Engineering Outreach: Ambassador Girls Empowering Girls in the Field (Evaluation)

Dr. Sarah Hug, CERC

Dr. Sarah Hug is director of the Colorado Evaluation & Research Consulting. Dr. Hug earned her PhD in Educational Psychology at the University of Colorado, Boulder. Her research and evaluation efforts focus on learning science, technology, engineering, and mathematics, with a special interest in communities of practice, creativity, and experiences of underrepresented groups in these fields across multiple contexts.

Dr. Suzanne Eyerman, Fairhaven Research and Evaluation

Suzanne Eyerman, Ph.D. is a researcher and evaluator for STEM programs in higher education, K-12 classrooms, and afterschool programs. A former classroom teacher, Dr. Eyerman has investigated learning in a variety of contexts, including school playgrounds and children's museums. Currently, her works focuses on increasing the participation of women and people of color in engineering and computer science. Dr. Eyerman received her B.A. in Psychology from Monmouth University and her Ph.D. in Education from the University of Colorado, Boulder. Her research interests are in the areas of representation in STEM fields, girls' and women's identities in STEM fields, engineering and computer science in K-12 education, and iteration.

Dr. Trina L. Fletcher, Florida International University

Dr. Fletcher is currently an Assistant Professor at Florida International University. Her research focus includes people of color and women in STEM and quality in K-12 and higher education. Prior to FIU, Dr. Fletcher served as the Director of Pre-college Programs for NSBE. Additionally, she spent time in industry holding technical and operations-based roles and has experience with outreach projects focused on STEM education and mentoring.

Dr. Araceli Martinez Ortiz, Texas State University

Araceli Martinez Ortiz, PhD., is Research Associate Professor of Engineering Education in the College of Education at Texas State University. She leads a comprehensive research agenda related to issues of curriculum and instruction in engineering education, motivation and preparation of under served populations of students and teachers and in assessing the impact of operationalizing culturally responsive teaching in the STEM classroom. As executive director of the LBJ Institute for STEM Education and Research, she collaborates on various state and national STEM education programs and is PI on major grant initiatives through NASA MUREP and NSF Improving Undergraduate STEM Education and NSF DUE . Araceli holds Engineering degrees from The University of Michigan and Kettering University. She holds a Masters degree in Education from Michigan State and a PhD in Engineering Education from Tufts University.

Dr. Michael A Soltys, University of Colorado, Boulder

Mike Soltys is an Instructor for the Engineering Plus degree program at at the University of Colorado. Mike is passionate about engineering education, and teaches engineering design in First-Year Engineering Projects (GEEN 1400), Engineering Projects for the Community (GEEN 2400), Statics (GEEN 3851), Thermodynamics (GEEN 3852) and Theoretical Fluid Mechanics (CVEN 3313).

Mike is the co-PI for TeachEngineering, a curricular digital library with the goal of democratizing engineering by project to providing free, standards-aligned, hands-on engineering curricula for K-12 STEM teachers.

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Background of the EngineerGirl Ambassadors program

The purpose of the Ambassadors program is to develop a cadre of young women currently enrolled in high school who are equipped to engage middle school youth in engineering. The Ambassador program is an extension of the programming developed and disseminated through the EngineerGirl website. The website was developed in 2001 as a mechanism for engaging young women in engineering and for providing them resources for understanding how to follow an educational and career path in engineering. It was originally developed (and, in 2012, upgraded) with guidance from a Girls Advisory Board. The website evolved by adding an essay writing contest to prompt young women to consider what draws them to engineering. United States' policies regarding online communication with youth under 13 meant the EngineerGirl team must create a separate mechanism for attracting middle school youth to the field of engineering. In considering the assets of the online community, leadership and engaged funders at the National Academy of Engineering chose to support the efforts of their active online community in serving as role models and mentors to "near peers" in their local communities. In this way the Ambassadors program was born.

Making the Case for the Ambassadors Program

Gaining access to pathways in science, technology, engineering, and mathematics (STEM) fields can be challenging for women and people of color (POC). Research has revealed multiple historical, institutional, and cultural factors that contribute to the lack of women and female POC in scientific and technical fields and identified strategies for supporting youth once they have chosen to pursue STEM pathways (Gasparra & Johnson, 2008, Wacjman, 2010). One idea that has been raised is the concept that people must "see it to be it". This encapsulates two notions: Engineering careers can be difficult to conceptualize and to aspire to because they are not visible in their communities (as opposed to say, firefighters doctors, and store clerks); and women are underrepresented in Engineering, so girls do not imagine themselves as Engineers (as opposed to other careers in which they see many women, such as teaching and nursing). Another factor in the underrepresentation of women, people of color (POC) and, when taking an intersectional lens, women of color (WOC), in Engineering, is implicit bias, or the embedded subconscious partiality against women, which affects hiring and employees' performance reports (Aeby, et al., 2019; Hill, Corbett, & Rose, 2010).

The Approach= Positive youth development + Guided participation

The EngineerGirl Ambassadors Program takes a *Positive Youth Development* approach to engaging youth. Positive youth development is an approach to working with youth in ways that partner with young people and provide opportunities for growth (Larson, 2000). It is a conception of adolescence that is "strengths-based" in that it takes an optimistic view of the ways the skills, abilities, and interests of youth can be utilized to promote desired outcomes. Positive youth development stands in contrast to ways of viewing youth that are viewed as "deficit" perspectives. That is, within positive youth development, youth are viewed as having the agency to make decisions that can lead to positive, healthy, and helpful outcomes for themselves and others. Specifically, Ambassador youth are encouraged and supported in sharing their passion for

engineering with younger students, specifically middle school youth which in the US context corresponds to youth typically 11 to 14 years of age.

While positive youth development is the lens with which Ambassadors views participants, *guided participation* is the method by which Ambassadors are intentionally developed. The concept of guided participation indicates how the girls' progress, development, and learning within EngineerGirl Ambassadors can be facilitated by adults. Guided participation describes how more experienced people (here, adults) can help less experienced people (here, girls chosen to be Ambassadors) navigate progress within a setting (Rogoff, 1995; Rogoff et. al, 2003). In the beginning, adults provide a good deal of guidance and structure, and that is lessened over time as youth gain greater proficiency.

Guided participation within EngineerGirl Ambassadors means that girls are in close contact with the adults (e.g., sponsors, program staff, engineer role models), and the adults provide some assistance, direction, and support while girls participate in various activities. This facilitation given by adults lessens over time until the girls themselves become experts in tasks, activities, and communication. As girls learn about how to create and run their individual projects, they become able to participate more fully in the community within the Ambassadors and to manage their projects more independently, as the adults lessen their facilitation. This is guided participation in action, and it encourages girls to develop agency in their communities and in Engineering.

Ambassador recruitment and timeline

The funders hoped to see growth each year, with the cohorts doubling in size annually. The first cohort served in the 2018-2019 school year. The intended number of scholars was 8, yet only 6 were awarded based on quality of applications. Table 1 below highlights the actual and planned number of ambassadors by cohort between 2018 and 2023.

Year	Cohort	Number of Applicants Who completed their application	Number of Ambassadors Expected (# Selected in parentheses)
2018-19	1	52	8 (6)
2019-20	2	47	16(16)
2020-21	3	37*	32
2021-22	4	75	64
2022-23	5	100	128
*In 2020, a website error may have influenced low participation in the applications			

Table 1. The actual versus planned number of Ambassadors by cohort between 2018 and 2023

Girls apply to serve as Ambassadors in the spring preceding their Ambassador year, and they also select an adult sponsor who will help them implement their project. Decisions regarding who will be included in the program are made in early summer. Girls receive modest funding for supplies and are expected to attend the national Society for Women in Engineering conference in the fall along with their local sponsor or a chaperone. Ambassadors are asked to write monthly journals of their progress in their projects, including photos when possible of any events. Via online webinars and phone calls, the Ambassadors have a few opportunities to meet one another

before attending SWE and sharing a room with a peer. Formative feedback suggested that girls who are paired together for rooming at SWE should receive notice of their partner early in the fall, so they could communicate before sharing space for 4 days. At the SWE conference, Ambassadors engage in some of the content of the conference, including keynotes, networking lunches, leadership programming for high school women provided by SWE, and the job fair. They also spend a day preparing for their work in informal engineering education with professional development from Techbridge Girls, a partner organization.

When Ambassadors return to their local communities, they implement their programming and are asked to gather evaluation data from participants in the form of a survey. At the end of the Ambassadors' local programs, they are expected to complete a final report of their experience. In some instances, Ambassadors have considered ways to continue their programs beyond their involvement with EngineerGirl Ambassadors, either through continuing the programs they developed themselves, or for graduating high school seniors, by enlisting near-peers to continue the efforts locally.

Recruitment and selection

Ambassadors are recruited from the website and the EngineerGirl newsletter, which currently has about 6,000 individuals on the mailing list, consisting of parents, high school youth, and educators. In addition, recruitment occurs through communications by SWE to its membership. The Ambassadors will increase targeted recruitment to underrepresented groups in 2020—Advisory board members have received flyers, bookmarks and stickers about the program to distribute to professional communities, for example, through the National Society for Black Engineers (NSBE). Applicants are encouraged throughout the process to continue their efforts—for example, in year one, individuals who started an application received emails from National Academy of Engineering EngineerGirl staff offering to answer their questions if needed. Similarly, those applicants not selected are given feedback to improve their applications for the following year. From feedback received from current Ambassadors, we learned that girls found out about the program through their own internet searches, familiarity with the EngineerGirl website, formal and informal educators (e.g., teachers in their schools, coaches on robotics teams), and parents.

Selection of Ambassadors is based on an application submitted by the high school girl and a separate document submitted by the local sponsor. The application form has undergone revision, in part because in year one it was clear that those who provided more information in that year's less structured application were more likely to be selected as Ambassadors. The application now is segmented, and greater detail was provided in the prompt to ensure all applicants provided similar information. Word count limitations were added as well. A sample of details embedded within the application appears below. Since establishing greater detail in the application documents, information obtained from applicants appears more uniform across completed applications.

> Timeline. Please describe your project timeline. Explain roughly when any major events will happen. (150 characters)
>
> Give readers an idea of when your project will begin and end along with major dates along the way. You do not need specific dates, but a general idea of timing is important. Give as much detail as you are able, but do not worry if you don't have exact dates

planned out. Some examples: “this is a summer program, so I plan to begin my planning and recruitment in the spring, and we will meet every week in June and July.” And “I will begin planning my program in September. Announcements and initial marketing will take place by November. The event will happen in mid-spring, and I will complete all follow up activities by May.”
An excellent proposal will give an estimated timetable for events or activities that appears reasonable to achieve over the course of the year as an Ambassador (Sept 2019-Aug 2020).

Scoring for the Ambassador applications is run similar to another competition run by EngineerGirl, which has a legacy of recruitment through engineers featured on the website in the “I’m an Engineer” and through coordination through industry sponsor volunteer staff. Those who score the Ambassadors do not undergo a rigorous training—however, in year 2 they received four short documents developed to articulate the values and aims of the Ambassadors with reference to relevant social science research. The documents are: Mentoring, Why Women and People of Color?, Positive Youth Development, and Leveling the Playing Field.

The scoring rubric has gone under revision from year 1 to year 2 based on feedback from scorers, staff, and the evaluation team. The changes occurred in content and format, with an attempt to clarify differences between what poor, average, and exemplary applications would look like. The rubric was developed to codify scoring across different engineering professionals and educators engaged in the scoring process, as well as to create opportunity to flag or highlight content that was not directly scored in the rubric.

The Ambassador Model: Guiding Leaders in Engineering
EngineerGirl Ambassadors aims to prepare young women to serve their communities as role models and mentors in the field of engineering. “Near-peer” outreach activities like those proposed by the Ambassadors have the benefit of developing engineering identities within the ambassadors as well as within the participants. The Ambassador program assumes high school students need support in considering themselves role models for other youth, and so specific preparation activities were designed for Ambassadors.

Techbridge Girls is a non-profit organization that specializes in providing research-based informal STEM professional development to educators and volunteers who work with youth. Because of their expertise in professional development with an emphasis on equity, Techbridge Girls contracted with the National Academy of Engineering to develop and implement professional development for Ambassadors. Workshops were implemented online and face to face at the Society of Women in Engineering meeting, most recently in November 2019.

The partnership with Techbridge involved collaborative development of a list of professional development content needs for Ambassadors, continuous communication between National Academy of Engineering staff, evaluators, and the Techbridge Girls Senior program manager for professional development. In our second year, we shifted content areas in response to participants’ feedback—specifically we added a workshop about project management, in which participants created timelines for their projects and used backwards design strategies to consider

when they needed to communicate with partners, begin recruitment, manage logistics like reserving space, and purchase supplies.

The virtual workshop in the second year took place in September of 2019 and had three main goals: to provide girls an opportunity to meet their peers in the program, if virtually, before the SWE conference; to create an opportunity to meet with NAE staff; and to begin to collaborate as they made decisions about their participation in SWE. The virtual workshop focused on how to choose a STEM activity that focused on inquiry, and the Ambassadors who participated chose together the activity they would facilitate at the SWE Expo for middle and high school girls. This exercise served as practice for considering what they would need to do to prepare for outreach with youth, and had a practical component as well, since Ambassadors were staffing a booth at the Expo and needed to come up with a way to engage youth who in the Expo.

The design of the face to face workshops in 2019 were influenced by Techbridge Girls' expertise and bank of curricular resources, feedback provided in one-on-one interviews with the first cohort of Ambassadors in 2018-2019, and EngineerGirl staff and evaluators' impressions of cohort 1's struggles. For example, the difficulty one Ambassador had in securing space for an event led to the recommendation to have a project management workshop for cohort 2. Table 2 below highlights the list of workshop topics that were discussed during the 2019 event.

Workshop Component	Workshop Topic
1	Icebreakers
2	Gender Responsiveness
3	Teaching 101 Facilitation Strategies
4	Cultural Responsiveness
5	Project Management/Project Preparation
6	Reflection

Table 2. The 2019 Ambassador workshop outline

An element of support that is built into the Ambassadors program is the development of the "sponsor" role. Ambassadors apply with their sponsors, who are asked to fill out a separate document at the time of the Ambassador's application. Sponsors are expected to serve as local support for Ambassadors in their outreach endeavors and are invited to attend SWE alongside their Ambassador. In some cases, sponsors are family members, though other sponsors have been teachers, coaches, library staff, and other community members. Often family member sponsors have been STEM professionals themselves, or teachers in schools where outreach will take place. Sponsors are asked to communicate with EngineerGirl Ambassadors staff as needed.

Additional preparation and support are provided through the use of journaling. Ambassadors are asked to turn in a journal every month describing their progress and are expected to send the journal to EngineerGirl Ambassadors staff as well as their sponsor. The senior program officer responded directly to each journal with comments and questions. The cohort 1 Ambassadors responded favorably regarding the journals, describing how they helped the Ambassadors stay on track, and created a dialog with staff about the programs. The Ambassadors were appreciative of the feedback provided by the EngineerGirl Ambassadors program officer.

Female Ambassadors Targeted Outreach to Younger Female Students

High school age Ambassadors implement their projects for one academic year. In most cases, these projects have included after school, summer, and/or one day events in which ambassadors gather middle school youth together for hands-on, inquiry-based engineering activities. Table 3 below describes the different programs proposed and implemented as a part of the Ambassadors program.

Geographic Region	Project Structure	Targeted Participants	Project Description
U.S. Territory	Online Learning Platform and Weekend Workshops	Girls in grades 3-8	The Ambassador is building an online learning platform to help participants learn about biomedical engineering. Her platform is comprised of videos, quizzes, and laboratory simulations. The platform will first be implemented in in-person workshops, though its use is expected to expand after testing, use, and modifications.
Pacific Northwest	Series of Workshops	Girls under age 18 staying in homeless shelters	The Ambassador is creating a series of workshops that she will implement on a monthly basis. The workshops will provide an opportunity for her participants to explore and learn about mechanical, chemical, and aeronautical engineering.
The South	Half-day, one-week summer camp	Girls in grades 3-5	The Ambassador is designing a camp focused on chemical engineering that will engage her participants in activities and also highlight female professionals in the field.
The Midwest	Afterschool program	Girls in grades 3-5	The Ambassador has created and implemented an afterschool program that designs and builds projects in mechanical and electrical engineering. Projects are taken home to facilitate participants sharing their learning with their families.
The Mid-Atlantic	Workshops	High school girls	The Ambassador has created and implemented a series of workshops that are held at a local library. Participants are introduced to electrical and mechanical engineering through team-oriented projects.

Table 3. Programs implemented by Ambassadors

In addition to providing an overview of their projects and who the intended populations are, the Ambassadors provided further details on their plans, purpose and passion surrounding their ideas. The first ambassador showed excitement around being able to empower other girls and build their confidence:

> *"I would like to spread my passion for STEAM and my passion for empowering girls so they can learn to believe that all they need is knowledge, confidence, strong work ethics and determination to achieve anything they want in any field they want. I will be conducting two programs for my project. The first one will be an after-school program. The second will be 3-hour hands-on expos in a couple of summer camps."*

Another Ambassador spoke about the importance of working with girls from underrepresented populations – a very important focus for the program overall:

> *"I'll be holding workshops every few months for kids, especially girls and underrepresented minorities. We'll do engaging, interesting activities that teach engineering principles. I will also have some professional engineers tell the kids what being an engineer is like, and through this I'll teach children about engineering."*

The relevance surrounding giving back in your community and utilizing the resources that are there and the incorporating the engineering design process were present in the following two Ambassadors applications:

> *"My project is an after-school engineering club for girls at my local middle school. The club will allow girls to complete independent projects following the engineering design process, then present their research at science fairs. Participants can develop critical-thinking and creative problem-solving skills while connecting with the engineering community. While there are already several large organizations promoting girls in STEM in (city), I think my smaller-scale project will be more accessible to the disadvantaged students in my area."*

> *"We will offer a week-long summer "design camp" for ten middle school girls in rural (state). The sessions will be collaborative and creative, focused on how engineering helps solve real world problems. We will partner with a science museum and arts organization to expand programming and highlight diverse career opportunities. The free program will be open to ten middle school girls (grades 6-8), and we will use our relationships with (Middle School) and (Arts Organization) to market the program to this group."*

Ambassadors are asked to distribute and send in surveys of youth participants at the end of recurring programming and following "one day" programming. This element of evaluation was piloted in year one (2018-19) and will be in practice for year 2 (2019-2020).

Formative and summative evaluation

In this project, the evaluators have consulted with EngineerGirl Ambassadors staff and the steering committee chair continuously, providing formative and summative feedback based on their expertise in STEM informal learning as well as on their data gathering and data analysis of

the Ambassadors project. Both evaluators earned PhDs in Educational Psychology studying youth learning in informal settings and have over 20 collective years of experience evaluating STEM education programming. Based on this experience and expertise, the evaluators support program development and programmatic adjustment based on data from Ambassadors and their participants.

The evaluators employ *developmental evaluation methods* to provide formative feedback while simultaneously gathering summative evaluation data from Ambassadors, and systematically from Ambassadors' program participants in year 2. According to Michael Quinn Patton, "*The developmental perspective, as I experience it, feels quite different from the traditional logic of programming in which goals are predetermined and plans are carefully made for achieving those goals. Developmental programming calls for developmental evaluation in which the evaluator becomes part of a design team helping to monitor what's happening, both processes and outcomes, in an evolving, rapidly changing environment of constant feedback and change.*" (Patton, 1994, p. 313).

Formal summative evaluation methods have included participant observation in trainings and Ambassador-led programs, surveys of Ambassadors, focus groups with Ambassadors, and surveys with Ambassador program participants. In year 2, three programs will be observed by evaluators—in this year, we are focusing on one urban program observation and one rural observation to understand the program in areas beyond the more common suburban setting. Evaluators are trained in the Dimensions of Success tool for measuring quality and impact of STEM outreach (https://www.thepearinstitute.org/dimensions-of-success), and provide feedback true to the values and metrics of that tool. To date, one observation occurred, with an ambassador receiving feedback on her program via email and in-person communication.

Preliminary Findings

As only 6 girls were engaged in the first cohort with 4 successfully completing projects, qualitative evaluative methods were more practical than quantitative survey data and proved rich for describing the benefits of the program and the ways in which the program could improve. In determining an approach to take in conceptualizing how to design the program for the first cohort of Ambassadors, program stakeholders looked to ideas around "positive youth development. Positive youth development researchers refer to the goals as the "Five Cs", and they stand for competence, confidence, connection, character, and caring. The Ambassadors Program looked to the Five Cs as goals for developing and sustaining a positive youth development program. Table 4 below is adapted to describe youth development outcomes for EngineerGirl Ambassadors.

The Five Cs of Positive Youth Development	
Confidence	Girls have an internal sense of overall positive self-regard and self-esteem
Connection	Girls feel positive about their bonds with others and feel part of the group (not competitive)
Competence	Girls have a positive view of their actions and impact on others
Character	Girls show respect for cultural norms and differences and for societal rules and standards
Caring/Compassion	Girls have a sense of empathy and sympathy for others

Table 4. The Five C's of Positive Youth Development

Employing the Five Cs framework is useful for assessingEngineerGirl's endeavor to implement positive youth development because it allows examination of the impact it made on the girls and can also help us make sense of their individual projects' effects in their communities across the United States. By employing the Five Cs, we can gain insight into whether and how girls were changed by being part of the Ambassadors as a strengths-based program. All four Ambassadors who completed their projects were interviewed by phone. The questions asked in interviews with girls were mainly focused on determining whether and how the girls grew in competence, confidence, connection, character, and caring. Their transcripts were coded for ways in which the Ambassador program influenced their development of the five Cs, and responses are summarized by theme below.

Confidence

Being selected to be an Ambassador was an initial confidence boost in the girls' time with the program. One girl described how she felt when she was selected by saying that it was "just an idea last year" but then she was selected and felt "excited to know that I was selected out of the entire US, and there's only six of us." This girl describes finding out that she was selected as an event that communicated to her that her idea was viable and that she in particular was equipped to realize the idea into an actual outreach program. She also described the monthly journals that she wrote and submitted to the program director as a way that EngineerGirl Ambassadors staff members come alongside girls and encourages them: "The program specifically goes step-by-step with you on your progress and everything you're doing to actually make [my program] happen." The journals were a space in which she could reflect on what she had accomplished in the past month, think through her plans for the next month, and then receive individualized feedback from the program director.

> *"After doing the project I feel a lot more excited and self-motivated about becoming an engineer."*

Another Ambassador gained new confidence by being part of a community of peers with similar interests. Prior to the program, she had not had interactions with other high school girls who also had a passion for engineering. Meeting the other Ambassadors in video discussions in early fall and then being at the SWE Conference a short time later boosted her confidence in herself as someone who could be an engineer. One of her peers gained confidence at the SWE Conference as well. She was bolstered by meeting female college students majoring in Engineering and female adult professionals working in Engineering at SWE. As she described it, she came to see her future self in them.

> *"I've gotten more excited about just my identity as an engineer."*

One Ambassador described gaining confidence because she was taking on the role of teaching and guiding other girls in learning about engineering. She felt motivated because she knew the younger girls within her project were depending on her. Although she lacked confidence in her engineering knowledge when she started her project, over time she came to see herself as someone who could help others lean more. She began to view herself as a someone who knew "enough" to teach others, though she knew that she still had much more to learn herself.

> *"The fact that I have students looking up to me and asking me questions about engineering motivates me to look things up in my free time and learn new things so I could teach them."*

Connection

All four Ambassadors were excited to have been able to attend and participate in the SWE Annual Conference. They were pleased to have been able to spend time with peers who were like themselves; they appreciated spending several intensive days with girls who also valued learning more about Engineering and were also planning projects to reach out to younger girls.

> *"During the conference, all the [Ambassadors] were able to really grow close with each other."*

Three Ambassadors reported that the younger girls in their projects/club were able to make new connections with their peers. Some girls had known each other previously, but many of the girls went to outreach clubs/programs run by the Ambassadors without knowing the other participants. Ambassadors reported that they enjoyed helping younger girls to find like-minded (i.e., engineering-interested) peers.

> *"They had never talked to each other or anything, but they made friendships.*"

Two Ambassadors made new relationships with their local peers, other high school girls, who helped them run their projects/clubs. In anticipation of her approaching high school graduation, one Ambassador set out to locate peers in her community who were also interested in engineering to she could recruit someone to run over her project next year. She said those new relationships were an unexpected bonus from her year with EngineerGirl Ambassadors. One Ambassador was able to meet local university students, young women studying Engineering, because she recruited them to volunteer as role models for her project.

Two Ambassadors became closer to their project sponsors, who acted as mentor to them as they planned and implemented their Engineering clubs. One Ambassador built rapport with the Ambassador program director and appreciated being able to establish that new connection.

> *"EngineerGirl Ambassadors isn't just getting paired up with a mentor and being [reimbursed] $250 to run a project, it's a lot more than that. The fact that you're in a cohort, basically, which a bunch of other girls who are really motivated to make a change is something different and I enjoy that."*

Although three of the four Ambassadors reported many new relationships and the strengthening of existing relationships, one student had a different experience. With the exception of having met the other Ambassadors at the SWE conference (with whom she did not stay in touch after the conference), the student who created a one-time-event program did not report gaining any new relationships or growing any current relationships through her involvement. In future years, we recommend monitoring connection across Ambassadors to ensure each participant has an opportunity to build relationships beyond the SWE conference.

Competence

All four girls described gaining "leadership skills" by participating. They went on to describe what they meant by leadership as what it takes to make moves to bring ideas to fruition: talk to new people, ask for help, make decisions, take actions. That is, they all described being a "leader" as being someone who is capable.

> *"I can't even find words to describe how much more capable I am of being proactive, of running things, of having ideas and actually acting on them, and networking and calling people. Before this year I was a bit more scared and felt like I had to ask permission [before acting]."*

Three girls spoke about how they learned how to engage younger girls in Engineering activities through their projects this year. It required them to be flexible with their ideas – to make a plan and then be willing to make changes when the people, place, or circumstances required them to tweak their plans at the last minute.

> *"I've never really had that much experience with younger kids and getting to know them and how to work well with them and engage with them has been really great and interesting."*

The Ambassadors stated that the practice for the "Invent It, Build It" event, as well as facilitating an activity at event itself, was excellent preparation for them in running their programs, events and clubs during the year.

> *"I thought it was really helpful – learning how to navigate through that without telling them the answers and really encouraging them along the way."*

All four girls spoke about learning about communication through their experiences with organizing and running a program or event. They mentioned challenging such as administrators who do not respond to their emails, long wait times and unclear responses in bureaucratic school processes (e.g., gaining approval to hang up a flyer at school), getting messages to parents about their kids' participation in the outreach programs. All girls took on a level of responsibility for communication that was new to them, and all reported having learned lessons about communication along the way.

Character

Three of the four Ambassadors were able to learn about the likes, interests, strengths, and/or culture of the girls who participated in their programs and then adapt their programs to suit the participants. The Ambassador who did not learn about her participants organized a one-time event, rather than an ongoing program.

> *"Within [my] program, I met kids [for whom] English wasn't their first language, or they were special needs, or they had never done engineering before, or they thought they were experts at engineering, or girls with different medical needs. I had to take into consideration when bringing snacks or doing activities. Making sure that they were accessible to everyone and engaging."*

All four of the Ambassadors described experiencing setbacks in their planning and/or implementation of their projects, and all were able to discuss ways they persevered through those challenges. One girl talked about having had only 10 girls and their parents at her culminating event, which was far below her expectations. She said it was a great surprise, but she had had enough practice adapting her activities in the moment at her weekly programs that she was able to adjust her event to suit the smaller number of participants. Another Ambassador described having a great deal of trouble recruiting girls to participate in her afterschool program because the school had no busing available for afterschool programs. She spoke with the principal about the situation, and he then organized a bus to take the middle school girls' home.

> *"I think that because of all the EngineerGirl Ambassadors support, it really helped me persevere."*

Caring/Compassion

All four Ambassadors experienced empathy for their participants' feelings around challenges and triumphs in the course of implementing their projects.

> *"I think my patience… I think my patience really developed because I encountered some kids who maybe were not as cooperative at the start of this program… I really think that helped me develop emotionally and helped me kind of empathize with the student as well."*

Two Ambassadors described having special needs students in their afterschool program and the ways they adapted their activities and interactions to suit those individuals. One girl described a student as becoming extremely frustrated by how difficult it was for her to do the activity, and

the Ambassador worked with that student so she could regulate her emotions, accomplish tasks, and feel the satisfaction of having participated in the program.

> *"I enjoy engineering so much. I fell in love with it in seventh grade when I took my first engineering classes at that same middle school. And those were probably the most influential classes that I ever had under that teacher that I'm now working with. And seeing a positive female role model who is powerful and not afraid to get her hands dirty, and had just such a personality, and was able to get us all excited about engineering. I wanted to pass that down to girls who didn't have that, like those who were going to the same school but couldn't get into those engineering classes because they had to be taking remedial reading."*

Preliminary Ambassador Participant Findings

Quantitative online surveys were piloted with 3 of the Ambassadors' participants. The online surveys were chosen for 3 Ambassador projects that were long term, meeting regularly for more than 4 sessions. Participants were asked to take the surveys online or in paper and pencil format. While ambassadors initially asked for online surveys, in the end most were taken in pencil and paper format, then mailed or faxed to the evaluators for analysis.

Respondents were participants in ambassador-lead programming and were all of middle school age, typically 11-14 in the United States. The surveys were anonymous—no names were collected in the instrument. The instrument was based on tools developed for similar youth programming that focused on STEM, with an emphasis on engineering in particular. Items asked participants to mark the extent to which their experience of the program *changed* some element of their interests, attitudes, or knowledge regarding engineering.

Thirty participants responded to the survey. Pilot study results from the first cohort indicate youth attending outreach activities run by Ambassadors increased their interest in engineering (88%), know more about what engineers do (91%), learned about the engineering design process (84%), and feel increased belonging to a group interested in the field (87%).

Discussion

Challenges and opportunities moving forward with Ambassadors

In this section, we document our anticipated challenges and opportunities as the Ambassadors program expects to scale, doubling in size each year to honor more and more ambassadors, and through them, more youth. As shown in table 1, the goal of EngineerGirl Ambassadors is to double the number of Ambassadors each year through this 5 year funding cycle. This would mean year 3 (2020-2021) would include 32 Ambassadors, Year 4 64 Ambassadors, and so on. Scaling programs to reach more youth creates multiple challenges and opportunities as a program matures. Though some researchers have posited that moving to scale is purely a numbers game (e.g., McDonald, Keesler, Kauffman & Schneider, 2006), others suggest that scaling up is a much more detailed and arduous process. Coburn, for example, suggests that scaling up in educational settings is not simply a quantitative measure of who is reached, but instead involves consequential change that endures over time and a shift of knowledge and

leadership to new community members (2003). We briefly detail how scaling the Ambassadors program will lead to new challenges and opportunities.

Providing high quality professional development to young people who plan to engage in outreach takes time, human resources, and opportunity to connect to peers and helpful adults who have knowledge about engaging young people in engineering. Yet, a workshop with 64 young women is a very different experience than the workshops that have occurred thus far, with only 6 and subsequently 16 Ambassadors. Considering the goals of both *developing and recognizing* young women with aspirations in engineering, the development model that involves synchronous and face to face engagement with facilitators will need to shift in some way to preserve quality.

As the number of Ambassadors grows annually, the extent to which they can build familiarity with one another and a sense of community together will need to be reconsidered. Women who persevere in engineering often cite a peer group as vital to their success— Ambassadors has an opportunity to become a rich peer network of support. The Ambassadors leaders are considering how Ambassadors might develop sub-groups to communicate more regularly, and to build comradery around being young women interested in engineering.

Currently, EngineerGirl Ambassadors staff collect journals and respond to them in detailed ways—in fact, the feedback often involves multiple emails back and forth with each participant. In year 1, this was a manageable feat with only 6 Ambassadors, yet the growth to 16 Ambassadors in year 2 is already producing a strain on human resources. Providing rich, useful feedback is an important element of the program, yet the processes for providing this feedback will need to be reconsidered with programmatic growth.

The National Academy of Engineering values increasing the diversity of youth participating in engineering. To make a difference in the field of engineering, it is vital that selected Ambassadors serve communities that have limited access to engineering opportunities. As the program scales, it will be important to create avenues for underresourced young women and particularly young women of color to learn about EngineerGirl Ambassadors, apply to participate, and develop programming in their communities that support girls' aspirations in engineering.

Conclusion and Next Steps

The Ambassadors program has created an avenue for young women to lead in engaging youth in engineering within their communities. Qualitative data from Ambassadors indicate the program has supported their development of the 5Cs, critical to positive youth development. In addition, the program has solidified Ambassadors' interests in engineering. Pilot survey data indicate that the youth who participate in Ambassadors' programs are developing interest in and knowledge about engineering. As the program continues to grow, we will continue to measure the impact of the Ambassadors program on both the Ambassadors and their participants.

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