Engineering Ambassadors Network: Progress in 2014 on Creating a National Network of Ambassadors

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Christine Haas brings ten years of experience working in marketing and communications with a focus on the science and engineering fields. She’s held positions as the director of marketing for Drexel’s College of Engineering and director of operations for Worcester Polytechnic Institute - Engineering.

Now, as CEO of Christine Haas Consulting, LLC, Christine travels around the world teaching courses to scientists and engineers on presentations and technical writing. She has taught clients across government, industry and higher education, including Texas Instruments, Brookhaven National Laboratory, European Southern Observatory (Chile), Simula Research Laboratory (Norway) and the University of Illinois-Urbana Champaign. Christine works closely with Penn State University faculty Michael Alley (The Craft of Scientific Presentations and The Craft of Scientific Writing) and Melissa Marshall (TED, “Talk Nerdy to Me”) on these courses.

Christine is also the director of the Engineering Ambassadors Network, a start-up organization at 25 plus universities worldwide that teaches presentation skills to undergraduate engineering students, particularly women and underrepresented groups in engineering. These Engineering Ambassadors develop valuable leadership and communication skills, which they apply through engineering outreach to middle and high school students.

Christine received her MBA in marketing and international business from Drexel University and her BA in English and film from Dickinson College.

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Summary and Introduction

To solve today’s engineering challenges, we need a wide range of solutions, which can be realized only by having enough engineers with diverse and strong technical backgrounds. Workforce studies have shown that the number of students being educated in STEM (science, technology, engineering, and math) cannot meet projected demands [1]. Also, the current enrollments in engineering are not diverse, especially among women, blacks, and Hispanics [2]. On another issue, a recent survey of engineers in industry indicates a compelling need for engineers to have strong communication skills [3].

Addressing these challenges is the Engineering Ambassador Network: a network of professional development programs for undergraduate engineering students with an outreach mission to middle and high schools. The development mission is to enrich the communication and leadership skills of engineering undergraduates through academic programs. The outreach mission is to attract a diverse population of middle and high school students into engineering. In short, the Engineering Ambassador Network places the right messenger (engineering undergraduates with advanced presentation skills) with the right message (messages about engineering from Changing the Conversation [4]) in front of middle and high school students.

This paper describes progress on the expansion of the Network during 2014 and plans for continued expansion in 2015. Support for this work has come from a grant by the National Science Foundation [5]. In addition, the efforts this year were deeply influenced by our participation in an NSF I-Corps workshop [6].

This paper begins with the influence of NSF I-Corps on the project itself. Following that is a discussion of the on-site training workshops at three pilot schools and a regional workshop at a member school that included 100 trainees from six pilot schools. Next, the paper discusses online materials developed in 2014 to enable pilot programs to teach advanced communication skills to new members so that they can perform the outreach. After that, the paper describes efforts in 2014 to assess the effect of the Network, especially the effects of the Network on the ambassadors themselves. Concluding the paper is a summary of what occurred in 2014 and what we plan for 2015.

How NSF I-Corps Has Influenced the Engineering Ambassador Network

From January through February 2014, three members of the Engineering Ambassador project participated as an I-Corps team in the completion of the I-Corps curriculum. Serving as the entrepreneurial lead was Kathryn Kirsch, a Ph.D. student in mechanical engineering from Penn State. Dr. Joanna Garner, a faculty member in psychology from Old Dominion University, served as the mentor, and Michael Alley, a faculty member in engineering communication from
Penn State, served as the principal investigator. The experience of going through the I-Corps curriculum has had a deep influence on how we see our NSF project on the Engineering Ambassador Network.

First, the experience has made us reassess how we intend to sustain and scale the Engineering Ambassador Network. For instance, NSF I-Corps influenced us to be open to the pivot of incorporating larger regional workshops into our yearly trainings in which multiple schools attend. One specific influence in the I-Corps curriculum was the analysis of market size. Given the limited numbers of instructors ready to train new ambassadors and the wide distribution of pilot programs across the country, we realized that we can disseminate our training to many more ambassadors through regional workshops.

In addition, NSF I-Corps has caused us to increase our efforts to develop online training materials. Put simply, the online training allows us to train many ambassadors at any time and at any location. Although online training is certainly not as effective as face-to-face training, the process of going through I-Corps curriculum persuaded us that posting quality online materials should be a priority in our project.

Going through the I-Corps curriculum also led us to come up with the minimum viable product for our project. For our I-Corps curriculum, this product was the core strategy of our presentation training for the engineering ambassadors: the assertion-evidence approach [7]. In deciding how to make this product available to a wide market, we posted a tutorial for this strategy. As discussed in a later section, we realized through the I-Corps curriculum that this tutorial would benefit all presenters in STEM, not just the engineering ambassadors.

Going through the I-Corps curriculum has shown us the value of pivoting. Before going through the I-Corps curriculum, we were conservative in proposing changes in the original scope and direction of our project. Now, however, we know that if our audience interviews reveal that a pivot is needed, we should not only make that pivot, but celebrate that pivot. One such pivot for us arose during the I-Corps curriculum’s evaluation of market size. In this evaluation, we realized that if we limited our dissemination of our training materials to engineering ambassadors, the numbers of people affected by our project would be only in the hundreds. However, if we also disseminated a slightly altered version of our training materials, the numbers of people in STEM whom we could reach could be in the tens of thousands. As discussed later in this document, we have added a different version of our training materials to have a broader impact on this much larger audience.

The I-Corps curriculum also taught us the value of personal interviews as a way to understand our customers. Since going through the I-Corps curriculum, we have conducted an additional set of personal interviews to understand the pain points that engineering students experience in delivering presentations in the way that expert presenters in STEM present: fashioning sentences on the spot after planning and practice. For engineering students, the biggest two pain points are learning the sequence of ideas for the talk and then having the confidence to fashion sentences on the spot (after practice) to convey those ideas. From these interviews, we came up with a new tool to help engineering students learn the sequence of ideas: a memory map [8], which is an image-based outline that students use during the practicing of their talks.
On-Site Training Activities of Engineering Ambassador Network

During spring 2014, the Engineering Ambassador Network held training workshops at three pilot schools: San Jose State University, Vanderbilt, and Oregon State. In total, these workshops launched seven new Engineering Ambassadors programs, since Oregon Institute of Technology, Portland State University and the University of Washington all attended the training at Oregon State. In total, 78 Engineering Ambassadors were trained. Of those 78 Ambassadors, over 75% of them were women or a member of another underrepresented group in engineering.

During fall 2014, network members helped advance our training model by organizing the largest workshop to date at Rensselaer Polytechnic Institute (RPI) for schools in the Northeast. Held in September 2014, seven schools attended this workshop with 138 attendees in total. In order to recruit some of these schools to attend the workshop, the Worcester Polytechnic Institute (WPI) and RPI Engineering Ambassadors visited various universities to present about the Engineering Ambassadors Network. Thanks to their efforts, Union College and Tufts University joined the Engineering Ambassadors Northeast Regional Workshop. Attendees also included University of Connecticut, WPI, University of Maine and Louisiana State University.

Of the 138 attendees at the regional workshop, 100 were new Ambassadors and 22 were veteran Ambassadors. Seventy percent of the Ambassadors were women or an unrepresented group in engineering. In addition, attendees at the regional workshop included a mix of new and veteran Engineering Ambassadors, program advisors, corporate sponsors, observers, and Science Ambassadors. Science Ambassadors is a program started at RPI with a similar mission to Engineering Ambassadors, but with a focus on science.

Thanks to the efforts of our members, we have realized that we can disseminate our trainings to a larger number of Ambassadors, helping to maximize our resources. We have added a regional workshop to our annual training schedule. In 2015, another regional workshop will be held in the Northeast since there is a large cluster of mature Engineering Ambassador Programs in that area. However, we hope in 2016 to launch these regional workshops in other areas of the country.

Online Training Activities of Engineering Ambassador Network

Our participation in the NSF I-Corps project revealed the importance of having online materials that could deliver training at any place and at any time. That importance came through during our interviews of new Engineering Ambassadors, who wanted to access training at a wide variety of times and from different locations across the United States. Meeting such needs could not be done using the half-dozen trainers whom we currently have. Instead, this goal required having the training placed online and available on demand. Shown in Figure 1 is a screen capture of a website to provide training that parallels what Engineering Ambassadors would receive in an onsite training workshop.

Accompanying these training modules is a website tutorial on slide design, delivery exercises to help Engineering Ambassadors with their outreach presentations, and sample outreach talks used in the slide and delivery tutorials. Note that the slide tutorial and delivery exercises are specific to Engineering Ambassadors. Shown in Table 1 are usage statistics for this module, the website tutorial on slide design, the delivery exercises specific for Engineering
Ambassadors, and the sample outreach films. In short, the usage statistics are modest. For instance, only 85 users visited the online training module, with an access total of only 294 views. On the positive side, the statistics typically are only for about half the year. Also, the average length of stay on those pages was high (2:51), which suggests that learning occurred during a typical visit. Moreover, our interviews with Engineering Ambassadors reveal that they found the site valuable. Still, from a marketing perspective, given the numbers of potential “customers” for this site, the annual usage statistics for these resources will remain in the hundreds.

Figure 1. Screen capture from online training module for Engineering Ambassador Network: https://www.softchalkcloud.com/lesson/serve/1n3irHBU9XfWyh/html
In 2014, we posted one module on the content of outreach presentations for the Engineering Ambassador Network. In 2015, we intend to post three more: Organization, Visual Aids, and Delivery.

Table 1. Online resources to train Engineering Ambassadors to give outreach presentations.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Training module</td>
<td><a href="http://www.softchalkcloud.com/lesson/serve/1n3irHBU9XfWyh/html">www.softchalkcloud.com/lesson/serve/1n3irHBU9XfWyh/html</a></td>
<td>Sep 6</td>
<td>294</td>
<td>02:51</td>
</tr>
<tr>
<td>Slide Tutorial</td>
<td>writing.engr.psu.edu/assertion_evidence_EA.html</td>
<td>Mar 15</td>
<td>166</td>
<td>02:25</td>
</tr>
<tr>
<td>Delivery Exercise</td>
<td>writing.engr.psu.edu/teaching/exercise3.html</td>
<td>Jul 23</td>
<td>211</td>
<td>02:14</td>
</tr>
<tr>
<td>Delivery Exercise</td>
<td>writing.engr.psu.edu/teaching/exercise4.html</td>
<td>Aug 2</td>
<td>81</td>
<td>02:07</td>
</tr>
<tr>
<td>Delivery Exercise</td>
<td>writing.engr.psu.edu/teaching/exercise5.html</td>
<td>Aug 2</td>
<td>89</td>
<td>01:48</td>
</tr>
<tr>
<td>Delivery Exercise</td>
<td>writing.engr.psu.edu/teaching/exercise6.html</td>
<td>Mar 15</td>
<td>166</td>
<td>02:25</td>
</tr>
<tr>
<td>Outreach Talk 1</td>
<td>vimeo.com/73537143 (Film)</td>
<td>Jan 1</td>
<td>258</td>
<td>11:37</td>
</tr>
<tr>
<td>Outreach Talk 2</td>
<td>vimeo.com/81809530 (Film)</td>
<td>Oct 1</td>
<td>12</td>
<td>12:32</td>
</tr>
</tbody>
</table>

As mentioned, our participation in the NSF I-Corps revealed the opportunity to use slight modifications of these training materials to reach a much larger number of individuals in
STEM—in particular, graduate students doing research presentations and undergraduates preparing presentations for courses and internships. As we identified in the I-Corps curriculum, a minimum viable product of our Engineering Ambassador Network is an advanced presentation strategy that we teach to our Engineering Ambassadors: the assertion-evidence approach [7]. In short, the assertion-evidence approach challenges the common approach to technical presentations. This commonly followed approach, marked by a reliance on bulleted lists, has arisen from STEM presenters following PowerPoint’s defaults. Instead of designing presentation slides with phrase headlines supported by bulleted lists, the assertion-evidence approach calls for a slide to have a succinct sentence-assertion headline supported by visual evidence: photographs, drawings, diagrams, graphs, and films. Our research has found that audiences of STEM presentations have a deeper understanding and better recall, when the presenter follows the assertion-evidence approach [9]. Shown in Figure 2 is an example of an assertion-evidence slide that presents a result from engineering research on how dogs detect trace scents.

![The way a dog sniffs does not contaminate the vapor stream from the scent source](image)

**Figure 2.** Example slide that follows the assertion-evidence approach [7]. This approach calls for challenging the defaults of PowerPoint and building the slide with a succinct sentence headline supported by visual evidence. In this approach, bulleted lists are not used.

Through the I-Corps curriculum, we realized that we could dramatically increase our market size on communicating the minimum viable product by creating slightly altered versions of the websites that we created for targeting the Engineering Ambassadors. For instance, we took the slide tutorial and for the EAs and made it more general for all presenters in STEM. In addition, we created two delivery exercises that would serve not only Engineering Ambassador programs, but all courses teaching presentations to STEM students.

Presented in Table 2 are usage statistics for these resources. Included with each resource are the number of page views in 2014, and the average time that visitors spent on the web pages. Because no statistics exist for the time spent with each film, we simply included the length of the film.
Table 2. Online resources arising from NSF project to train STEM professionals and students to give scientific presentations using the assertion-evidence (AE) approach.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Posted Date</th>
<th>Page Views (2014)</th>
<th>Page: Avg. Time (Film: Length)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE Slide Tutorial</td>
<td>writing.engr.psu.edu/assertion_evidence.html</td>
<td>Mar 15</td>
<td>7895</td>
<td>02:18</td>
</tr>
<tr>
<td>Delivery Exercise</td>
<td>writing.engr.psu.edu/teaching/exercise1.html</td>
<td>Jul 21</td>
<td>875</td>
<td>03:03</td>
</tr>
<tr>
<td>Delivery Exercise</td>
<td>writing.engr.psu.edu/teaching/exercise2.html</td>
<td>Jul 22</td>
<td>617</td>
<td>02:40</td>
</tr>
<tr>
<td>AE Commercial</td>
<td>vimeo.com/88991194 (Film)</td>
<td>Mar 15</td>
<td>4223</td>
<td>1:37</td>
</tr>
<tr>
<td>AE Slide Design</td>
<td>vimeo.com/81809530 (Film)</td>
<td>Mar 15</td>
<td>1409</td>
<td>6:16</td>
</tr>
<tr>
<td>AE Delivery</td>
<td>vimeo.com/76866610 (Film)</td>
<td>Mar 19</td>
<td>905</td>
<td>6:30</td>
</tr>
</tbody>
</table>

A comparison of Table 1 and Table 2 reveals the dramatic difference in the number of audience users reached from our using the I-Corps curriculum and marketing aspects of our education innovation to a wider audience. For instance, the number of page views for the Engineering Ambassador tutorial in 2014 was 166, while the number for the tutorial targeting all STEM presenters was 7895. That is a 50-fold increase. Other increases can be seen for the delivery exercises and the training films. While the numbers of users for the Engineering Ambassador resources could certainly increase (into the hundreds) as the Engineering Ambassador Network spreads, the number of users for the STEM resources could increase even more so (into the thousands or tens of thousands) as teachers and workshop leaders learn about those resources.

What these differences reveal about I-Corps is that the I-Corps curriculum made us more opportunistic to pivot and expand the original target audience in our NSF proposal. Put another way, because the I-Corps curriculum emphasizes scale and sustain, we were open to new opportunities to achieve broader impacts from our project.

Assessment of Engineering Ambassador Network

In 2014, we began our assessment of the Engineering Ambassador Network. Two broad goals guided the assessment strategy. These are (1) to assess the impact of the Engineering Ambassador Network training, and (2) to identify elements of site experiences that may be critical to the success and sustainability of the sites. To date, preliminary data have been gathered in service of the first goal only. During 2015, a purposive sample of participants will be contacted to provide additional information about their progress since the workshop training.

Workshop training experiences were assessed through quantitative and qualitative means. Quantitative data were gathered through the administration of a survey typically completed at the end of the workshop or shortly thereafter. Data from student ambassadors and their advisors at the Vanderbilt, San Jose State, Oregon State, Rensselaer Polytechnic Institute and Nebraska regional workshops revealed overwhelmingly positive responses to the training and networking experiences. Responses were obtained from 180 Engineering Ambassadors, 13 Science
Ambassadors, 22 Advisors and 4 Observers/Alumni. Qualitative data were gathered through interviews with students and advisors following the Vanderbilt and RPI workshops. In these workshops, the main question to be addressed was as follows: *What is the impact of the Engineering Ambassador Network training?*

**Students’ ability to conduct outreach presentations.** The workshops were well received by the students who participated. Only 3% of student respondents indicated that the workshop did not meet their expectations, whereas 46% indicated that the workshop met their expectations and 51% indicated that the workshop exceeded their expectations. Students indicated that the training equipped them to create and deliver outreach presentations. Descriptive statistics for key questions targeting this topic are presented in Table 3. Response options ranged from 1 (needs improvement) to 5 (excellent).

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>The workshop was relevant to me as an EA.</td>
<td>4.66</td>
<td>0.69</td>
<td>170</td>
</tr>
<tr>
<td>I feel ready to develop an outreach presentation.</td>
<td>4.68</td>
<td>0.58</td>
<td>170</td>
</tr>
<tr>
<td>I feel ready to deliver and outreach presentation.</td>
<td>4.62</td>
<td>0.64</td>
<td>170</td>
</tr>
<tr>
<td>I can access resources to help me create and deliver outreach presentations.</td>
<td>4.55</td>
<td>0.73</td>
<td>170</td>
</tr>
<tr>
<td>The workshop was a good networking experience.</td>
<td>4.14</td>
<td>1.03</td>
<td>170</td>
</tr>
</tbody>
</table>

The survey also asked participants to rate their confidence in their ability to carry out key aspects of an outreach presentation. Figure 3 presents the percentage of students who indicated that they felt confident to carry out each particular task.
Advisors’ ability to fulfill their role. The workshops were also well received by all 22 advisors who completed the post-workshop survey indicated that they were in attendance for all three days of the workshop. Table 4 presents summary statistics for advisors’ responses to questions about key aspects of the advisor role. As shown, nearly half (41%) of the advisors indicated that the workshop exceeded their expectations, and slightly fewer (36%) indicated that the workshop met their expectations. Nearly one fourth (23%) did not respond to this question.

Table 4. Advisors’ ratings of preparedness to fulfill role at their site.

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>The workshop was relevant to me in my role as an EA advisor.</td>
<td>4.33</td>
<td>1.03</td>
<td>22</td>
</tr>
<tr>
<td>I feel ready to facilitate Engineering Ambassador activities.</td>
<td>4.28</td>
<td>1.13</td>
<td>22</td>
</tr>
<tr>
<td>I can access resources to help my students create and deliver effective outreach presentations.</td>
<td>4.39</td>
<td>0.85</td>
<td>22</td>
</tr>
<tr>
<td>I am ready to contact schools to schedule Engineering Ambassador visits.</td>
<td>4.28</td>
<td>1.18</td>
<td>22</td>
</tr>
</tbody>
</table>
When asked to indicate what their next steps would be as advisors, six advisors stated that they would be scheduling outreach visits. Other advisors gave answers that included meeting with their students; appointing student leaders to various tasks; developing presentations; starting training, etc. Five advisors did not respond to this question.

Data analysis is currently underway to code the N=20 interviews with students and advisors in order to provide further insights into their experiences. One of the major themes to have emerged from the interviews in the analysis to date is the impact of learning assertion-evidence presentation techniques. Most of the students with whom the evaluator spoke indicated that this technique allowed them to produce a much higher quality presentation than they would have been able to by themselves. This finding was echoed by the comments from advisors, who were pleased with the students’ presentations and who appreciated having the EA trainer(s) teach the technique in such detail. A second major theme that emerged from the interviews was the positive reaction to the critique sessions, including the expectation that they would not be enjoyable (but they were), and the degree to which their talks improved as a result of the sessions. A final theme that emerged from the interviews was the positive reaction to being able to network with other students. The only consistent comment that was not positive was about the amount of work that the workshop required; students frequently mentioned staying up late into the night each night to prepare their talks for the next day.

Conclusions from 2014 and Plans for 2015

In summary, the Engineering Ambassador Network had the following major accomplishments in 2014. First, the Network fulfilled its promise of training a significant number of new Engineering Ambassadors at new sites around the country. In 2014, we trained 178 new Engineering Ambassadors from a geographically diverse segments of schools in the northeast (RPI, WPI, Union College, Tufts University, the University of Connecticut, WPI, University of Maine), the south (Vanderbilt and Louisiana State University), and the west (San Jose State, Oregon State, Portland State, Oregon Institute of technology, and the University of Washington). In addition, most of the trained Engineering Ambassadors came from groups historically under-represented groups in engineering: women, blacks, and Hispanics.

Second, we developed online materials to support the training of new Engineering Ambassadors. In particular, we have developed one of the four needed training modules, a tutorial page for Engineering Ambassadors to learn the assertion-evidence approach, and delivery exercises for Engineering Ambassador programs to help members continue to develop their delivery and improvisation skills. Usage statistics revealed that while the time spent on the resources was good, the page views of these resources were low—ranging from the dozens to the low hundreds.

Third, we have begun assessment on the following research question: What is the impact of the Engineering Ambassador Network training? The following themes have arisen. First, learning the assertion-evidence strategy has helped the Engineering Ambassador trainees produce a much higher quality presentation than they would have been able to by themselves. Second, the trainees found that the critique sessions were both enjoyable and valuable. Third, the
trainees valued the opportunity to network with other Engineering Ambassadors. A negative theme concerned the large amount of work that the workshop required.

A fourth major accomplish in 2015 was that three members from the project participated as an I-Corps team in the January-February NSF I-Corps curriculum. Arising from this participation was a set of online materials that paralleled the training of the Engineering Ambassadors, but targeted a wider audience. The usage statistics of these resources were successful, with the number of page views in the thousands and the average time spent on each resource appropriate. In essence, participation in the NSF I-Corps curriculum has made us more opportunistic in reaching wider audiences with our educational innovations, thereby increasing our project’s broader impacts.

In 2015, we will further expand the Network through training workshops. Building on our experiences in 2014, we will focus on workshops at pilot schools, such as Oregon State, that can draw Engineering Ambassador trainees from nearby campuses. In addition, because of the large impact, we will have another regional workshop in the Northeast such as what we had at RPI. In 2015, we will expand our online training to include modules on organization, visual aids, and delivery. In 2015, we will also deepen our assessment of the effect of the Network’s training and experiences on the Engineering Ambassadors themselves.

Finally, in 2015, we will leverage our I-Corps experience to pursue opportunities to scale and sustain our educational innovations. For instance, where possible, we will add modifications of our presentation training materials to serve larger groups of students in STEM. One group that we will target are STEM graduate students preparing to give research presentations. In addition, we will apply the I-Corps curriculum principles to newer innovations such as memory maps [8].

Acknowledgments

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References


