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Encouraging Young Women to Pursue Engineering: 25 Years of Summer Camp Successes and Challenges

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Abstract

Twenty-five years ago, the University of Evansville, a small, private liberal arts institution in the Midwest, initiated a hands-on summer camp to encourage high school girls to pursue engineering. UE's OPTIONS in Engineering camp has evolved into separate week-long residential experiences for high school and middle school girls, as well as a week-long day camp for middle school boys. The engineering camp for high school girls has included an international experience on two occasions. University students act as counselors and mentors, allowing the camp to impact young women at multiple educational stages. Testaments from past participants and counselors depict the experience as inspirational and positively transforming perceptions of STEM. Participants have pursued STEM degrees, including graduate degrees, and worked professionally as engineers after attending the camp.

This paper presents the best practices, challenges, and successes of the camp as it has adapted to new generations of participants and advances in engineering and technology. Originally created to increase the representation of women in engineering, the camp exposes participants to like-minded peers, female college students, faculty, and practicing engineers in order to provide a critical mass of role models and begin developing a professional support network - both of which have been shown to improve retention and self-efficacy of women in STEM fields.

The university assesses learning outcomes via a pre-test and post-test covering topics within various engineering disciplines. Participants are asked to provide both qualitative and quantitative feedback regarding the camp experience in an exit survey on the final day of camp. All assessment is completed anonymously; however, archival data are not available for each year. This paper highlights qualitative and quantitative findings from the past decade.

Introduction and Background

In 1992, several faculty members from the University of Evansville (UE), a small, private, master's-granting institution in the Midwest, were discussing methods to increase enrollment. The lack of female representation in engineering and computer science programs was a primary concern, prompting the idea of offering a summer program targeting women in engineering. 25 years later, the summer program has evolved from a single week-long residential camp for high school girls to include a separate 3-5 day residential camp for middle school girls, and a 5-day day camp for middle school boys.

The program addresses the critical need to help young women overcome cultural stereotypes and prepare for careers in engineering and computer science. The National Center for Education Statistics reported in 2015, 31% of all STEM degrees and certificates awarded at all levels were earned by women; STEM was defined to include biological and biomedical sciences, computer and information sciences, engineering and engineering technologies, mathematics and statistics, and physical sciences and science technologies [1]. The percentage of women earning engineering and computer science degrees was significantly lower.

Numerous studies have been conducted to determine why more women do not enter and remain in a STEM field when the interest is clearly present. Lack of female representation in STEM is often described as a leaky pipeline, where of the few women that begin in a STEM field, even fewer persist and remain in STEM. Biological, social, structural, psychological, behavioral, and theoretical explanations have all been presented as causes for limited female representation, but it is difficult to separate the effect of these often-overlapping factors [2].

A 2005 literature review debunked claims that biological differences can sufficiently explain the gender gap in STEM [3]. According to an assessment of national-level data, claims that the gender gap in STEM is due to deficits in prior achievement disagree with findings that STEM fields are universalistic, noting socioeconomic backgrounds may limit preparedness in higher levels of math and science [4]. Studies suggest that structural barriers and stereotypes can be overcome with interventions aimed at making the STEM environment more welcoming, which produce greater implicit STEM identification and fewer stereotype concerns for women [5, 6]. Gendered stereotypes and institutional barriers undermine female interest and performance in STEM, and stereotypical thinking patterns are apparent in young women by middle school [7-9], which further emphasizes the need for interventions such as summer programs for middle school women.

Lack of female role models is commonly cited having a negative impact on female interest and persistence in STEM [3, 6, 10, 11]. Data suggests that female experts act as a buffer to societal stereotypes, which can help young women overcome gender sensitivity and self-efficacy barriers [12, 13]. Numerous professional societies, educational institutions, and organizations have worked to increase visibility of women in STEM and provide a critical mass of female role models. The Million Women Mentors® organization highlights the movements to develop and provide a network of support for young women in STEM [14]. Mentorship is a key contributor to retaining women in STEM, according to the National Science Foundation [15]. Female professionals and college students act as mentors for the OPTIONS summer camps, building a critical mass of female representation and support for participants.

While the OPTIONS program predates many of these studies, components of the program include many of the research-supported recommendations for decreasing the gender gap in STEM. Anecdotal best practices from the summer program are echoed by best practices in the literature for recruiting and retaining women in STEM. A 2012 report compiled by the Girl Scouts of America summarizes research-based methods for improving female representation in 10 main points [16]. These points support the goals and implementation of the OPTIONS summer programs.

Program History

The UE OPTIONS in Engineering summer program for high school girls was developed as a weeklong, residential experience on the university campus, running Sunday afternoon through Saturday morning. During the week, camp participants were introduced to various engineering disciplines (i.e. civil, computer, electrical, and mechanical) and computer science by faculty and local professionals who provided educational instruction with a hands-on component. Lessons were designed to expose participants to the wide variety of career opportunities in STEM fields.

The exploration of possibilities within engineering provided multiple opportunities for a camper to identify an educational and career path that matched her personal interests. The participants also completed a myriad of team-building exercise and activities designed to improve confidence and self-image.

A cornerstone of the program was the opportunity to job-shadow a practicing female engineer volunteering as a mentor for the camp. Participants were paired with local professionals to spend a day at their workplace, learning what an engineer actually does and developing a personal relationship with the mentor. Mentors were invited to attend other camp activities throughout the week, such as a high ropes course, to enhance the support network for OPTIONS participants.

The week culminated with a closing ceremony on Saturday morning, where parents and mentors were invited to a full brunch service and a presentation by the camp participants summarizing the OPTIONS experience. The presentation was developed entirely by the program participants, required each participant had a speaking role, and was delivered in front of all families, mentors, and staff present at the closing ceremony. In addition to sharing an overview of the camp activities and resulting impacts, the presentation also demonstrated personal growth as each participant confidently delivered her spoken part to a room full of adults. After several years, the closing ceremony was moved to Friday afternoon to reduce costs and facilitate other travel plans and time commitments of participants.

Laptops and personal email were not widely used when the program began in 1992; a portion of the initial funding provided each participant with a personal laptop and email address on a university server. The laptops were loaned to participants for a year, after which the laptops were returned in time for the next offering of the summer camp. Designed to establish a network for maintaining communication, the laptop lending arrangement and dial-up internet access proved to be more cumbersome than beneficial and was discontinued after the first few years.

An Advisory Panel was formed in the late 1990s to solicit recommendations for improving and modernizing the program workshops and activities. Five to seven mentors participated in the Advisory Panel for a few years before the panel slowly dissolved. Feedback is continuously solicited from participating mentors, counselors, and faculty regarding the current program offerings, but a formal panel has not been in place for the last decade. The panel suggestions resulted in significant improvements in the past; a new Advisory Panel may benefit the program as it continues to adapt to remain current and successful.

Due to the success of the program for high school girls, a similar program was introduced in 2004 for middle school girls. The camp for middle school girls began as a week-long residential experience, with counselors and mentors leading more of the workshops than faculty. The workshops are less technical than those offered at the high school level, but reflect the broad introduction to multiple engineering disciplines and computer science. The program also advises participants how to prepare for future studies in STEM. Middle school is a critical age for young women where self-confidence and perceptions of others have a big impact on actions and decisions. A well-known study has shown that young girls have gendered perceptions of STEM even as middle school students [8]. By reaching the girls at a younger age, the program aims to increase the STEM pipeline and encourage more young women to explore and pursue STEM.

Confidence boosting activities play a bigger role in the middle school program to empower participants to overcome negative messages and improve self-efficacy.

A third camp was introduced in the late 2000's after receiving multiple inquiries and interest about a similar program for boys. The OPTIONS camp for boys is hosted as a day camp, not a residential experience, on the university campus and includes many of the same components as the programs for girls. Mentors and networking are not as heavily emphasized in the camp for middle school boys; workshops with hands-on learning and industry tours are coordinated to introduce the young men to the myriad of opportunities engineering presents.

After 25 years of operation, the essential components of the program remain the same. Faculty involvement has increased, thereby adding more variety to the engineering instruction for the high school girls. The objectives of the program continue to be provide avenues for career exploration, improve self-esteem and self-image among young women, and to promote STEM education.

Program Implementation

One of the biggest challenges consistently faced by the program is recruitment. A significant increase in the cost for attending the camp in the late 1990s resulted in a lower enrollment that summer. Otherwise, registration costs have remained relatively steady, as have the dates of the camps. The current registration fee is $500 for the high school girls camp and $300 for the middle school girls camp, both of which are offered in June. Occasional partnerships with other groups providing youth services have increased enrollment and diversity some years. Competing dates with other summer programs and extracurricular activities has become more noticeable in the past decade.

Advertising for the camp initially consisted of founding faculty members visiting local schools, meeting with math and science teachers, and contacting parents directly. In the late 1990s, the program was advertised online and in multiple local and national media outlets and camp directories. National advertising attracted participants from outside the Midwest, including Oregon, Montana, California, and Texas. In 2016, the program had two international participants that were in the US with parents traveling for work.

Participants are asked each year how they heard about the program and why they chose to attend. For the first 10-15 years, the common response was that a teacher or counselor recommended the camp or a parent forced them to attend. In the past decade, the response has shifted to more participants reporting attending the camp of their own volition, and more participants are actively looking for STEM camps or career exploration opportunities. This shift indirectly decreased need for disciplinary actions as participants treated the program more as an academic opportunity than as a social sleepaway camp. The personal investment of participants has led to more meaningful discussions and an apparent desire to learn the 'how and why' behind each activity. Many participants still attend based on parent or school recommendations but generally seem more invested in the program mission.

Program planning begins with securing funding, as OPTIONS relies solely on external funding to continue operating. The curriculum is adjusted to meet the goals and requirements set by the

funding agency, while remaining true to the program mission of encouraging young women to explore and pursue engineering and computer science. Curriculum planning coincides with scheduling field trips, mentor visits, and faculty-led workshops. Advertisements generally begin in December and January, and college counselors are finalized in the spring semester. Registration is accepted on a first-come, first-serve basis until the camp has reached full capacity. The program is generally limited to 24 participants but has allowed as many as 26 participants to attend.

A representative schedule for the high school program is provided in Figure 1, where the workshops are hands-on engineering and computer science lessons developed and led by university faculty.

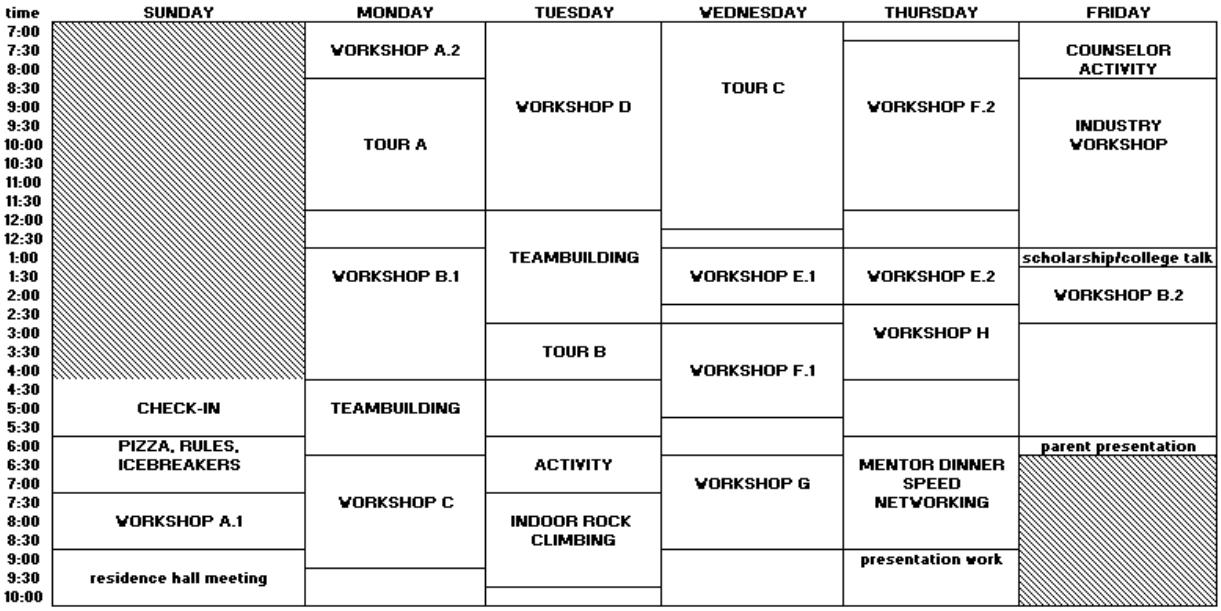

Figure 1: Representative schedule – high school program

Every activity is designed to empower young women. The workshops and tours provide opportunities to explore various career paths available in engineering and computer science while forming connections with female role models. The educational activities foster a stronger STEM-identity; content delivery is designed to improve self-efficacy. The teambuilding activities teach participants the importance of teamwork, increase self-confidence, build relationships, and challenge the girls to solve problems both mentally and physically. Counselors lead a variety of teambuilding activities and challenges throughout the week during downtime and provide breaks during long workshop sessions to keep participants engaged. The evening with mentors and the closing ceremony wrap up the week with events that encourage reflection, communication, and support to continue exploration in STEM.

In 2016, eight faculty members led, or co-led, workshops for the high school girls. Generally, the program aims to introduce participants to a faculty member from each engineering/computer science discipline offered at UE. The number of tours included in the programs is dependent on site availability and scheduling conflicts. The high school camp may include 3 to 4 tours or

industry-led workshops; whereas the middle school camp may only include 2 tours. The program attempts to include sites that have at least two female professionals willing to act as mentors for the tour and site visit. Most sites provide additional mentors to interact with participants. A 2:1 ratio of program participants to mentors has proven to be ideal for the mentor appreciation dinner and speed networking events.

Mentors

Local professionals have played a pivotal role in the camp since inception. A primary objective of the camp was to pair participants with a female mentor working in an engineering field. Mentors would host camp participants as job shadows for a day to share experiences and expose the participants to 'a day in the life of an engineer'. The mentors also acted as role models, demonstrating that women can succeed in engineering, providing advice, and relating personal stories of overcoming challenges. Mentor time commitments became a challenge as more outreach activities were introduced in the local area, and some activities became cost-prohibitive.

The role of the mentor switched from attending multiple events to attending a panel discussion and a mentor appreciation dinner with all participants. Participants dressed professionally and practiced professional etiquette at the dinner. One mentor would provide a short keynote speech before opening the floor for a question and answer session with participants. Due to costs, the mentor appreciation dinner has occasionally taken the form of a casual meal on campus.

Tightened security after the 9/11 attacks made job shadowing and tours at some locations more difficult, if not impossible. As mentors assumed new roles and transitioned in the workplace, scheduling shadow visits for all participants, while pairing participants with a mentor that matched their interests, became increasingly challenging. The logistical challenges heightened after 2010 when the university stopped leasing vehicles, which had previously been driven by counselors and staff to transport participants during the camps. Two international offerings of the high school program also disrupted the annual call for job-shadowing locations, increasing the difficulty of securing enough openings for all camp participants.

For the past two years, the mentors have not been paired with participants for individual job shadowing. More tours are included in the current schedule, and the mentor appreciation dinner has been reconfigured. The dinner is a catered affair on campus and is now followed by 60-90 minutes of speed networking. Mentors are seated at different tables while the participants rotate through every table, getting the opportunity to connect with each mentor and ask questions. Following the speed networking session, mentors are invited to stay for 30 minutes of follow up questions and informal discussions with the program participants. The speed networking event received praise from numerous mentors and participants in its second year, and the program will continue to include the event in future offerings.

The role of mentors has continued to shift and adapt, but mentor participation remains a pivotal feature and key success of the camp. During a period of low enrollment in the mid-1990s, mentors were a driving force in keeping the program alive. Mentors spearheaded the Advisory Panel for the program to help modernize the camp offerings and revitalize the workshops. The OPTIONS program owes much of its success to the enthusiastic participation of the working women that volunteer their time as mentors.

Counselors and Instructors

In initial camp offerings, only a Residence Director was enlisted to stay with the participants in the dorms. Shortly after, counselors were incorporated. Counselors were selected from current female, engineering and computer science students at the university. College counselors introduced an additional demographic that would benefit from the camp experience. Counselors continue to act as mentors for the camp participants, provide insider information on college life in engineering, and facilitate hands-on problem solving activities. One counselor for every four participants is the ideal ratio based on past offerings of the camps.

Counselors benefit from the experience in many ways. Many of the engineering lessons for the middle school participants are led by the college students acting as counselors. This provides the counselors with an opportunity to share their knowledge and passion for STEM, to practice leadership skills, to improve communication skills, and to take ownership to become more invested in the success of OPTIONS. By requiring counselors to lead workshops, the program aims to increase confidence, improve STEM-identity, and encourage mentoring relationships. Studies have shown that low self-efficacy and weak identifications with STEM have a negative effect on female persistence in STEM careers [3, 7]. To date, more than 95% of counselors have completed a bachelor's degree in a STEM field. Many counselors return to the summer program for multiple years during their college career. Several counselors and mentors are past program participants working to preserve and promote the legacy of the program. Counselors receive many of the same benefits as camp participants, as they also attend the tours and mentor visits.

Instructors for the high school offering of the summer program are primarily faculty members from five disciplines: Civil Engineering, Computer Science, Electrical Engineering, Computer Engineering, and Mechanical Engineering. Faculty prepare workshops with projects, typically including a design challenge, that introduce camp participants to each discipline. The faculty-led workshops generally last 3 to 8 hours, depending on the complexity of the project. Larger projects are completed in a series of shorter sessions to maintain participant interest and engagement. As the reported attention span of teenagers continues to diminish, the program is challenged to determine the appropriate number of breaks and time spent focused on single tasks.

Faculty members from other STEM disciplines and some mentors have also acted as instructors for both the middle school and high school offerings. Workshops in Chemistry, Physics, Industrial Engineering, Process Engineering, Environmental Engineering, and Biomedical Engineering have also been included.

Partnerships

The university has partnered with various organizations in the past 25 years to increase involvement and reach new participants. Partnerships with organizations that empower young women and promote self-confidence have included need-based scholarships and introduced new groups to opportunities within STEM. One community partner offered a self-defense class for the program participants and counselors, which was a positive and empowering experience for all involved. Most partnerships have only lasted for a few years at a time, usually due to changes in funding sources for one of the organizations.

For the past two years both the middle and high school programs have partnered with a nearby community college, as part of the Indiana Space Grant Community College Partnership. The university engineering programs have an articulation agreement with the community college partner, producing a few transfer students every year. As part of the partnership with the summer program, the community college is expected to provide two college counselors from STEM majors to participate for the duration of the program. The university selects 3 college counselors, for a total of 5 counselors. The counselors reside in the dorms with the camp participants and facilitate activities throughout the week.

The counselors from the community college are expected to plan and lead approximately 6-8 hours of STEM workshops to be conducted at the community college campus. The motivation to partner with a community college is threefold: the camp participants are exposed to both a 2-year and 4-year college environment; the community college counselors develop a connection with the university; and the support network for young women in STEM is expanded. The community college counselors present an alternative path for pursuing a college degree and share diverse perspectives and experiences with the camp participants.

The community college counselors can also explore the opportunities within engineering and discover more about a four-year degree. They participate in the tours and activities with mentors, which likely promotes STEM-identity to support persistence in a STEM field. The community college counselors are in a unique position to simultaneously reap the benefits of camp counselor and camp participant. The counselors from the university benefit from the added diversity of students from the community college and increase their personal networks. The potential benefits described above have not been assessed at this point, but qualitative feedback from the counselors support the claims.

The partnership with the community college was driven by funding opportunities for the summer program. In addition to the benefits described above, several challenges have accompanied the partnership. The biggest challenges can be categorized as logistics. The partner community college is an hour drive from the university campus, and it is in a different time zone. To accommodate schedules of both institutions, the day at the community college campus begins with a very early departure time, spurring complaints from camp participants about lack of sleep. Coordinating lesson plans and purchasing supplies for workshops hosted at the community college campus can be challenging. Unfamiliarity with the counselors from the community college also led to a sense of uncertainty for camp leaders, who are already familiar with the counselors from the university. Planning deadlines and decisions proved more difficult to meet between two institutions via phone calls and emails. Improved communication and advanced coordination would benefit both partners in the future.

International Experience

In 2009, UE OPTIONS in Engineering for High School Girls piloted a 10-day program held in England. The camp, billed as *The OPTIONS Harlaxton Experience*, included 5 nights at a historic English manor owned by the university, located in Grantham, England, and 3 nights in London. Four faculty members, a mentor from local industry, a college counselor, and two staff members also participated in the camp.

The structure of the camp included an engineering or computer science class taught by faculty in the morning, followed by a field trip to enhance the lesson with tours, discussions with STEM professionals in the UK, and viewing historical sites and artifacts. Afternoons and evenings included a hands-on project and at least one teambuilding activity. One evening also included a teleconference with female professionals that typically participated as mentors in the stateside offering of the camp. The two days in London consisted primarily of tourism activities, including tours of the Tower of London and Westminster Abbey, a ride on the London Eye, and a popular theater performance. Many of the visits spurred discussions related to the engineering involved, in addition to the historical significance and general excitement of travel.

To attract participants interested in exploring STEM fields, rather than just traveling abroad, participants were required to attend either the 2008 or 2010 traditional stateside offering of the camp, as well. Advertising for the international experience began in 2008, to attract young women to the stateside camp. Participants in the 2008 stateside offering were also given priority placement in the 2009 international offering. A total of 14 participants were selected for the inaugural offering of the *OPTIONS Harlaxton Experience.*

The *OPTIONS Harlaxton Experience* was a success, receiving stellar reviews and feedback from the participants. Each participant was asked to provide written feedback summarizing the experience and the impact of the program. Common negative feedback related to food choices and excessive walking while in London. The engineering classes and field trips were lauded for providing a new perspective with a richer history. A trip to Isaac Newton's boyhood home was a highlight for many of the participants. The *OPTIONS Harlaxton Experience* was offered again a few years later with much the same success. Pending funding, the summer program for high school girls is planning to celebrate 25 years of operation with a new *OPTIONS Harlaxton Experience* offering in 2018.

University Recruitment

The University of Evansville recognizes the recruitment opportunity the program presents, and various efforts have been initiated to recruit the high school participants as prospective students. The program has not succeeded in significantly increasing the number of female engineering students at UE, but an enrollment rate of about 10% of OPTIONS participants is typical. It is difficult to ascertain if these students would have entered engineering or enrolled at the university had they not attended OPTIONS. Meetings with staff from the Admissions Office were added to the camp curriculum for a few years but received negative reviews from participants. Participants disliked overt attempts to share information about the university admissions process, but preferred learning about the campus through informal conversations with OPTIONS counselors and faculty. Discussions with staff from the Admissions Office have been replaced with counselor-led discussions about college life and the university.

Program Results

Assessment

Participants in the camp are required to complete a pre-test on the first day of camp, consisting of approximately 20 questions in the form of multiple choice, True/False, and fill in the blank.

Questions are developed based on engineering and computer science concepts that will be covered during camp activities as a tool to measure learning that occurs as a direct result of participating in the camp. A post-test is completed on the final day of camp, consisting of the same questions as the pre-test. In the past decade, gains in engineering knowledge of 12-24% have been reported, validating the camp success in educating young women.

Demographic records have not been maintained for past participants. Partnerships with other local youth-centered groups have increased ethnic diversity in previous camp offerings. Photos and oral histories of OPTIONS indicate diverse groups in terms of socio-economic background, ethnicity, religion, occasionally nationality, sexuality, and disability. Future assessment efforts will include methods to measure and track diversity of camp participants.

Assessment has been primarily driven by funding requirements and reporting criteria. Data-driven assessment has been limited, to date. 2009 and 2010 saw intentional efforts to incorporate more data-driven assessment in the form of anonymous exit surveys. The surveys included questions about the hands-on workshops, tours, camp events, accommodations, etc. using numerical ratings and open ended responses. Records of continued implementation of these surveys are not available. In 2016, anonymous exit surveys were again implemented as an assessment tool. Future offerings of the program will continue collecting both quantitative and qualitative data to evaluate program effectiveness for continuous improvement.

A summary of the 2016 exit survey revealed that 100% of participants would recommend the program to a friend. The surveys contained two questions about general satisfaction with the camp, corresponding to the results in Table 1.

Table 1: 2016 Survey results – general program satisfaction

Survey Question	Middle School	High School
Would you recommend this experience to a friend?	100% responded "yes"	100% responded "yes"
Overall, I am very satisfied with the summer camp experience	65% - "strongly agree" 30% - "somewhat agree" 5% - "strongly disagree"	92% - "strongly agree" 8% - "somewhat agree"

Participants in both programs were asked to rate their experience with the major camp activities on a scale of 1 to 5, with 5 being the most satisfactory. The middle school program survey listed 12 major experiences, with an average rating of 4.14. The lowest rated experience was a tour and received a rating of 3.3. The highest rated workshop, with a score of 4.6, was directly related to environmental engineering which supports the claims in the literature that women prefer engineering fields with a clear connection to helping people.

The high school program survey included 17 major experiences to be rated based on participant satisfaction. The average rating was 3.78, with tours earning both the highest and the lowest ratings. Potentially identifying information from tour and workshop descriptions is omitted in the selected results presented in Table 2.

Table 2: 2016 Survey results – high school experience

Survey Question **1 = highly unsatisfactory, 5 = highly satisfactory**	**Average Results**	**% Responses Ranking 4 or 5**
The Speed Mentoring event	4.33	91.7
Team Building Activities	4.25	91.7
Tour A	4.67	100
Tour B	4.50	100
Tour C	2.08	00.0
Workshop A	3.42	58.0
Workshop B	3.83	58.3
Workshop C	3.50	50.0
Staying at the Residence Hall	4.5	83.2

Three open response prompts were included in the exit surveys. The prompts were: please share with us a few things we could do better; please share with us your favorite experience for the week; and how has this camp experience influenced your perception of engineering and other STEM fields.

Common themes in responses from both camps for areas of improvement were more time for sleeping, more free time, and more activities just for fun. A few participants commented that certain tours and workshops feel longer and less exciting than others.

The high school participants all cited a tour or workshop for favorite experience from the week. A few participants mentioned the relationships made with other campers, counselors, and mentors. 95% of the middle school participants listed a specific workshop or tour as the favorite experience of the week; the other remaining were food and a water balloon fight.

The prompt asking about the program's influence on perceptions in STEM primarily solicited comments regarding the wide variety of opportunities within engineering. A middle school participant said,

> *"I had never really done any engineering activities before. I've heard science camps and other STEM camps but I wasn't familiar with an engineering camp. I have been interested in the STEM categories for the past year, so this camp was perfect. It has really broadened my views for possible job opportunities.*

Two representative responses from the high school participants are included below.

> *"It has shown me more specifically different jobs available for people interested in STEM studies and disproved that engineers mostly work on computers, cars, and bridges."*

> *"It has SIGNIFICANTLY affected my perception of engineering and other STEM fields, also my choice of schools. I discovered that I really did enjoy some of the*

things I thought I would, and that I did not enjoy some of the things I thought I would. I also learned a lot about myself and my own limitations."

Similar exit surveys will be implemented in future camps to compare satisfaction rates for changing activities and aid in the planning process. Records of tour ratings will be helpful for scheduling future tours and making decisions when scheduling conflicts restrict tour options.

Longitudinal Study

One challenge of the camps is maintaining contact with past participants. Contact information frequently changes and messages are often met with no response. Email attempts to communicate may be filtered into spam folders or deleted as spam without reading. As use of social media has become more widespread, a few cohorts of participants have opted to create restricted groups on social media sites to keep in touch. Use of such sites is sporadic and activity decreases significantly within three months after camp completion. A reliable method for maintaining contact with participants has yet to be discovered, making longitudinal studies difficult.

A short survey was emailed to participants from the middle and high school camps from the past 10 years, using the email address provided at the time of camp registration. The anonymous survey consisted of eight questions which asked participants to respond using a scale of one to five, (1 = strongly disagree, 5 = strongly agree) and two open ended questions. Participants were also asked to indicate which camp(s) they had attended.

The eight ranked questions and results are summarized in Table 3.

Table 3: Longitudinal survey results

Survey Question **1 = strongly disagree, 5 = strongly agree**	**Average Results (Standard Deviation)**	**% Responses Ranking 4 or 5**
As a result of attending OPTIONS I had more positive feelings about pursuing a career in STEM	4.25 (0.75)	89.3
As a result of attending OPTIONS I had a better understanding of engineering and computer science	4.46 (0.64)	92.9
As a result of attending OPTIONS I discovered more female role models	4.18 (0.67)	85.7
As a result of attending OPTIONS, I chose to pursue a career in STEM	3.68 (1.19)	57.1
I still keep in touch with (or follow) people I met at OPTIONS	3.32 (1.33)	50.0
I would recommend OPTIONS to other young women	4.57 (0.69)	89.3
OPTIONS had a positive impact on my self confidence	3.96 (0.79)	75.0
OPTIONS opened new opportunities for me	4.04 (0.98)	70.3

Only 28 participants responded to the survey, further highlighting the need to improve methods for maintaining contact with camp participants. Potential bias is present in survey responses; participants with deeper connections to the program may have been more likely to respond. Participants that did not benefit from the program experience may have been unlikely to respond. Without a better method for maintaining contact with past participants and a higher response rate, the results cannot be fully evaluated.

Two survey responses came from participants that had attended all three offerings of the program: middle school, high school (stateside) and high school (England). Seven responses came from participants that had only attended the middle school program. A Venn diagram describing the camp experiences of all survey responders is provided in Figure 2.

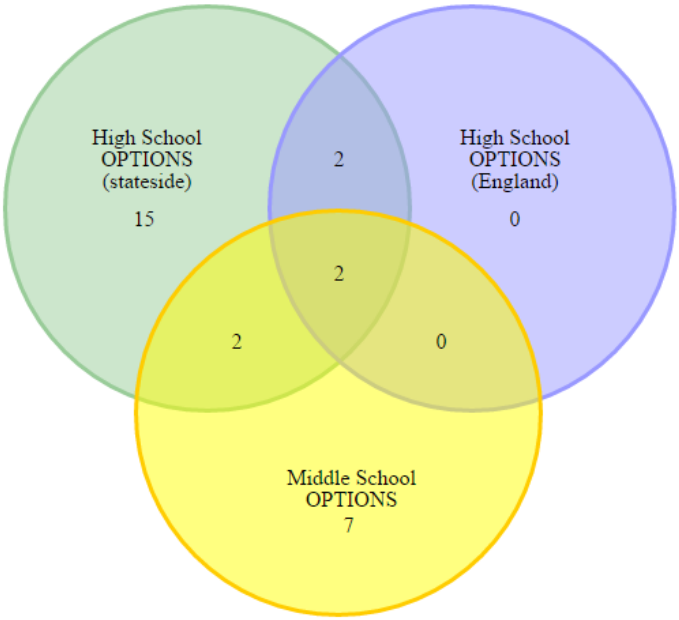

Figure 2: Program Attendance of Longitudinal Survey Responders

One open-ended question prompted survey takers to, "Please share some general information about your career/education path (i.e. degrees earned or currently pursuing, work experience)." 15 of the 28 responders were pursuing or currently engaged in a STEM career; seven respondents opted not to provide information regarding education or career.

The second open-ended question, "Please provide any additional comments regarding your OPTIONS experience(s) and the resulting impacts," returned 22 responses with common themes of fun and educational program experiences. One responder commented that the experience was the worth the challenge of early morning classes during summer break. Three selected responses highlight the impact of the broad introduction to engineering disciplines and the activities designed to improve self-efficacy:

> *"When I applied to the program, I was unaware of the depth of the field of engineering. I knew I liked math and science, and engineering incorporated both of those. During the program I learned that engineering was not just math and*

science, but art, problem solving, humanities, etc. and it actually required a great deal of social and people skills. This camp opened my eyes to the endless possibilities of the engineering and other STEM fields. It also increased my confidence in my ability to pursue a career in this field, as I learned I was capable of tackling tasks often presented to engineers."

"After OPTIONS, I felt that I could pursue any field for any career. I felt more confident and more interested in engineering. I initially sought a BS in Biomedical Engineering from the U of M, before finding that Genetics and Cell Biology was a better fit and would prepare me better for applying to Dental and Physician Assistant programs after undergrad."

"The projects were fun and showed me first hand how cool engineering was. I would have done something else with my life instead if it weren't for this camp. Meaning, it helped me understand what was really out there and to dream bigger."

All responses were analyzed using word cloud software to identify common words and themes. A sample word cloud is provided in Figure 4.

Figure 4: Sample word cloud for open response survey results

Best Practices and Future Implementation

As the OPTIONS program enters the next 25 years, it will face the challenge of adapting with technology and changes in society and industry. Female representation in engineering is not growing rapidly, thus perpetuating the importance of offering such experiences to young women. Efforts to continuously improve the program and attract diverse participants will have an impact on the implementation of the camps. Prominent features of the program will remain, but new methods of assessment will be implemented to evaluate the success of the program and proposed improvements/additions.

Best Practices

Based on experience, and primarily qualitative feedback, the "best practices" from the past 25 years will continue to be implemented. These practices include the utilization of female professionals in STEM fields acting as mentors. The role of mentors may vary, but providing a link to working professionals is a cornerstone of the program and has been shown to have a significant impact on the perceptions of participants. The inclusion of mentors agrees with research findings from the past decade indicating that fostering a critical mass and support network of women in STEM positively impacts female persistence in STEM [10, 14-16].

The program will continue recruiting current college students in engineering disciplines to act as counselors-in-residence for the camp. The college students provide an additional layer of mentor/mentee relationships, form more informal and personal connections with the participants, bring new ideas and energy to the camp, and benefit from the leadership experience in terms of personal growth and connections to the university. Counselors are also one of the best marketing tools for attracting prospective students to the university.

While some newer summer programs for young women interested in STEM focus on a specific discipline, OPTIONS has always been a broad introduction to engineering and computer science. The program is billed as an exploration of opportunities with the intention to demonstrate the multitude of career paths opened by an engineering degree. Ideally, participants will identify with at least one of the paths, regardless of prior knowledge or perceptions. Past program evaluations have indicated the wide range of workshops, variety of tours, and broad introductions to multiple disciplines have a positive impact on perceptions of STEM and intentions to pursue a STEM career. Many participants come in to the program with limited knowledge of engineering and leave with a world of new possibilities to consider. Continuing to offer a broad introduction allows the program to potentially reach more participants that would not otherwise consider pursuing a STEM career. The breadth over depth approach aims to increase the STEM pipeline rather than just plugging the leaky holes.

Tours to local industry partners, hosted by female engineers, have always played a key role in the program. The opportunity to witness a myriad of working environments and learn about the processes and responsibilities can significantly alter perceptions of STEM careers. Quantitative and qualitative feedback from participants consistently ranks industry tours as a highlight and highly impactful component of the program. Visiting industry partners allows participants to see engineering in action and make connections to the hands-on workshops and lessons taught on campus. Local tours have included a variety of manufacturing facilities, power plants, consulting firms, research facilities, and offices. Tightened security measures after the events of 9/11 made touring some facilities more difficult. One industry partner that can no longer accept tour groups now sends a group of female engineering to campus to share a presentation about the facility and lead a workshop with program participants.

A closing ceremony planned and presented by program participants concludes the programs every year. Communication and public speaking skills are practiced by all participants; each girl is required to have a speaking part in the presentation. Planning and creating the presentation inherently prompt reflection and evaluation of the camp experiences. Participants conclude the camp on a positive note, sharing their excitement and pride from the week's activities. The

presentation is given to an audience of family members, counselors, program staff, and occasionally mentors. Parents often comment on the apparent increase in self confidence after witnessing their daughter's role in the closing ceremony. The event also serves to inform parents of what the registration fee has included during the weeklong residential camp. Enthusiasm shared by the participants during the presentation impresses upon parents the importance of continuing to provide support and encouragement. Closing ceremonies end with certificates being awarded to each participant by the Dean of the College of Engineering and Computer Science; high school girls receive a scholarship letter that can be applied upon enrollment at the university; middle school girls receive a scholarship letter to attend the high school camp when eligible. The closing ceremony is an important event for both parents and participants and will continue as a best practice of the program.

As previously discussed, the role of mentors continues to adapt with the program. The addition of a speed mentoring event has been well received by both participants and mentors. Counselors join the participants to connect with mentors and get advice. The event fosters building a support network and seeking multiple mentors. Prior to the speed networking portion of the evening, participants have dinner with the mentors and have informal conversations with those seated nearby. During speed networking, all participants meet with all mentors, thus increasing the chance that a participant will identify a personal connection with a mentor. The event also allows more mentors to participate with fewer time commitments. Speed mentoring is a new addition to best practices of the program, and was more successful in the second year due to participants brainstorming questions and topics of discussion before attending the event.

Program Future

A recurring challenge for the program is maintaining contact with participants for more than one year after completing the camp. Scant tracking capabilities increase the difficulty of longitudinal studies to evaluate the success of the program. Failure to maintain open lines of communication limits the ability to recruit program participants to the university as prospective students, as well. OPTIONS for High School girls maintains an internal website with contact information for participants, counselors, and mentors, but the site traffic severely diminishes after program completion. Registration records are retained from past years, but often phone numbers, addresses, and email addresses become obsolete without a method for past participants to update contact information.

One goal for future program offerings is to establish an internal database with participant contact information that can be updated annually. The database would act as a tracking method to record persistence in STEM with regards to degrees earned and employment. The database will be used to recruit program participants to attend the university and to return to the program as mentors. New assessment opportunities will become available with improved tracking capabilities and stronger relationships can be fostered with camp participants over time. Social media sites may prove more effective for keeping in touch with millennials; however, privacy concerns and safety of minors must be considered if using a public platform to share any information. In 2017, the high school camp will introduce participants to LinkedIn and include a discussion of professional image on social media platforms.

Similarly, the program plans to establish a database with mentor and counselor contact information to share with participants. An internal database with mentor contact information currently exists for planning visits and mentor activities each summer. Mentors will be given the opportunity to opt in to an external database to be made available to all program participants. The external database will allow participants to connect with mentors after completing the program and to search for mentors they may not have met during the camp. The database will give professionals an opportunity to interact with participants and support the program, whether the professional is available to participate during the week of the camp or not. Motivation to develop an external mentor database stems from research supporting female networks and support systems to increase persistence of women in STEM. Hopefully the addition will foster longer-lasting relationships between the mentors and participants and encourage participants to continue seeking new mentors.

In addition to a mentor database accessible to program participants, the program plans to create 'trading cards' of mentors willing to provide a photo and some personal information. The trading cards will begin as slides that can be used throughout the camps to highlight the variety of positions that women occupy within STEM. Storytelling and connecting with the journey of other women are tools for improving stem-identity and self-efficacy for women in STEM. As women share stories about overcoming challenges in their personal journey, young women begin to connect with the story and find relatable role models. Increasing the number of female role models in STEM is a key component to enhancing female participation, per research findings. Recognizing that working professionals are not always able to commit to attending camp activities, the trading cards will expose participants to more working women in STEM. Mentors will have the option to share a story about their motivation to pursue STEM, advice for success, hobbies, challenges they have overcome, and any career highlights. The trading cards will mimic a cross between a baseball card and an author's bio on the inside of a book jacket. Similar methods for introducing role models have been adopted by other organizations, including the creation of Career Cards by TechBridge, a nonprofit group promoting STEM education for young girls [17].

In the next five years, the program plans to develop a method to share information and resources with parents to continue encouraging participants to explore and pursue STEM opportunities after completing the program. The resources would include suggestions for expanding camp workshops and learning opportunities, advice for developing beneficial mentor/mentee relationships, sources for scholarships, and commercially available products, books, or videos to inspire creativity and practice problem solving. One resource will highlight the benefits of utilizing the external mentor database previously described. Suggestions for preparing to pursue a college degree in a STEM discipline will also be included.

The impact of the program on college counselors has not been assessed. Personal communication with past counselors has indicated an overwhelmingly positive experience, but no attempts have been made to collect qualitative or quantitative results. Hence, no longitudinal study has tracked the educational and career path of counselors or compared persistence rates with female peers that do not participate in the program. To measure program success regarding the enhancement of STEM-identity and the previously described benefits for counselors, survey methods will be implemented and annual tracking will be recorded in an internal database.

Future goals of the program also include implementing flipped classroom techniques to encourage self-guided inquiry. Current technology such as smartphones will ease the transition to flipped classroom approaches. Innovation workshops, policy discussions, and global design challenges are topics the program will attempt to incorporate in future offerings. After further development, an interdisciplinary project that connects several individual workshops from the week could be added as a culminating team design challenge. These changes will occur over a period of time, and program goals may be modified as new research is published on how to reach young women and support exploration in STEM.

Conclusion

After 25 years, the summer program encouraging young women to explore opportunities in engineering has reached well over 400 teenage girls. Best practices of the program, many of which are supported by research, include introducing same-sex mentors and experts, activities designed to improve self-confidence, tours of local industry to demystify engineering, college students acting as counselors-in-residence, residential experience on a university campus, and teambuilding activities and group projects. Participant-led closing ceremonies and speed networking are noteworthy components of the program that regularly receive glowing reviews from participants, parents, and mentors.

Evidence of program success is primarily anecdotal and qualitative. Records do not include the immediate successes and changes seen in participants during the program. Longitudinal studies have not been possible due to ineffective tracking methods. Occasionally past participants or parents will share a memory of their OPTIONS experience; one mother wrote that her daughter told her *"I didn't realize I was smart until I went there,"* after completing the program.

Expected challenges include maintaining enrollment and external funding. Effectively modifying the program offerings to match changes in technology, society, and industry will always be a concern. Looking toward the future, the program leaders plan to be more intentional in implementing data-driven assessment methods, recommendations backed by research, and maintaining contact with participants and mentors by creating internal databases which will be updated annually.

The success of the program for another 25 years will depend on its ability to continue adapting. Earlier this year the program modified the advertisements to appeal to the desire in young women to help people and change the world, based on research of what hooks girls' interest. Past advertisements asked if girls like math and science. With an eye on assessment and new research, the program goal to empower young women and encourage exploration of STEM fields appears more attainable than ever.

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