on presentations; presentation training modules</td>
</tr>
</tbody>
</table>
History of the Engineering Ambassador Network

The Engineering Ambassador Network began with a small group of students at Penn State. At its inception, the goal was to spread the messages of *Changing the Conversation*, primarily that engineers make a difference in the world and that engineers contribute to the health, happiness, and safety of society.\(^1\) Since the organization began in the spring of 2009, expansion of the program has occurred not only within Penn State, but also to other schools in the northeast region and nationally. Figure 1 shows the inception and the development of the Engineering Ambassador Network. Depicted in the following paragraphs is the development and growth of this network.

![Timeline of the development of the Engineering Ambassador Network.](image)

**Figure 1**: Timeline of the development of the Engineering Ambassador Network.

**Origins at Penn State.** The Engineering Ambassador Network began in 2009 with a single program at Penn State. In four years, the program has grown to four member schools, 17 pilot schools, and two international schools. The original Engineering Ambassador program at Penn State grew out of a public speaking course offered to Penn State engineering students. Wanting to capitalize both on the strong presentation skills that the students developed in the course and to increase number of females coming into engineering, the two instructors enlisted two excellent female speakers from the course to make presentations about engineering in area high schools. With one of the instructors (Melissa Marshall) serving as coach, the two female bioengineering
students piloted the first Engineering Ambassador presentations in two area high schools in May 2009.

Those pilot presentations were so successful that the College of Engineering decided to fund a larger effort for the 2009-10 year. This academic year, the program grew to twelve ambassadors with several engineering disciplines represented: four Mechanical Engineering ambassadors, two Nuclear Engineering ambassadors, two Bioengineering ambassadors, one chemical Engineering ambassador, and three Industrial Engineering ambassadors. All twelve of these ambassadors were female and were compensated by the College for their outreach efforts.

Having women as the members of the organization was appropriate for the organization’s original mission of trying to increase the ranks of females in engineering at Penn State. The idea was that young female engineers would be role models to whom girls in the middle and high school classes could relate. In this initial year, the 12 ambassadors spoke at 8 different schools and reached over 1000 students. The map in Figure 1 of the state Pennsylvania depicts the location and number of schools visited during the 2009-2010 school year.

![Figure 2: 2009-2010 Pennsylvania Map of School Outreach competed by Penn State.](image)

During the 2010-2011 academic year, the number of Ambassadors increased again to 36. The 2010-2011 Ambassadors covered almost every engineering discipline. One of the major changes that took place during the 2010-11 school year was that the program included both male and female engineering Ambassadors. However, the majority of the Ambassadors that year were still female. Having a mix of male and female ambassadors allowed more outreach to be done and to more effectively reach male and female middle and high school students. There was a great deal of growth in the organization during this time period, as the ambassadors traveled to ten schools and spoke to 2500 students over the academic year.

The growth of the Engineering Ambassador Network continued into the 2011-2012 year. Another large jump took place in September 2011 when the number of ambassadors reached 48.
At the close of the 2011-12 school year, the Engineering Ambassadors at Penn State had visited 11 schools and reached 2900 middle and high school students.

In the 2012-13 school year, the Engineering Ambassador organization at Penn State reached 66 engineering ambassadors, with 64% being women. This class of ambassadors covered a diverse group of eleven different types of engineering majors. With eleven majors being represented, much opportunity existed to discuss different types of engineering on outreach visits. As of August 2012, the organization had 67 school visits and reached almost 10,000 middle and high school students.

**Expansion to Northeast Schools.** The Engineering Ambassador Network grew out of the Engineering Ambassador program started at Penn State in 2009. Global recognition of the Engineering Ambassador program came in September 2010, when Simula Research Laboratory in Oslo invited Engineering Ambassador program director, Melissa Marshall, and two engineering students to hold training workshops. These workshops shared the communication and leadership skills that became the foundation of the Engineering Ambassador Network. This workshop was the inaugural training session that would become a model for the future training sessions held by the Penn State Engineering Ambassadors.

Within a year, Penn State was holding another training workshop, this one involving three other engineering colleges in the northeast. With support from United Technologies Corporation, which wanted Penn State’s Engineering Ambassador program to spread to other schools in the region, the University of Connecticut, Worcester Polytechnic Institute, and Rensselaer Polytechnic Institute launched their own Engineering Ambassador programs. In April 2011, the Engineering Ambassadors at Penn State created a three-day training workshop. In all, twenty-two ambassadors were trained in communication and presentation skills.

The workshop proved to be a success. The interest of RPI, WPI, Connecticut continued after the training workshop. Each school developed an Engineering Ambassador Program to have the same core values and missions as the Penn State program. Moreover, in September 2011, a second training workshop took place, this one at RPI. The four schools had forty-two students trained to be ambassadors during workshop.

Again, in September 2012, the four schools met again for a third training workshop—this one at WPI. This workshop trained sixty-two students. The relationships built through these training workshops and similar training led to the development of the Engineering Ambassador Network. These four schools became member schools of the Network. The goal was to share resources and work together to continue to change the conversation on engineering. Table 2 shows the growth of each of the four member schools not only in ambassadors, but also in the outreach done by each of the schools.
Table 2: Outreach by Member Schools of the Engineering Ambassador Network.

<table>
<thead>
<tr>
<th>School</th>
<th>2009-2010</th>
<th>2010-2011</th>
<th>2011-2012</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Ambassador: 12</td>
<td>Ambassador: 36</td>
<td>Ambassador: 46</td>
</tr>
<tr>
<td></td>
<td>School Visits: 8</td>
<td>School Visits: 10</td>
<td>School Visits: 11</td>
</tr>
<tr>
<td></td>
<td>Students Reached: 1000</td>
<td>Students Reached: 2500</td>
<td>Students Reached: 2900</td>
</tr>
<tr>
<td>Penn State</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UConn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WPI</td>
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</tbody>
</table>

National Dissemination. In December 2011, the Engineering Ambassador Network grew to a national level when President Obama recognized one of the Engineering Ambassador advisory board members (Karen Thole) for her work at recruiting and retaining women in engineering.

Because of interest from schools across the nation, a need arose now for a national training workshop. Through grants from the National Science Foundation (Grant Number 0835875) and the Penn State Electro-Optics Center, Penn State was able to sponsor a national workshop to train Engineering Ambassadors from schools across the country. Because of the large number of schools wanting to attend (17), the number of ambassadors trained from each school would be only 2-4, which meant that the schools were at a pilot stage. In August 2012, the four member schools, two international schools, and the seventeen pilot schools gathered at Penn State University to attend a training workshop. The pilot schools are seen in Figure 3 with blue flags, and yellow flags display the member schools. Each of the seventeen pilot schools was given a one-year pilot status to implement a program at their respective schools.
Conclusion

The Engineering Ambassador Network is a professional development program with an outreach mission. Since its inception at Penn State in May of 2009, the Engineering Ambassador Network has grown to four member schools and 17 pilot schools.

Two main features distinguish the programs in the EAN from other programs around the country with the name “Engineering Ambassadors.” One is the off-campus outreach to middle and high school students.\textsuperscript{14} This outreach is based on conveying the messages of \textit{Changing the Conversation}.\textsuperscript{1} A second feature is professional development of the ambassadors in the EAN.\textsuperscript{15} An emphasis is put on the members developing advanced communication and leadership skills.

References


