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Engineering Ambassador Program Connects High School Students with University Students and Career Engineers in their Communities

Dr. Howard L. Greene, Ohio State University

Howard L. Greene directs K-12 Education Outreach for the College of Engineering at The Ohio State University, bringing university research and teaching intersections to the K-12 community, especially those underserved and/or underrepresented. Prior to Ohio State, Dr. Greene worked for 12 years in medical device development and later in STEM education and outreach at Battelle in Columbus, Ohio. Prior to Battelle, Dr. Greene was a professor of Electronics Engineering Technology at DeVry University in Columbus. Dr. Greene received the Ph.D. and M.S. degrees from The Ohio State University in Biomedical Engineering and Electrical Engineering, respectively.

Dr. Paul E. Post, Ohio State University

Ph.D. in Industrial Technology, Purdue University M.S. in Industrial Education, Purdue University B.S. in Industrial Arts Education, Pennsylvania State University

OSU faculty member since 1984 Currently in the STEM education program

2013 International Technology and Engineering Educators Association Conference Co-Chair

A Past-President of the Ohio Technology and Engineering Educators Association

Dr. Lisa Abrams, Ohio State University

Lisa Abrams is currently serving as the Interim Director of Diversity and Outreach for the College of Engineering at The Ohio State University. She oversees the women in Engineering and Minority Engineering programs promoting a culture of diversity in the College through recruitment, retention, and advancement of underrepresented groups at all levels. Lisa received her Bachelor's and Master's Degrees in Mechanical Engineering and PhD degree in Industrial Engineering from Ohio State. She has seven years of industry experience in the areas of Design and Consulting. She was previously the Director of Women in Engineering Program at Ohio State and the Assistant Dean of the School of Engineering and Applied Science at Miami University. She mostly recently held the position of Assistant Professor of Practice in the Department of Mechanical and Aerospace Engineering at Ohio State where she taught a wide variety of engineering courses in First Year Engineering and Mechanical Engineering. In the last several years, she has received four teaching awards including the 2013 Boyer Award for Excellence in Undergraduate Teaching Engineering Innovation and the Charles E. MacQuigg Award for Outstanding Teaching.

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Introduction

Hometown Ambassadors (HA), has been developed at the Ohio State University (OSU) to efficiently and effectively connect undergraduate engineering students and university alumni in engineering careers to high school students. The purpose of HA is generating better engineering career awareness, appropriate preparation for study and encouragement to consider engineering careers. As part of this university program, small teams of volunteer engineering students and alumni are formed who then visit their hometown high schools across the state to foster candid conversations wherein high school students get answers to critical questions related to engineering as a college and career choice. The program helps undergraduate engineering students improve their communication and leadership skills while reinforcing the importance of life-long career ambassadorship. Further, the program gives university alumni the opportunity to give back to their communities.

The Design

The primary motivation for creation of the HA Program was a need expressed by high school principals and guidance counselors who wanted a) feedback on how well their programs were preparing their graduates for success as well as b) the creation of real intersections with engineers at the next level to motivate and inspire their students. These administrators want to encourage students to consider careers in fields that are perceived as lucrative, rewarding and for which there is considerable industry demand. However, unlike other careers, engineering tends to be accompanied by lower societal awareness, perhaps because it is not commonly portrayed in TV programming and news media. As such, it suffers from a lack of identity in public perception[1]. High school administrators and teachers seemed to be asking the university "What exactly is it that an engineer does and how do I expose my students to these career opportunities in a compelling way?" Additionally, we have heard repeated expressions of frustration by high schools on how to reconnect with their graduates who have moved on to successes in college and career and how to get feedback on whether the pre-engineering experiences they are delivering in high school indeed represent authentic engineering.

Guidance counselors at the high school and middle school level can help provide career counseling to both guide students already interested in engineering careers and help students learn about engineering as a potential career. Most counselors have little or no experience with engineering and that limits their effectiveness in guiding students to engineering careers. McCuen and Greenberg[2] developed a one-day workshop for guidance counselors that proved effective but has not reached many counselors. Even trained counselors have to fit career counseling into an already overflowing stack of tasks. Surveys of undergraduate engineering students have shown that few describe their guidance counselors as having influenced their choice of engineering as a college major[2]. More unfortunate is that guidance counselors are

sometimes cited as having discouraged students, particularly women, from majoring in engineering[2,3].

Teachers can provide some elements of career counseling as well. Teachers generally do not have an engineering degree or engineering career experience limiting the exposure that they can provide their students to 'authentic engineering' from academic or career perspectives.

In communication with our high school partners, we interpreted their need as *college and career ambassadors to effectively communicate the essence of engineering to high school* (and perhaps middle school) *students* and encourage them in these pathways. The Office of K-12 Outreach in the College of Engineering at OSU frequently gets requests for engineering faculty to speak to K-12 groups and at STEM engagements on engineering careers. However, while valuable, faculty perspectives tend to be representative of experiences in, and of academia, which is a small sector of practicing engineers. In addition, because of the requirement of advanced degrees to be a university professor, most engineering faculty are considerably removed in age from K-12 students. For these reasons, faculty are, at best, incomplete engineering career ambassadors.

Central to career ambassadorship is *functioning as a role model*. Research has shown the effectiveness of having role models in choosing careers[4,5] and that role models can be taught to be more effective[2,5,6]. Effective career role models come from a variety of sources. Perhaps the most potent are parents. A number of women cite a parent who was an engineer as being a significant part of why they have chosen engineering as a career[2,7]. Other relatives also may serve as role models[2]. Through a variety of programs such as robotics competitions or architecture teams, students can be introduced to engineers and the engineers can serve as role models.

Schneider, Judy, and Mazuca[8] stated that:

> Without access to role models, awareness of college programs, and specific academic guidance, high school students — especially those in underrepresented groups — are unlikely to be adequately prepared for college and have the requisite information for choosing a career, in STEM or other fields. (pp. 62-63)

In the design of HA, we chose upper level (3rd and 4th year) university engineering students to be the role models for several reasons. First, they are in the midst of experiencing the rigors of their engineering program and have completed a significant number of courses within their majors. All have experience in learning to use the tools and procedures important to their engineering disciplines. Second, many have experienced early career elements that extend beyond the classroom, such as serving on a capstone design team, participation in an industry co-op or internship or undergraduate research. Third, this group is considerably closer in age to K-12 students and more likely to be listened to than their teachers or parents. Finally, we have

observed that college students of the present millennial generation are marked by strong participation in community outreach and are motivated to 'give back' through volunteer opportunities[9]. These factors make them strong career ambassadors.

The HA program seeks to reconnect successful upper level engineering undergraduates with students who are only a few years behind them who may have an interest in engineering, but who have questions about whether the field is a good match for them and how they can be prepared for the rigors of an engineering program in college. However, what makes HA events different from other university student-led informational sessions is that the program *leverages the loyalty university students have to their hometown schools and communities*. We have found that our engineering students will gladly give up a few hours on a day when they would normally be in their hometown to relate to students from their former high school how they have experienced engineering as an exciting and rewarding college and early career path. While at times the motivation can be self-centered ("Look at what I have accomplished!"), the motivation appears to be mostly altruistic; students just want to help someone and want nothing in return.

We encourage HA teams to schedule ambassador events on days when the hometown high school is in session and the university is not. This program design feature improves volunteer participation by reducing conflict with academic schedules and utilizing times on the calendar when college students are likely to be uncommitted when they are back in their hometowns. Dates that work well are Veteran's Day (especially when a 3-day weekend is created), the week before the December holidays, the week after New Year's, spring break and early May when university students are out for the summer.

The advantages of a hometown-based ambassador program are not limited to the motivation of the volunteers. When alumni of a high school convene with the school's current students, there is a free flow of information and an opportunity to ask real questions that, without the affiliation of the ambassadors to the school, might be perceived as dumb questions and never be asked.

It is important to note that HA is not a recruiting arm of the College or the University as a whole. This distinction between recruiting and outreach is made carefully when the invitation to participate is extended to the high school and when the ambassadors are trained. To reinforce this distinction, university students are not provided with university literature that is marketing-based or recruitment-oriented and are discouraged from distributing these materials or even answering such questions at an HA event. The behavior that is being encouraged in HA is *early career ambassadorship*, not the promotion of attendance at a particular university or career at a particular employer. That being said, effective ambassadors reflect well on their institutions and employers and there is likely some marketing or recruiting benefit to these institutions in the activity.

The HA program was piloted in 2013-14 with 28 participating schools (resulting in 24 visits) and repeated in 2014-15 with 38 participating schools (21 visits completed at the time of this

writing). The second year implementation was accompanied by one significant program enhancement added in response to feedback from school representatives that indicated they thought industry representation on HA teams would improve the visits. In response, we sought out and identified university alumni working in industry positions in the vicinity of the participating high schools. These professionals were invited by student team leaders to join the engineering student teams at the ambassador events.

The inclusion of industry professionals on the team has added to the authenticity of the visit, giving it a true career perspective not well-represented by engineering students. University alumni have gained engineering experience in their jobs, a sense of the lifestyle afforded by an engineer's salary, and experienced the shortage of qualified engineers in the workplace. We have found that alumni like to encourage students to pursue engineering careers and are willing to help out in their communities. They also enjoy interacting with current engineering students from their alma mater. Also, alumni appreciate an opportunity to connect with and help their university that doesn't involve an appeal for funds or purchasing athletics tickets.

While each HA event is unique, there tend to be common elements that work well at all venues. First, is the introduction, where students and industry alumni each give a short introduction to who they are and what they do related to engineering. For students, this can be as a simple 2-minute introduction accompanied by a presentation slide backdrop with their name, the type of engineering degree they are working on, work or school affiliation (with projected graduation date) and a picture of themselves in an engineering or personal context. Another format that works well is the panel format where 3-6 students sit in the front of the room and, after giving brief introductions, take questions from the audience. Sometimes they have several seed questions ready to get the audience participating. Questions can range from "What is the food like in the dorms?" (less career relevant, but still important to the person posing the question) to "What kinds of experiences should I be having in the summer that will help me to do well in engineering school?" However, because the HA team is from the school/community, breaking the ice with the students is usually not an issue.

A common request is for university students and industry alumni to represent their particular engineering disciplines and to break down into stations with 1-2 ambassadors per discipline (sometimes even with a poster or other backdrop prepared ahead of time). Then high school students spend time at each of their top stations, corresponding to their career leanings. After 5-7 minutes, they are instructed to 'switch stations'. Bringing a demo, or actual representative output of a project creates interest and focuses audience attention.

As far as reaching the greatest number of high school students, the best venue is during the school day, during one or more class sessions. If the class is an engineering class, all the better, because most, if not all, of the students are interested in an engineering career. Another venue that works well is in a dedicated room, like a library, as long as the school has done its job in

making sure interested students (or whole classes of students) have been identified and are released to that room at the right time.

The Process

The HA Program starts by recruiting high schools throughout the state that have sufficient representation (>10) of junior or senior engineering students at OSU with good GPAs who graduated from these high schools. For OSU, which recruits nearly 80% of its students in-state, this yields approximately 60 schools eligible for participation. This list is generated by searching the university's student database using major, GPA and high school name as filter criteria. The reason for setting a minimum number of students representing a school is that Ambassador events are intended to be executed by small groups of approximately 3-12 students as opposed to individuals. Since the student response rate is about 40%, 10 is a reasonable threshold to be able to field an HA team. Group events not only lower the time commitment per student to prepare for the event; they significantly reduce the stress factor associated with solo presentations. Additionally, fielding a larger group generally improves the team coverage of the distinct engineering programs at OSU, of which there are 14, and reduces the impact on the event if a student is sick or otherwise unable to participate.

In June of each year, guidance counselors or assistant principals from each of the qualifying schools are contacted via email to invite them to participate in the program. The response to this email not only confirms school participation, but supplies the contact information for the person who will be the building or district level liaison for the program. In subsequent years, this communication amounts to inquiring if the school still wants to be a part of the program for another academic year and if there are changes in the school liaison. As far as school communication is concerned, the Ambassador team leader interacts exclusively with this liaison during the academic year. A spreadsheet is used to keep track of affirmative responses and the contact information for associated liaisons.

The procedure to identify and recruit the university alumni is relatively straightforward as well, but requires some programming skills. The university alumni database is queried for all engineering graduates of the university for the last 10 years who have in-state home addresses. For OSU, this query results in a list of nearly 7500 alumni. These addresses are then copied as a batch to a free website (http://batchgeo.com/) that generates the GPS coordinates for each address. These coordinates are copied back into the spreadsheet database. Then the same website is used to generate the GPS coordinates associated with each participating school. A spreadsheet macro program is written to compare the GPS coordinates of the alumni and schools and indicate which schools (if any) are within 15 miles of each alumni residence. Finally, for alumni who are close to one or more schools, they are invited to be a part of the program via a personal email and are given a choice of which school they would prefer to visit. To make generation of this large number of personal emails efficient, they are produced as part of a mail

merge with the spreadsheet as the data source. Additionally, alumni are told that a student ambassador team leader will follow up with them to discuss the details of their participation. In 2014-15, this operation yielded 150 alumni who wanted to be a part of the program and at least 2 for every participating school.

Shortly after the university students return for autumn semester, a personalized email is sent to each of the qualifying students (meeting the 3rd or 4th year status with minimum GPA) who are alumni from each of the participating high schools explaining what the program is all about and inviting them to participate. It also invites them to a 90-minute orientation event with free pizza where alumni from all of the participating schools are trained on how to be a Hometown Ambassador.

At the training event, university student teams sit organized by their hometown high school. The training is student-facilitated, allowing prospective ambassadors to hear directly from ambassadors of a prior year on the best ways to engage high school students in conversations about college and career. By the end of the training, each team has elected a team leader who becomes the sole point of contact with the college Director of K-12 Outreach going forward. The last third of the training allows time for teams to meet with one another and begin discussing possible dates for the Ambassador event and the venues and content that work best for the team. During this time, the ambassador-facilitators circulate around to answer questions and give guidance. Before adjourning, team members share contact information with the team leader to allow follow-up.

After the training event, teams are effectively empowered and dispatched to plan and organize their ambassador event(s) with minimal assistance from the Office of K-12 Outreach. Team leaders contact their team members, school liaison and alumni and meet again with their teams to finalize the event date(s) and venue. This autonomy and empowerment of the teams allows them to design their event to meet the particular needs of their hometown high school and leverage their own skillsets and experiences in putting together an effective outreach event. It also keeps the central management and maintenance of the program to one of supporting and answering the questions of the team leaders, as opposed to whole teams.

When the team leader reports back that the HA event has taken place, short email-based surveys are administered to 4 individuals/groups: the team leader, the university students, the industry alumni and the school liaison. The purpose of the surveys are to gauge effectiveness and incorporate feedback in program design and training for the ensuing year as a form of continuous improvement. Questions are open-ended and are designed to bring out issues and lessons learned as well as reinforce design elements that participants and school liaisons believe are effective.

Results

All 4 groups surveyed in 2014-15 were asked the question: "Did the visit seem to be effective? (Please give specific feedback on what worked and/or didn't work)" While responses varied, there were strong perceptions that the HA events were effective. These perceptions are best illustrated in the following comments:

> "I believe this visit was highly effective! We had many interested students and were able to portray engineering in a positive light with the time and presentation that we had. We left time for questions at the end and had some really good questions. We also explained our own experiences and club <involvement> which I think helped the students feel at ease about college and engineering." (team member)
>
> "The format worked very well; the audience was engaged, the presenters were able to hit all their key points, and many questions were asked at the end."
>
> "Our students related well with the OSU students. It is always a pleasure to receive our former students and especially rewarding to listen to them explain how they are doing in school and or their careers." (school liaison)
>
> "I believe that there was a tremendous amount of interest generated from the presentation... our students could relate with the OSU students and could see themselves as engineering students." (school liaison)
>
> "From choosing which type of engineering to establishing a career in engineering, it can be tricky but I feel as though I and the other presenters gave a solid insight to the process." (industry alumni)

In analyzing responses to the questionnaire more deeply, some common themes emerged. In the discussion that follows, these themes are organized as five key factors (audience group size, alumni participation, team communication, engagement and team recruitment) that we found on the basis of survey responses to contribute to program effectiveness, including Quotable Comments and Lessons Learned, for each, as applicable.

1. Key Factor: Audience Group Size

All respondent groups said that smaller group settings tended to be more effective because the high school students seemed more engaged. This format appears to create a comfort level for both HAs and high school students that yields more questions and valuable conversation. Conversely, feedback from several of the larger auditorium venues with 100+ students indicated that there were not a lot of questions asked.

Quotable Comment:

> "We broke out and had students go to learn about each of the majors that were represented and what internship or research experiences we had related to our majors. This let us talk with smaller groups (5-10 students depending on the class) and gave everyone more time for questions. Students were able to visit most of the different majors during the class period (3 or 4 of the 5) and choose which majors they wanted to learn more about." (university student)

Lessons Learned:

- When the high school student group is large (>20), the team should aim to quickly break down into subgroups, perhaps by engineering discipline, and have high school students switch groups periodically.
- Teams should be provided with some rough guidelines for preparatory materials dependent on group size. The university should consider the creation and distribution of one (or several) structured presentation templates for the introductory portion so that the team only has to fill in the blanks.

2. Key Factor: Alumni Participation

In 2014-15, industry alumni were included on HA teams for the first time and there was strong positive feedback from respondents on their inclusion. This feature seemed to shift the balance in the presentations away from more student-centric, academic experiences to include more practical industry perspectives. Some university students even brought resumes to the HA event in case their conversations with alumni indicated a possible employment opportunity at a company.

Quotable Comments:

> "The inclusion of the alumni … also seemed like a good idea. It allowed the kids to see a real world example of an engineer and not just another student." (university alumni)

> "I saw a lot of different fields represented by the alumni, and it was interesting to learn about various career trajectories that I hadn't personally considered before." (university student)

> "The experience was great and I was happy to talk with the young students about my job and college engineering experience." (university alumni)

"As a graduate of both OSU and <my hometown high school> it was a great opportunity for me to give back a bit by encouraging young students who are considering a career in Engineering. (university alumni)

"With the way our team brought our experiences from the classroom and the real world to the students at <high school>, I feel like they learned what it would take to succeed as an Engineering student and as an Engineer. (university alumni)

"I shared with them some of the specifics of what I do on a day to day basis, tools that I use, and various subjects and classes in school and college that helped me get there." (university alumni)

Lesson Learned:

- Alumni participation is important in helping the high school students learn about engineering careers beyond academia.

3. Key Factor: Team Communication

In planning an HA event, team leaders have a tremendous responsibility to communicate with three separate and very different groups of people: their peers (OSU students), industry alumni and high school liaisons. Some industry alumni and university students expressed that their team leaders did not keep them adequately informed. Clear and proactive communication about event day expectations, plans and logistics has to flow between team leader and team. However, communication is a shared responsibility among communicators and some team leaders reported that the responsiveness of both university students and industry alumni could have been better.

To their credit, team leaders have to juggle their volunteer event coordinator role with the demands of their academic schedules. They need to be excellent and timely communicators with strong organization skills. Not all of the team leaders who volunteered were ready for this responsibility. Some, who found themselves in the team leader role, were volunteering only because no one else on the team would sign up at the training event.

Another critical communication challenge is with the high school liaison. Team leaders found that guidance counselors were not as responsive to their emails as when a science/engineering teacher was assigned the role. Team leaders reflected that counselors seem to be contacted by many outside university recruiters and they cannot keep up communication with them all. As a result, details were frequently overlooked and there tended to be more unwelcome surprises on the day of the event. In addition, guidance counselors tended to be less effective at internally promoting the event at the school such that not all of the venues were well- or appropriately attended with interested students. In other cases, the net effect was a venue disconnect. Several respondents indicated that the team came to the high school prepared for a less formal, smaller

group interaction and were greeted by an auditorium with 100+ students for which they were unprepared.

Lessons Learned:

- Teams need to establish a way to quickly and effectively communicate with one another. There are several text-based list services, such as "groupme.com" with phone apps available to do this. This is especially important if the ambassador event gets cancelled at last minute due to a snow day or other issue.
- Ambassador training needs to be very clear on the responsibilities of the team leader, including the time commitment and the necessary personal skills. There also needs to be a straightforward way to transition team leader responsibility to another team member, if necessary.
- During the recruiting phase, the university needs to make sure the liaison the high school assigns to HA is the appropriate for the program. Content area personnel (like science or engineering teachers) as liaisons are encouraged instead of guidance counselors, as long as they are properly empowered by their administration.
- Train team leaders on how they can communicate with high schools to better advertise the presentation and recruit more focused groups likely to be interested in engineering.

4. Key Factor: Engagement

The best HA experiences seemed to be accompanied by hands-on activities and visual aids brought by the team. One team brought a 3-D printing demo. All groups surveyed commented that demos, models from project work, videos or just relevant engineering materials kept audiences better engaged.

The second element leading to a more engaged high school student audience was when a more focused student group had been recruited for the venue. Some schools have pre-engineering curricula, such as Project Lead the Way; when these entire classes participated, the audiences were highly engaged. When entire classes of math or science students participated, the engagement was not as strong, especially when these students were earlier in their programs, such as at the middle school or freshman level. However, one industry alumnus reflected that this approach might not help increase the pipeline of engineers, because to "increase the number of kids and the diversity of kids going into engineering, we should talk to kids who aren't already set on engineering".

Quotable Comments:

> "We also brought in some pieces from a robot created in the First Year Engineering program, which was cool for the kids to see." (Team Leader)

> "We put together an interactive presentation that involved the kids helping us list design requirements of a hammer. We then went back and created a hammer out of some items I brought. The hammer we made was nothing like the kids had expected and we talked about the importance of cooperation in engineering." (Team Leader)

Lessons Learned:

- In HA training, stress the importance of small, interactive groups with manipulatives or hands-on elements, as opposed to longer lecture-style slide presentations.
- In HA training, instruct teams to have seed questions prepared in advance so that the Q&A time has good participation. As an alternative, have the school liaison require the high school students do this in advance.

5. Key Factor: Team Recruitment

While the attendance at the ambassador training event was good (>150 students), team leaders' ability to get the minimum 3-4 team members for an actual HA event was challenging for a number of teams. This may be related to HA being a volunteer, extra-curricular event, causing it to get less than top priority in competing with academic pursuits. Other conflicts such as co-op or internship jobs and family commitments when the event fell over a holiday break were also mentioned. In some cases, team members who committed to an event simply did not show up without notice.

Several school liaisons noted that they would prefer having all of the engineering disciplines (14 at OSU) represented on the team so that they can address all possible engineering perspectives and questions. However, even on the larger teams, there are seldom enough students to achieve this coverage of the disciplines.

While alumni were highly enthusiastic about participating as indicated in their email responses, actual participation rates were fairly low. There are two factors that seem to contribute to this phenomenon. First, event dates tended to be arranged between the team leaders and the school liaisons and alumni were informed after the fact. In general, industry alumni need to take off work for several hours or even an entire day to participate and some employers are not flexible enough to accommodate this, especially on short notice. Second, team leaders seemed to be less motivated to contact the alumni on the list they were given and some never contacted them at all. At the midpoint through the 2014-15 academic year, only 21 alumni had participated on an HA team, out of 150 who said they were interested, even though 21 out of 38 school visits had already been completed.

Lessons Learned:

- The program should lower the GPA threshold from 3.0 to perhaps 2.7 to get more students involved. (There are students who can serve as effective ambassadors with GPAs lower than 3.0.) The number of university students eligible to be on a team across all schools ranged from 10 to 53. For schools on the lower end, having a few more university students from which to recruit would help the yield problem.
- As an incentive for participation, the program should reward students for volunteer service. At OSU there is a council for engineering student organizations that redeems student volunteer hours for funds that can be directed to their particular student organization. Verification would simply require a program coordinator and team leader signature on a form.

Summary

In its second year at the OSU, the HA program recruited and trained 38 teams of university upper level engineering students and industry alumni to plan and conduct visits to their hometown high schools around the state. As part of the program, the university solicited feedback from four different participant groups after the HA visit: team leaders, university students, industry alumni and school liaisons. All groups indicated positive perceptions of effectiveness based upon survey responses to open-ended questions. As well, closer analysis of the response themes yielded five key areas that appear to contribute to HA program effectiveness: audience group size, alumni participation, team communication, engagement and team recruitment. In all of these areas, 'lessons learned' were formulated based upon the feedback, leading to programmatic enhancements in recruiting and training of ambassadors that will be implemented in ensuing years of the program.

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