

## **Engineering Ambassadors Network: Progress in Year 3 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.

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# **Engineering Ambassadors Network: Progress in 2015 on Creating a National Network of Ambassadors**

## **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.<sup>1</sup> Also, the current enrollments in engineering are not diverse, especially among women, blacks, and Hispanics.<sup>2</sup> On another issue, a survey of engineers in industry indicates a compelling need for engineers to have strong communication skills.<sup>3</sup>

The Engineering Ambassadors Network addresses these challenges. The Engineering Ambassadors Network is a collaboration 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*<sup>4</sup>) in front of middle and high school students.

This paper describes progress on the expansion of the Network during 2015 and plans for continued expansion in 2016. Support for this work comes from a grant by the National Science Foundation.<sup>5</sup> In addition, our efforts continue to be influenced by our participation in the NSF I-Corps workshop.<sup>6</sup>

This paper begins with a discussion of how the NSF I-Corps continues to influence the Engineering Ambassadors Network. Next, we discuss the onsite and online training for Engineering Ambassadors. After that, the paper describes efforts in 2015 to assess the effect of the Engineering Ambassadors Network, especially the effects of the training and outreach on the Ambassadors themselves. Finally, this paper provides a summary of what occurred in 2015 and what we plan for 2016.

## **How NSF I-Corps Continues to Influence the Engineering Ambassadors Network**

The NSF I-Corps curriculum, which three members of the Engineering Ambassadors Network Core Team completed in 2014, continues to influence the Network. For instance, going through I-Corps has led us to increase our efforts to develop online training materials. Through customer interviews, we realized the importance of having online training so that we could train new ambassadors at any time and at any location. Although online training is certainly not as effective as onsite training, the process of going through I-Corps curriculum persuaded us that

posting quality online materials should be a priority in our project. As discussed later in this report, we expanded our online training materials this past year.

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. As seen later in this report, our posted tutorial continues to draw presenters from all of STEM, not just from the Engineering Ambassadors.

Going through the I-Corps curriculum showed us the value of pivoting. One such pivot in 2015 has been our decision to pursue larger training events. As discussed in this paper, we held our largest training event to date in 2015. In addition, we pivoted on the scope of these training events by including sessions specifically for senior Engineering Ambassadors. Senior Engineering Ambassadors include students who have been in their home programs for a year and who have taken the basic training before.

### **Onsite Training Activities of Engineering Ambassadors Network**

During the first half of 2015, we held a training workshop at the University of Nebraska-Lincoln, launching their program. We also held a training at Simula Research Laboratory in Norway for the Prepare Program (their equivalent of the Engineering Ambassadors program), though this training was supported by Simula.

During the second half of 2015, we held three workshops total. We found many universities prefer to hold trainings in the fall to train their new cohort of Engineering Ambassadors. All these workshops were “regional” workshops, meaning they were attended by multiple schools in the area. We held another workshop at University of Nebraska-Lincoln, which Wichita State attended. We also held a workshop at Ohio University, attended by West Virginia University and Ohio State University. See Table 1 for attendance numbers at these workshops.

We held our largest regional workshop to date at Worcester Polytechnic Institute (WPI), with 170 attendees from WPI, Rensselaer Polytechnic Institute (RPI) (including Engineering Ambassadors and Science Ambassadors), University of Connecticut, Penn State University (PSU), University of Maine, James Madison University (JMU), Tufts University, Union College, and Geneva College. This year, we included more advanced training for senior Engineering Ambassadors. We held a training session for the senior Ambassadors on memory mapping, in addition to a session on advanced presentation styles.<sup>7</sup> The senior Ambassadors also took a session on improvisation with a group called Speechless that specializes in presentation-style improv. In addition to the ambassador training, we had training and networking opportunities for advisors, including sessions on program assessment, demonstrations of different program models, and a speed networking session. Thanks to the success of the workshop at WPI, and the opportunity to test additional sessions, we are holding an Engineering Ambassadors Conference at Penn State in September 2016.

**Table 1. Attendance for the 2015 Engineering Ambassadors Network Trainings**

Host University	Date	Attending Universities	New EAs Trained	New EAs Underrepresented in Engineering (%)	Total Participants
UNL	Jan.	Vanderbilt	24	Unknown	30
Simula (Norway)	Jan.		8	50%	12
Ohio University	Sept.	West Virginia University, Ohio State University	20	85%	24
UNL	Oct.	Wichita State University	24	58%	33
WPI	Oct.	RPI, UConn, PSU, UMaine, Tufts, Union, JMU, Geneva	98	72%	170

In addition to the trainings, Engineering Ambassadors and instructors presented at a few conferences this year. We took Engineering Ambassadors and an Engineering Ambassador alumna to present at the Network at the Conference for Industry and Education Collaboration in Palm Springs, California, where we received the Best Presenter Award. Also, a group of three Engineering Ambassadors from Penn State, RPI and University of Illinois Urbana-Champaign presented on giving effective outreach presentations at the Society of Women Engineers Annual Conference, WE15, in Nashville, Tennessee.

### **Online Training Activities of Engineering Ambassadors Network**

Our online activities included continued development of the online training modules from 2014 and a redesign and launch of a website for the Engineering Ambassadors Network. The new website program we selected allows for easier content updates, as well as multiple editors for the site. This arrangement helps us keep the content fresh and is also useful when we have different university hosts for different trainings. In addition, the website redesign allowed us to refresh and organize the content we wanted to share with the Network.

In June of this year, we revamped the first training module on content, which focused on the messages from *Changing the Conversation*. Also in June of this year, we added three modules on the following topics: structure, visual aids, and delivery. In addition to having training modules, we also have online training delivery exercises to help Engineering Ambassadors with their outreach presentations. Note that the slide tutorial and sample outreach talks are specific to Engineering Ambassadors. Shown in Table 2 are usage statistics for 2015. Included as a reference are the usage statistics for 2014. For those sites that were launched (or relaunched) during the year, we placed the launch month beneath the statistic.

In short, the usage statistics are modest. For instance, although the session durations are substantial (in the minutes range), the numbers of page views for the year are only in the hundreds. One exception was the second training module on Structure. We are not sure why the page views are so much higher and the session duration so much less, but we suspect that pages for this module are simply linking to other pages, thereby increasing the number of page views and reducing the time on each page.

**Table 2.** Online resources to train Engineering Ambassadors to give outreach presentations.

Name	Location	Page Views (2015)	Session Duration	Page Views (2014)	Session Duration
Module 1 (Audience)	<a href="http://www.softchalkcloud.com/lesson/serve/1n3irHBU9XfWyh/html">www.softchalkcloud.com/lesson/serve/1n3irHBU9XfWyh/html</a>	520 (Jun)	7:27	294 (Sep)	02:51
Module 2 (Structure)	<a href="http://www.softchalkcloud.com/lesson/serve/943yau7Bztb8dA/html">www.softchalkcloud.com/lesson/serve/943yau7Bztb8dA/html</a>	3640 (Jun)	0:34	—	—
Module 3 (Visual Aids)	<a href="http://www.softchalkcloud.com/lesson/serve/6gstMXz9ekhFN4/html">www.softchalkcloud.com/lesson/serve/6gstMXz9ekhFN4/html</a>	335 (Jun)	3:35	—	—
Module 4 (Delivery)	<a href="http://www.softchalkcloud.com/lesson/serve/noDVOt7faMCA5P/html">www.softchalkcloud.com/lesson/serve/noDVOt7faMCA5P/html</a>	277 (Jun)	4:25	—	—
Delivery Exercise	<a href="http://writing.engr.psu.edu/teaching/exercise3.html">writing.engr.psu.edu/teaching/exercise3.html</a> Improvisation: Unexpected Slide	219	2:33	211 (Jul)	02:14
Delivery Exercise	<a href="http://writing.engr.psu.edu/teaching/exercise4.html">writing.engr.psu.edu/teaching/exercise4.html</a> Improvisation: Unexpected Topic	193	3:25	81 (Aug)	02:07
Delivery Exercise	<a href="http://writing.engr.psu.edu/teaching/exercise5.html">writing.engr.psu.edu/teaching/exercise5.html</a> Improvisation: Unexpected Question	196	1:29	89 (Aug)	01:48
Delivery Exercise	<a href="http://writing.engr.psu.edu/teaching/exercise6.html">writing.engr.psu.edu/teaching/exercise6.html</a> Giving a TED style talk	615	2;24	166 (Mar)	02:25

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 the Engineering Ambassadors Network is an advanced presentation strategy that we teach to our Engineering Ambassadors: the assertion-evidence approach.<sup>8</sup> Our research has found that audiences of STEM presentations have a deeper understanding and better recall when the presenter follows the assertion-evidence approach, as opposed to the common practice of style of having a phrase headline supported by a bulleted list.<sup>9</sup>

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 made for the Engineering Ambassadors 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 3 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

**Table 3.** Online resources arising from NSF project to train STEM professionals and students to give scientific presentations using the assertion-evidence (AE) approach.

Name	Location	Page Views (2015)	Session Duration	Page Views (2014)	Session Duration
AE Slide Tutorial	<a href="http://writing.engr.psu.edu/assertion_evidence.html">writing.engr.psu.edu/assertion_evidence.html</a>	12,068	2:15	7895 (Mar)	02:18
Delivery Exercise	<a href="http://writing.engr.psu.edu/teaching/exercise1.html">writing.engr.psu.edu/teaching/exercise1.html</a>	2,624	03:39	875 (Jul)	03:03
Delivery Exercise	<a href="http://writing.engr.psu.edu/teaching/exercise2.html">writing.engr.psu.edu/teaching/exercise2.html</a>	1,133	02:25	617 (Jul)	02:40

A comparison of Table 2 and Table 3 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 numbers of page views for the Engineering Ambassador tutorial are in the hundreds, while the number for the tutorial targeting all STEM presenters is more than ten thousand. Other increases can be seen for the delivery exercises. While the numbers of users for the Engineering Ambassador resources could certainly increase (into the high hundreds) as the Network spreads, the number of users for the STEM resources could increase even more so (into tens of thousands) as more teachers and workshop leaders learn about those resources.

What these differences reveal 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 the Engineering Ambassadors Network

Three main strategies were used to assess the implementation and impact of the Engineering Ambassadors Network training workshops during 2015. These were (1) direct observations of workshop activities (2) post-workshop telephone interviews with a sample of participants and their advisors and (3) online questionnaires completed by participants at the end of each workshop.

### Observations

During 2015, two workshops were observed. One was small ( $n \approx 20$  participants). The other workshop was large ( $n \approx 180$  participants). Both workshops shared the same activities and followed the same progression of tasks. These included (a) pre-workshop communication between the primary facilitator and the students, (b) selection of presentation topics by student pairs, (c) direct instruction on creating and delivering technical presentations, (d) direct instruction in using the Assertion Evidence slide structure, (e) guided and independent practice working with PowerPoint to create presentations, (f) two rounds of critique sessions in which participants practiced their presentations and received feedback, (g) a full-participation showcase presentation session as the culminating event of the workshop, and (h) social activities and group meals. In both workshops, students were observed to be highly engaged in their tasks.

Facilitators and mentors were observed to be available and highly capable of providing students with feedback. Students seemed to enjoy the opportunity to speak with others from different engineering programs and universities. At the large workshop, advisors met several times without the students in order to discuss various issues relating to creating and sustaining an Engineering Ambassadors program at their school.

## **Interviews**

Student interviews were conducted by one member of the evaluation team. Advisor interviews were conducted by both members of the evaluation team. Interviews were audio recorded and transcribed. From there, transcripts were analyzed using a coding scheme that identified roles (undergraduate student, workshop participant, and engineering ambassador) and self-perceptions, goals, beliefs and action possibilities within each role. Advisor transcripts were closely read and discussed by the evaluation team members and common themes were derived.

First, we focus on themes that emerged in regard to the effect of the training on the undergraduate students. One theme that emerged was a personal commitment to maintaining involvement in the program at their home institution, including participating in meetings and conducting outreach presentations to middle and high school students. Several students who were new to the organization articulated that they imagined participating as senior Ambassadors the following school year. One senior student at a school that was just beginning its chapter described a desire to be as involved as possible to build and grow a program that could benefit other students in the future.

A second theme that emerged from the interviews was an increase in students' confidence and self-perceptions in their public speaking skills and in their ability to put together an outreach presentation that would both inform and interest K-12 students with regard to engineering. Many interviewees mentioned a desire to communicate messages about engineering that were congruent with the National Academies document *Changing the Conversation*, including the fact that engineers contribute to the health, wellbeing and safety of society and that engineers solve problems. Learning the assertion-evidence slide structure and the associated strategies for constructing and delivering an effective talk was mentioned by every interviewee as being a significant highlight of the workshop experience. Students frequently noted that the critique sessions were extremely helpful in improving their presentations. Action possibilities for the future included developing and delivering outreach presentations at their home institution.

Interviews with advisors echoed the students' comments about the workshop providing opportunities to increase knowledge, skills and confidence in making and delivering outreach presentations. All advisors spoken with commented on the transformational process that students had undergone during the workshop training. Whereas advisors of existing programs spoke about the ways in which they had assigned students roles and responsibilities throughout the year, new advisers often articulated questions about the logistics of reaching out to schools to schedule visits, managing Engineering Ambassadors so that presentation quality could be ensured, and interest in accessing previously developed presentations. Most of the advisors had one or more existing roles within the institution. In general, advisors who were also full time faculty and who did not have an assistant advisor were more likely to articulate conflict between their role as advisor and their primary role within the institution.

## Questionnaires

Immediately following the end of each workshop, 170 participants completed a questionnaire. It asked them to rate several aspects of their experience at the workshop. It also asked them to use a five point scale to rate their perceived readiness to (a) develop and (b) deliver an outreach presentation, and their perceived confidence to (a) create content that will engage the audience, (b) integrate messages from *Changing the Conversation*, (c) create slides to help the audience understand the information. Nearly three quarters of participants (72%) indicated the highest rating for perceived readiness to develop an outreach presentation. Slightly fewer participants (69%) applied the highest rating for perceived readiness to deliver such a presentation. Nearly all (95%) respondents gave the highest rating of agreement that the workshop training was a “good networking experience.” The same proportion of participants (95%) indicated confidence to create content that will engage the outreach audience, and 95% also perceived themselves to be confident to create slides that would help the outreach audience understand the information. More than three fourths of the participants (80%) felt confident to integrate messages from *Changing the Conversation*.

## Conclusions from 2015 and Plans for 2016

In summary, the Engineering Ambassadors Network had the following major accomplishments in 2015. First, the Network fulfilled its promise of training a significant number of new Engineering Ambassadors at new sites around the country. In 2015, we trained 174 new Engineering Ambassadors from geographically diverse segments of schools in the Northeast and Mid-west. In addition, most of the trained Engineering Ambassadors came from historically underrepresented groups in engineering: women, blacks, Hispanics, and Asians.

Second, we developed online materials to support the training of new Engineering Ambassadors. We revamped a module on content and added three modules on the following topics: structure, visual aids, and delivery. In addition to having training modules, we also have online training delivery exercises to help Engineering Ambassadors with their outreach presentations. We also redesigned and launched a new website for the Engineering Ambassadors Network.

Third, we continued assessment on the question, “What is the impact of the Engineering Ambassadors Network training?” The following themes continue to emerge. First, the ambassadors expressed a strong commitment to maintaining involvement in their home institution’s program. Second, the ambassadors expressed a newfound confidence in their presentation skills, attributed to learning the assertion-evidence structure and the critique sessions. Advisors confirmed the students’ transformational experience, but also expressed concern over the operational tasks to support the program. This indicates a need to further develop Network resources that can help answer some of the advisors questions.

In addition to developing more operational resources for advisors, the Engineering Ambassadors Network has a number of plans for 2016. We will hold an Engineering Ambassadors Conference at Penn State, targeting an attendance of 200 people. We will also hold other regional workshops throughout the country. We are in discussions with Wichita State University, Louisiana State University, and Oregon State University about potentially hosting these workshops.



In 2016, we also intend to continue development on our online training materials. By using the I-Corps method of interviewing customers, we intend to determine how effective the current online training materials are and how they could be improved. In addition, we intend to determine whether opportunities exist for additional online materials to serve the Senior Ambassadors. Finally, we will watch the usage statistics on the site to determine how and when Engineering Ambassadors are using these materials.

Assessment plans for 2016 include continuing to use the three strategies (observations, interviews and questionnaires) for collecting information about the workshop training. A more thorough, theory-driven analysis of the interview transcripts is underway to better understand the impact of the training on the Engineering Ambassadors' role identities. A manuscript is under development pertaining to research questions about the impact of the workshop training on the Ambassadors. Follow up interviews with participants who were trained in 2015 will be scheduled during the late spring of 2016. Interviews will seek to capture information about the degree to which students were successful in implementing their plans and conducting presentations in their respective university or school communities.

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