Engineering Ambassador Network: Increasing Diversity through Outreach to Middle and High Schools

Ashlea Noelle Krupa, Pennsylvania State University
Ms. Melissa Marshall, Pennsylvania State University, University Park
Mr. Michael Alley, Pennsylvania State University, University Park

Michael Alley is an associate professor of engineering communication at Pennsylvania State University. He serves on the advisory board of the Engineering Ambassador Network. With Melissa Marshall and Christine Haas, he teaches advanced presentation skills to Engineering Ambassadors in workshops across the country.

Dr. Joanna K. Garner, Old Dominion University
Ms. Christine Haas, Worcester Polytechnic Institute

Christine Haas has worked for non-profits and higher education institutions for the past eight years. As the director of operations for Worcester Polytechnic Institute (WPI) Engineering, she managed operations and strategic initiatives for the newly formed Office of the Dean of Engineering. As director of Marketing for Drexel College of Engineering, she oversaw an extensive communication portfolio and branding for seven departments and programs. Haas currently consults with engineering and science related institutions to advise on best practices in communication, from presentations to print. Christine received her M.B.A. in Marketing and International Business from Drexel University and her B.A. in English and Film from Dickinson College.

Ms. Johanna Gretchen Hatzell, Pennsylvania State University, University Park
Engineering Ambassador Network: 
Increasing Diversity through Outreach to Middle and High Schools

Introduction

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. Common answers included building buildings and fixing cars. In addition, some students associated the term engineer only with someone who drives a train.\(^1\) The lack of knowledge about engineering among America’s youth creates a serious concern. Problems our nation currently faces and will face in the future will need engineers. Therefore, if not enough future students become engineers, we will face a shortage. To combat this shortage, many institutions across the nation have formed engineering outreach programs.

One such program is the Engineering Ambassador Network, which was formed by Pennsylvania State University, Rensselaer Polytechnic Institute, the University of Connecticut, and Worcester Polytechnic Institute. The Engineering Ambassador Network is a professional development organization with an outreach mission. Through advanced presentation training and the messages of Changing the Conversation, the Engineering Ambassadors in this Network aim to inspire the next generation of engineers.

This paper discusses how the Engineering Ambassador Network attempts to increase interest and diversity in engineering through outreach. Although the Engineering Ambassador Network includes four member programs and seventeen pilot programs, most of the data in this paper will come from the most established program—the one at Penn State. Because the Engineering Ambassador Network does not follow the middle and high school students with whom the ambassadors interact, we will evaluate the success of the outreach efforts by other means such as assessments by teachers. We will also report aggregated responses from anonymous student surveys gathered as part of ongoing program evaluation efforts.

First, this paper presents a literature review of programs at other universities who participate in engineering outreach to middle or high school students. In this review, we will examine three large engineering outreach programs: North Carolina State University, University of Colorado Boulder, and Colorado School of Mines. Next this paper will closely examine what distinguishes the Engineering Ambassador Network’s outreach presentations from other engineering outreach presentations. We will focus on the Engineering Ambassador Network’s messages, messengers, and the way the messages are delivered. Then we will present methods for evaluating the success of the Engineering Ambassador Network’s outreach programs. Success will be based on two methods: responses from teachers whose classrooms the Ambassadors visited and student responses from an anonymous questionnaire. Finally, this paper will present an evaluation of the Engineering Ambassador Network’s success based on the methods above.
Literature Review

Colleges across the country are realizing the importance of exposing K-12 students to engineering topics in their classrooms. Three key questions arise in these outreach efforts: (1) what messages to give the K-12 students, (2) who will deliver those messages, and (3) how those messages will be delivered. This literature review focuses on outreach efforts that under the banner of “Engineering Ambassadors” seek to inspire curiosity in students about engineering topics. Outside of the programs within the Engineering Ambassador Network, three programs that meet those criteria are at North Carolina State University, the University of Colorado Boulder, and the Colorado School of Mines. This literature review will examine several variables of these outreach efforts: the audience for the outreach, the purpose of the outreach, the technique and type of interaction for the outreach, the messengers who will perform the outreach, and the training of those messengers. In particular, this literature review focuses on how the outreach efforts of these other schools differ from the outreach effort of the Engineering Ambassador Network.

North Carolina State University’s College of Engineering has been conducting outreach programs to students in grades K-12 since the fall of 1998. Their outreach teams are composed mostly of undergraduate engineering students involved in the Women in Engineering program. Despite the fact that the outreach teams are heavily composed of female and minority students, the outreach mission does not specifically target these groups in their visits to schools throughout the state of North Carolina.²

Outreach teams at NC State begin their presentations by creating a definition of what engineers do. NC State’s definition states that engineers solve problems using math and science. After defining what engineers do, the outreach teams perform different demonstrations to the students. Each demonstration represents a different discipline of engineering. In order for the demonstrations to be effective, the outreach teams choose topics that will spark interest, but that have explanations that are easy enough for students to understand. To measure the program’s success, the program leaders calculate how many of the schools visited invited the outreach teams back. So far, the outreach program of the NC State ambassadors has been well received by students and teachers at the various North Carolina schools because every school visited has invited the outreach teams for a return visit.²

In contrast, the Integrated Teaching and Learning Program within the College of Engineering and Applied Science at the University of Colorado at Boulder has taken a different approach to reaching out to K-12 students about engineering. Rather than just reaching out to K-12 students, engineering students and faculty from UC Boulder also teach K-12 educators’ workshops about engineering. “Engineering in Everyday Life” is the name of this major outreach program.³

The unique idea about “Engineering in Everyday Life” is that University of Colorado students and faculties develop activities such as engineering demonstrations to teach to K-12 educators. The idea is to create a network of engineers and K-12 educators to help create effective engineering development activities for students. Ideally these workshops will be mutually beneficial. Teachers will gain insight into engineering, and the engineering outreach coordinators can learn what type of approach is most successful when teaching K-12 students.
Teachers who attend these workshops are encouraged to share ideas on how to incorporate engineering concepts into the classroom with other educators via a website specifically for “Engineering in Everyday Life.”

Teams at the University of Colorado also teach workshops to K-12 students. Workshops are centered on demonstrations. Each workshop has a different theme varying based on age groups. The workshops engage students by using engineering concepts that are relatable to students’ everyday lives.

In another part of the state, students from Colorado School of Mines have teamed up with researchers at IBM to visit middle schools in the Denver area. This engineering outreach effort is known as “Engineering Your Future.” This outreach effort brings several engineering students and a faculty member into local 7th and 8th grade classrooms each month throughout the school year to teach fifty-minute sessions. Local schools were chosen based upon poor performance on state tests in science. All of the schools were low income with a high minority student population.

The goal of the monthly visits is to engage students in interesting demonstrations. Ideally these demonstrations reinforce science and engineering concepts that students are beginning to learn about in their curriculum. Demonstrations are designed to connect science and engineering concepts to real world applications and show students how these concepts impact their daily lives. Each visit has a different theme. Some themes include Introduction to Engineering, Acid/Base Chemistry, Polymers, Sound, Light, Environmental Chemistry, and Algorithms. During the final visit, the middle school students teach a concept they learned throughout the year to reinforce what they learned. Students’ final presentations demonstrated a clear understanding of the concept or material they taught. Outreach efforts also include special events. Special events are such things as bringing the students on a field trip to the Colorado School of Mines.

Initial assessments of “Engineering Your Future” showed success. Teachers from the classrooms that were visited said students learned and retained more information when the outreach program came into their classroom. Teachers explained that students were excited to have the outreach program and looked forward to it every month. Also, the program was most successful when college engineering students were in the classroom. College students were positive role models for the students because they are only a few years older.

In this literature review, we examined three different university’s efforts at engineering outreach. Table 1 compares and contrasts the outreach efforts at North Carolina State, the University of Colorado Boulder, the Colorado School of Mines, with the outreach efforts of the Engineering Ambassador Networks. A common theme among three non-Network schools was the reliance solely on demonstrations to connect engineering to everyday life. Having students see something first hand and relate it to their own life seems to be the most important goal for these engineering outreach programs. Each school varied on what specific type of demonstrations it performed. North Carolina State aimed at having students see demonstrations showing differences among the disciplines of engineering. With their demonstrations, the University of Colorado aimed for specific topics that would grab students’ attention. In contrast, Colorado School of Mines aimed to connect what the students were learning in class to their demonstrations. North Carolina State and the Colorado School of Mines placed heavy importance on college engineering students interacting with the middle or high school students,
whereas University of Colorado Boulder emphasized the teachers implementing engineering topics into the classroom. The frequency of visits varied among the groups with NC State doing a onetime visit, UC Boulder having workshops and relying on teachers, and Colorado School of Mines making multiple visits to the same schools.

Table 1. Outreach activities of prominent Engineering Ambassador programs.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Audience</th>
<th>Purpose</th>
<th>Technique</th>
<th>Interaction</th>
<th>Instructors</th>
<th>Instructors Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Carolina State University</td>
<td>Middle and high school students</td>
<td>To show the different types of engineering</td>
<td>Demonstrations related to each engineering discipline</td>
<td>Middle and high school classroom visits for one class period</td>
<td>Engineering students, most from the Women in Engineering Program</td>
<td>No mentioned formal training</td>
</tr>
<tr>
<td>University of Colorado Boulder &quot;Engineering in Everyday Life&quot;</td>
<td>K-12 Educators</td>
<td>To create a network of teachers who can incorporate engineering into their classrooms</td>
<td>Demonstrations that highlight an interesting topic or idea</td>
<td>Weeklong workshops for educators; website for educators to stay connected Weeklong workshops for students</td>
<td>Engineering undergraduates and engineering faculty members</td>
<td>No mentioned formal training</td>
</tr>
<tr>
<td>Colorado School of Mines &quot;Engineering Your Future&quot;</td>
<td>7th and 8th grade students at low income diverse middle schools</td>
<td>To connect concepts being learned in curriculum to real world engineering application</td>
<td>Demonstration that correspond to what students are learning in class</td>
<td>Multiple visits to the same classrooms for one 50-minute session through the year (about 1 per month); field trips</td>
<td>Engineering undergraduates and engineering faculty; sometimes researchers at IBM</td>
<td>No mentioned formal training</td>
</tr>
<tr>
<td>Engineering Ambassador Network Penn State, WPI, RPI, University of Connecticut and 17 pilot schools</td>
<td>Middle and high school students</td>
<td>Communicate the messages of Changing the Conversation</td>
<td>Formal presentation accompanied by related student activity</td>
<td>Middle and high school classroom visits for one class period</td>
<td>Teams of two engineering ambassadors, who are engineering undergraduates, with most being from under-represented groups in engineering</td>
<td>3-credit class or 3-day workshop of advanced presentation skills</td>
</tr>
</tbody>
</table>
Three key differences distinguish the outreach program of the Engineering Ambassador Network from the programs mentioned above. The first main difference has to do with content. The Engineering Ambassador Network has its outreach presentations communicate the messages of *Changing the Conversation*.¹ The second main difference has to do with the messengers. The student ambassadors in the Engineering Ambassador Network are required to take a three-credit course or attend a 3-day workshop that teaches advanced presentation methods. The third main difference has to do with the way the message is delivered. The interactions of the Engineering Ambassador Network with middle and high school students consist not only of a demonstration (or student related activity), but a formal presentation. This presentation, which is given by a team of two ambassadors in a science or math class, follows an advanced presentation method—the assertion-evidence approach.²⁻⁶

**What Distinguishes the Outreach Efforts of the Engineering Ambassador Network**

As discussed above, three elements distinguish the Engineering Ambassador Network outreach programs from other such programs: (1) the Network’s messages; (2) the Network’s messengers; and (3) the way the Network’s messages are delivered. In the Network, Engineering Ambassadors focus on the messages of *Changing the Conversation* during their presentations. The Ambassadors are a group of diverse individuals trained in communication skills. As taught in the Network’s training, advanced communication strategies such as the assertion-evidence structure and TED-style approaches are used to convey the messages.

First, *Changing the Conversation* messages aim to change the way that engineers are viewed.¹ For example, when most middle and high school students think of a doctor, they think about how a doctor helps someone. However, when most middle and high school students think about an engineer, they think about how an engineer needs to be good at math and science. Engineering Ambassadors want to change that perception to show middle and high school students that engineers make a world of difference. This message is one of the recommended messages of *Changing the Conversation*.¹

Ambassadors do not just tell students about how engineers make a difference, but show how engineers make a difference through specific examples. According to *Changing the Conversation*, the message that engineers make a difference appeals to both male and female students.¹ Another recommended message from *Changing the Conversation* is that engineers contribute to the health, happiness, and safety of the world. To illustrate this message, Engineering Ambassadors provide middle and high school students with examples such as how engineers create spinal implants to help patients with scoliosis.² According to the marketing studies in *Changing the Conversation*, this second message appeals most highly to female students.¹

Second, the messengers that go into classrooms are a diverse group of college engineering students. The messengers are selected through an application process and then undergo significant training in presentation skills. Engineering Ambassadors are students from all engineering disciplines. Although males and females are both selected as Engineering Ambassadors, the majority of the Ambassadors at Penn State are female engineering students. The reasoning for having the majority of Ambassadors to be females is because Penn State wants to increase its percentage of females in engineering and because middle and high school female
students are more likely to see themselves being able to succeed as an engineering student if they see a female engineering student only a few years older than them succeeding.7

Engineering students cannot just join the Engineering Ambassadors, but instead are selected through an application and interview process. Once selected, students either undergo a three-credit course or training workshops. During the training, the Ambassadors learn about assertion-evidence slide design and how to apply it to their presentations.7 Figure 1 shows a sample of an assertion-evidence slide from an ambassador presentation. Assertion-evidence is an advanced presentation method in which the presenter creates a succinct sentence headline that states the main message of the slide and then supports that message with visual evidence (photographs, drawings, diagrams, graphs, or films) rather than with a bulleted list.5-6 Research has shown that an audience who views a technical presentation that uses the assertion-evidence slides understand and retain more information than those viewing a traditional presentation with phrase headlines supported by bullet points.8 Training also teaches about other presentation methods. For example, Ambassadors at Penn State are required to read Presentation Zen by Garr Reynolds.9 Reynolds’s book teaches ambassadors to create slides that avoid Power Points defaults and instead use simplicity that eliminates signal to noise ratio and utilizes empty space. These techniques are valuable because Power Point’s default settings lead to presentations that have high cognitive load and that violate Mayer’s principle of multimedia learning.10

![Figure 1. Sample slide from an ambassador presentation that follows the assertion-evidence structure.](http://www.ambientmedia.org)[11]

Engineering Ambassador Network outreach presentations teach the messages of Changing the Conversation and apply advanced presentation techniques learned during training. In these outreach presentations, a team of two ambassadors visits the science or math classroom of the middle or high school to make a formal presentation and to run a student related activity.7 During the presentation, ambassadors show how engineers are “contributing to the health,
happiness, and safety of the world” and “making a world of difference.” These two messages 
arise from Changing the Conversation. The student activity, such as constructing the highest 
tower with spaghetti sticks and masking tape, complements the presentation by giving middle 
and high school students a chance to have a fun hands-on experience that relates to engineering.

Methods

This paper uses two methods of evaluating the success of the Engineering Ambassador 
Network. Our first method of evaluation involves responses from school teachers whose classes 
that the Engineering Ambassadors visited. The second method of evaluation is an anonymous 
questionnaire of middle and high school students from the visited schools.

Success will be measured based on teachers’ responses to the Engineering Ambassador 
Network outreach program. We have two methods to evaluate teachers’ responses to the 
outreach program. First, we have questionnaire responses from teachers after the Ambassadors 
visited. Secondly, similar to the strategy at North Carolina States, we examined how many of the 
schools visited by the Engineering Ambassadors requested a second visit. A second visit may 
have been either an invitation for the Engineering Ambassadors to return to their school or a 
request by the middle or high school to visit the Ambassadors’ school. In other words, if a high 
school wants to visit the Engineering Showcase at Penn State, we would consider that a second 
visit. If a teacher’s school requested a second visit, we will consider this a positive response of 
the teacher toward the Engineering Ambassador Network’s outreach program.

Second, we examined the results of a questionnaire given to middle and high school 
students visited by Ambassadors. Questionnaires were administered to the students after the 
outreach presentation and activity. The questionnaire asked students about their gender, plans 
after high school, and intended careers. The questionnaire had students rank, on a scale from 1 
(strongly disagree) to 5 (strongly agree), four questions regarding the Engineering Ambassador 
presentation on their opinions of engineering. The questions were as follows:

(1) This presentation helped me better understand what engineering is
(2) This presentation has made me think about engineering as a career option
(3) Engineering is a profession that makes a difference in the world
(4) Engineering is important to our health, happiness, and safety.

The questionnaire had two open-ended questions asking students how the presentation changed 
their opinion of engineering and what from the presentation sticks with them most. At the end of 
the questionnaire was a section for comments or questions.

Results and Discussion

This section presents the results of the evaluation of the outreach program of the 
Engineering Ambassador Network. Included are the results of teachers’ questionnaire, a table of 
schools reached by the Engineering Ambassadors, and the results of the students’ questionnaire. 
Also included are selected quotes from teachers and students regarding the outreach 
presentations of the Engineering Ambassadors.
Seventeen teachers self reported on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree) on twenty different questions regarding the Engineering Ambassadors visit in Table 2. All the teachers surveyed taught in the state of Pennsylvania and were visited by the Penn State Engineering Ambassadors. Based on their high responses to the final question, the Engineering Ambassador outreach program was a success.

Table 2. Results of questionnaire to middle and high school teachers who science and math classes were visited by the Penn State Engineering Ambassadors.

<table>
<thead>
<tr>
<th></th>
<th>The Engineering Ambassador presentation increased students’ knowledge of the topic</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>4.59</td>
</tr>
<tr>
<td>2</td>
<td>The Engineering Ambassador classroom visit increased students’ understanding of the work of engineers</td>
<td>4.71</td>
</tr>
<tr>
<td>3</td>
<td>The Engineering Ambassador classroom visit made my students think about engineering in a new way</td>
<td>4.53</td>
</tr>
<tr>
<td>4</td>
<td>The Engineering Ambassador classroom visit helped to reduce stereotypes about engineers</td>
<td>4.18</td>
</tr>
<tr>
<td>5</td>
<td>My students were very engaged during the Engineering Ambassador classroom visit</td>
<td>4.71</td>
</tr>
<tr>
<td>6</td>
<td>My students were able to connect the presentation to their course content</td>
<td>4.29</td>
</tr>
<tr>
<td>7</td>
<td>After the Engineering Ambassador classroom visit, students seemed interested in discussing it</td>
<td>4.06</td>
</tr>
<tr>
<td>8</td>
<td>I referred back to the Engineering Ambassador classroom visit in another class period</td>
<td>4.12</td>
</tr>
<tr>
<td>9</td>
<td>I think that the class time used for the Engineering Ambassador classroom visit was worthwhile</td>
<td>4.71</td>
</tr>
<tr>
<td>10</td>
<td>The Engineering Ambassador presentation increased my understanding of the topic</td>
<td>4.29</td>
</tr>
<tr>
<td>11</td>
<td>The Engineering Ambassador classroom visit increased my understanding of the work of engineers</td>
<td>4.12</td>
</tr>
<tr>
<td>12</td>
<td>The Engineering Ambassador classroom visit made me think about engineering in a new way</td>
<td>3.94</td>
</tr>
<tr>
<td>13</td>
<td>The content of the Engineering Ambassador classroom visit was relevant to the subject I teach</td>
<td>4.47</td>
</tr>
<tr>
<td>14</td>
<td>The Engineering Ambassador classroom visit was relevant to the state curriculum standards</td>
<td>4.24</td>
</tr>
<tr>
<td>15</td>
<td>The content of the Engineering Ambassador classroom visit was relevant to our local community</td>
<td>4.24</td>
</tr>
<tr>
<td>16</td>
<td>An Engineering Ambassador classroom visit could help teachers connect their course content to topics in engineering</td>
<td>4.59</td>
</tr>
<tr>
<td>17</td>
<td>An Engineering Ambassador classroom visit could help teachers connect their course content to real world issues</td>
<td>4.65</td>
</tr>
<tr>
<td>18</td>
<td>State standards require me to address subject matter applications that are relevant to engineering</td>
<td>3.88</td>
</tr>
<tr>
<td>19</td>
<td>Local mandates require me to address subject matter applications that are relevant to engineering</td>
<td>3.59</td>
</tr>
<tr>
<td>20</td>
<td>In the future I would welcome another visit from the Engineering Ambassadors</td>
<td>4.88</td>
</tr>
</tbody>
</table>

Since its inception, the Engineering Ambassador Network Schools have reached thousands of students. All of the schools visited by Penn State Engineering Ambassadors had teachers request a second visit. Table 3 lists the number of schools and students reached by the Engineering Ambassador Network for 2011-2012. The four Engineering Ambassador Network schools reached almost 10,000 students in 67 different schools.

A questionnaire was used to gather information about the impact of EA visits on the engineering-related perceptions of middle and high school students. The questionnaire was completed by 272 middle and high school students (50 male, 222 female) from two school sites, 96% of whom indicated intentions to attend college after graduating from high school.

The questionnaire revealed ways in which the visit impacted students’ thinking about engineering. A five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to reveal ways in which (1) the presentation helped students to understand what
engineering is (2) the presentation made students think about engineering as a career option (3) the degree to which students believed that engineering is a profession that makes a difference in the world and (4) the degree to which engineering contributes to our health, happiness and safety.

Table 3. Number of schools and students visited by the Engineering Ambassador Network in 2011-2012.

<table>
<thead>
<tr>
<th></th>
<th>Schools Visited</th>
<th>Estimated Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penn State</td>
<td>11</td>
<td>2900</td>
</tr>
<tr>
<td>RPI</td>
<td>11</td>
<td>3230</td>
</tr>
<tr>
<td>WPI</td>
<td>17</td>
<td>575</td>
</tr>
<tr>
<td>UConn</td>
<td>28</td>
<td>3200</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td>9915</td>
</tr>
</tbody>
</table>

Responses to each question were aggregated for male and female students separately and for the group as a whole. A one-way ANOVA was used to establish significant differences between male and female respondents at the 0.05 level. As shown in Table 4, although male students were significantly more likely than female students to think about engineering as a career option, female students were significantly more likely to strongly agree that engineering is a profession that makes a difference in the world. Overall, the data show that male and female students tend to strongly agree that the presentation increased their understanding of what engineering is, and believe that engineering is a profession that makes a difference in the world through its contribution to our health, happiness and safety.

Table 4. Engineering related attitudes expressed by high school students after EA visit.

<table>
<thead>
<tr>
<th>Item</th>
<th>Male students (n=50)</th>
<th>Female students (n=221)</th>
<th>Group (n=271)</th>
</tr>
</thead>
<tbody>
<tr>
<td>This presentation helped me better understand what engineering is</td>
<td>4.40 0.57</td>
<td>4.43 0.56</td>
<td>4.42 0.56</td>
</tr>
<tr>
<td>This presentation made me think about engineering as a career option</td>
<td>4.06 0.89</td>
<td>3.96* 0.98</td>
<td>3.65 0.98</td>
</tr>
<tr>
<td>Engineering is a profession that makes a difference in the world</td>
<td>4.63 0.53</td>
<td>4.77* 0.42</td>
<td>4.74 0.45</td>
</tr>
<tr>
<td>Engineering is a profession that contributes to our health, happiness and safety</td>
<td>4.56 0.54</td>
<td>4.69 0.48</td>
<td>4.67 0.49</td>
</tr>
</tbody>
</table>

* p<0.05

The questionnaire also included open-ended questions asking students to indicate how the presentation changed their view of engineering (n=272 responses). Responses were coded iteratively using a constant comparison method in NVivo 10 software. First, open coding was used to determine the main idea of each statement. This resulted in nonexclusive nodes, or categories, of responses. A second round of coding within each category resulted in refined operational definitions and in a small number of cases (<25) category reassignment between the
first two categories listed in Table 4 and another group of responses (n=16) being listed under “increased positive affect towards engineering” instead of within “increased understanding of what engineering is” (refer back to Table 4). In all, 232 codes were assigned to 217 responses, indicating that most statements contained one main idea and were coded once according to that idea.

Because students’ statements often linked categories together, a cluster analysis for coding similarity using Jaccard’s similarity index was conducted. The resulting horizontal dendrogram visually describes the degree of similarity among categories. Interpreting the dendrogram indicates that statements appear to relate broadly to four groups of ideas: (1) the diversity of engineering fields and awareness of career options in these fields, (2) the notion that engineering makes a difference in the world, and positive affect associated with this idea, (3) changes in students’ understanding of what engineering is, which often seemed to co-occur with revision of specific conceptions of engineering, and (4) understanding of the widespread impact of engineering, which was related to an increased understanding and appreciation for engineers.

![Dendrogram](image)

**Figure 2.** Coding similarity for students’ responses to the question “How did today’s presentation change your view of engineering?”

Another way to evaluate the success of the Engineering Ambassador Network program is from comments teachers and students wrote on their questionnaires. Given below are comments from teachers and students. A common idea in the comments from students and teachers alike is how the outreach presentation made students realize how big of an impact engineers have on the world.

*The students definitely had their misconceptions about what engineers do clarified. They learned that engineers solve problems that improve the quality of life and that they work in many different fields.*

Teacher from Hershey, Pa

*It opened their eyes to the field of engineering. Especially the females in my classes! They may not have had the career of an engineer on their "radar" until meeting with the student ambassadors.*

Teacher from Mercersburg, Pa

*[Today’s presentation changed my opinion of engineering because] I did not realize it was such a worldly topic and so beneficial to life and the everyday.*
Female High School Student

[Today’s presentation changed my opinion of engineering because] I didn’t know how big of a part of my daily life engineering is.

Male Middle School Student

Based on these methods of evaluation, the outreach program of the Engineering Ambassador Network appears to be successful. However, a more formal means of assessment is needed before we can recommend a national dissemination of the program. A main reason is that the program requires much time from a faculty or staff member to train the ambassadors on the advanced presentation techniques, to set up and coordinate the high school visits, and to accompany the ambassadors on those visits. In addition, the training of the advanced presentation techniques is challenging, and goes well beyond what is typically taught in speech classes.13

To this end, our program has made two steps. First, we have held a national conference to train two to four ambassadors at seventeen engineering colleges across the United States.14 The purpose of this testing was to see whether a diverse grouping of schools could run pilot programs with the same anecdotal results as what our programs found. Second, we have applied for a grant from the National Science Foundation to perform a more formal assessment of the success of the Engineering Ambassador Network from the perspective of the professional development of the ambassadors.15 Should this grant be funded and should the results come back positive, then the Network would be in a position to pursue a formal study on the effect of the program’s outreach activities on middle and high schools.

References


