

**AC 2010-1192: SUMMER TECHNOLOGY AND ENGINEERING PROGRAM: AN
OUTREACH PROGRAM BENEFITING WOMEN ENGINEERING STUDENTS
FROM MIDDLE SCHOOL THROUGH GRADUATE SCHOOL**

Shannon Ciston, University of New Haven

Ellen Worsdall, Northwestern University

Jessica Swenson, Northwestern University

Summer Technology and Engineering Program: An outreach program benefitting women engineering students from middle school through graduate school

Abstract:

The Summer Technology and Engineering Program (STEP) is hosted by the Society of Women Engineers student chapter at Northwestern University, and invites girls in 7th and 8th grade to explore engineering disciplines and envision themselves as future engineers. The participants work closely with undergraduate and graduate student mentors from engineering to do hands-on activities from across multiple engineering disciplines. This experience results in positive outcomes for women students involved at all levels. Girls find supportive role models in the SWE women, and mentoring relationships have developed. This presentation will describe the program, and discuss results of post-program surveys of middle school, undergraduate, and graduate students to show the impacts of the program on these various groups, and to provide a model for similar programs.

The History of STEP:

At Northwestern University, the undergraduate chapter of the Society of Women Engineers hosts Career Day for Girls, a one-day event for girls in grades 7-12 to get girls excited about science, engineering, and technology. Through laboratory demonstrations, interactive multimedia lectures, and hands-on activities, girls meet positive role models (both female and male) and get to think about the possibilities they have for careers in the technical fields.

Many Career Day participants and their parents expressed a need for a multiple-day program held over the summer--a kind of engineering day camp for girls to get more information and experience with engineering, and to form relationships with female engineer role models. Undergraduate members of the Society of Women Engineers at Northwestern University therefore went about designing such a program: Summer Technology and Engineering Program (STEP) for Girls, which had its first session in summer 2008, and was followed by a session in 2009. Each of these sessions included about 20 girls.

Program Objectives:

To introduce middle school-aged girls to the engineering process

To instill in girls a sense of their own potential to be successful engineers

To show girls what an engineering graduate can do, and to demonstrate the value of that career path

To encourage girls to explore a career in engineering

Participant Selection:

Girls finishing 7th and 8th grade may apply for the program. Participants were selected based on expressed interest and enthusiasm by an application including free response questions, and evidence of potential, (selection was not based on previous academic achievement).

Program Details:

The programs were 3 days long, including 8 hour days. The days were a mix of classroom sessions, team design project time, research laboratory tours, and field trips. The theme “STEP UP! Design your future” was applied for summer 2008, and the theme “STEP into a Greener Future!” was applied for the summer of 2009. In 2008, there were 16 girl participants and 8 graduate or undergraduate facilitators. In 2009, there were 24 girl participants and 10 graduate or undergraduate facilitators, plus one high school volunteer facilitator.

Classroom activities consisted of an interactive lecture on what engineering is, and the various fields within engineering, as well as hands-on activity sessions meant to elaborate on specific engineering disciplines.

One **field trip** was incorporated into each summer session to allow girls to see engineering in action. Participants went to the local city aquarium in 2008 and to a green technology center in 2009.

Design projects were team-oriented and open-ended, to encourage creative exploration of problem solutions. In 2008, girls worked in teams to successfully dunk a cookie into a glass by creating a Rube Goldberg device in five steps or more, choosing from among approximately 60 different materials to accomplish the goal. In 2009, the girls created solar powered robots, including soldering work and the creation of design concepts.

Research Laboratory tours showcased Northwestern University’s graduate students in their element, and gave girls exposure to cutting-edge equipment and the research laboratory environment. These laboratories included: materials science, environmental engineering, and mechanical engineering facilities.

Both programs culminated in presentation of the girls’ team projects to their families, STEP staff, and other members of the university community. The presentation was followed by a banquet dinner to celebrate the girls’ accomplishments.

Outcomes:

Data were collected through surveys administered to girl participants at the end of the final day of each STEP program, with questions on a 5-point likert scale to rate their experience in the program in terms of: class sessions; field trips; projects; lab tours; undergraduate and graduate student friendliness, knowledge, willingness to help them learn, and enthusiasm; and the overall

program. Additional free-response questions asked girl participants about their favorite and least favorite* class sessions; what they would like to learn more about; what they thought they would learn but did not; if they get a feeling for Northwestern University engineering program; if they would become an engineer; if they would consider engineering school; what they would like to see more of*; what activity should have less time allotted*. (*Asked only during summer 2009 session.) These were analyzed to reflect on the objectives of the program, and to provide feedback for modifying future programs. In 2008 post-program surveys were collected from 14 of the 16 girls. In 2009 surveys were collected from all 24 of the girls who participated.

In the fall of 2009, graduate and undergraduate student participants were contacted to determine their motivation for participating in the program, and to determine the impacts of the program on their career goals, etc. Student were first asked about their involvement with STEP (what year(s), what roles) and educational program (what major(s), what year in program). Students were asked to rate various types of motivation on a 5-point likert scale, indicating how important these motivators were on their participation in STEP: enjoyment of working with middle-school children; increasing participation of females in engineering; gaining leadership experience; gaining teaching experience; earning money; expression of creativity through designing program materials; encouragement of participation by a professor; exploration of careers related to education and outreach; responding to a need for junior high girls to see women engineers. Students were then asked to give free responses for their top three motivators. Finally, students were asked to use a 5-point likert scale to rate various impacts on themselves as a result of their participation in the program: career goals; perception of engineers; attitudes toward the participation of women in engineering; research interests; gained valuable experience not available through the degree program. Undergraduate and graduate students were invited to comment on their impact responses. We received responses from a total of 15 undergraduate or graduate facilitators plus one high school volunteer from both years. This included 8 facilitators from 2008, and 11 from 2009 (some students served both years).

For girls:

Types of engineering they would enter:

The participants were asked an open question about their career goal: “If you become an engineer, what would you do?” Their responses were analyzed for trends across years, compared to national trends, and compared to the exposure they received to different engineering disciplines in the program.

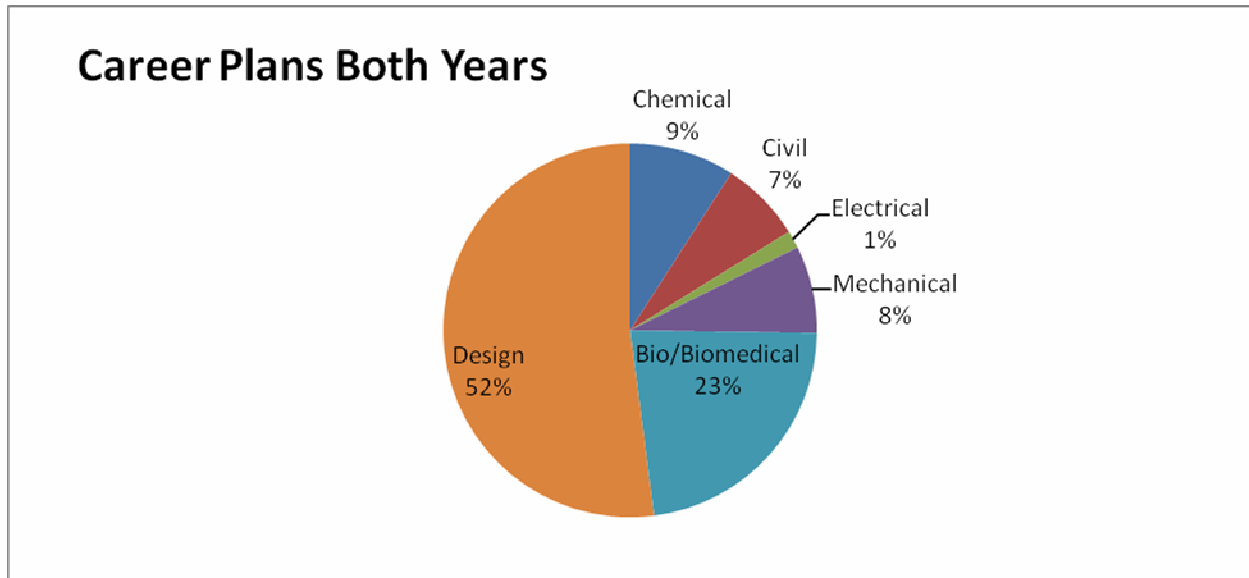


Figure 1- Program participants’ response to “If you become an engineer, what would you do?” composite of both years

Compared to national trends, the responses shown in Figure 1 have some similarity to women engineering students nationwide. Civil, Electrical, and Mechanical engineering, which might be considered the three main types of engineering, are all represented in their responses. The relatively low rate of women pursuing electrical engineering nationwide is also reflected in this collection of responses. Chemical engineering and biomedical engineering are two of the leading degrees for women engineers; nationwide, roughly 35% of biomedical engineering BS degrees and 35% of chemical engineering BS degrees are awarded to women. Biomedical engineering is also the fastest-growing engineering degree at the BS, MS, and PhD level¹. A full 23% of responses indicated that they would do biomedical engineering, making this a very significant career interest among our participants.

Design engineering or design was the top response among the girls participating in the STEP program in each of the two years, with 40% of respondents in 2008 and 59% of respondents in 2009 saying that they would go into design. This is very interesting to the authors because it is not a traditional engineering field, but one that may emphasize creativity, which may be an important factor for our participants. The responses of our participants may reflect the exposure that they have to various engineering fields during the program.

Areas they wanted to learn more about:

When asked what they would like to learn more about, the girls gave a wide range of responses, indicating a general curiosity about many different areas of engineering and physical and life science.

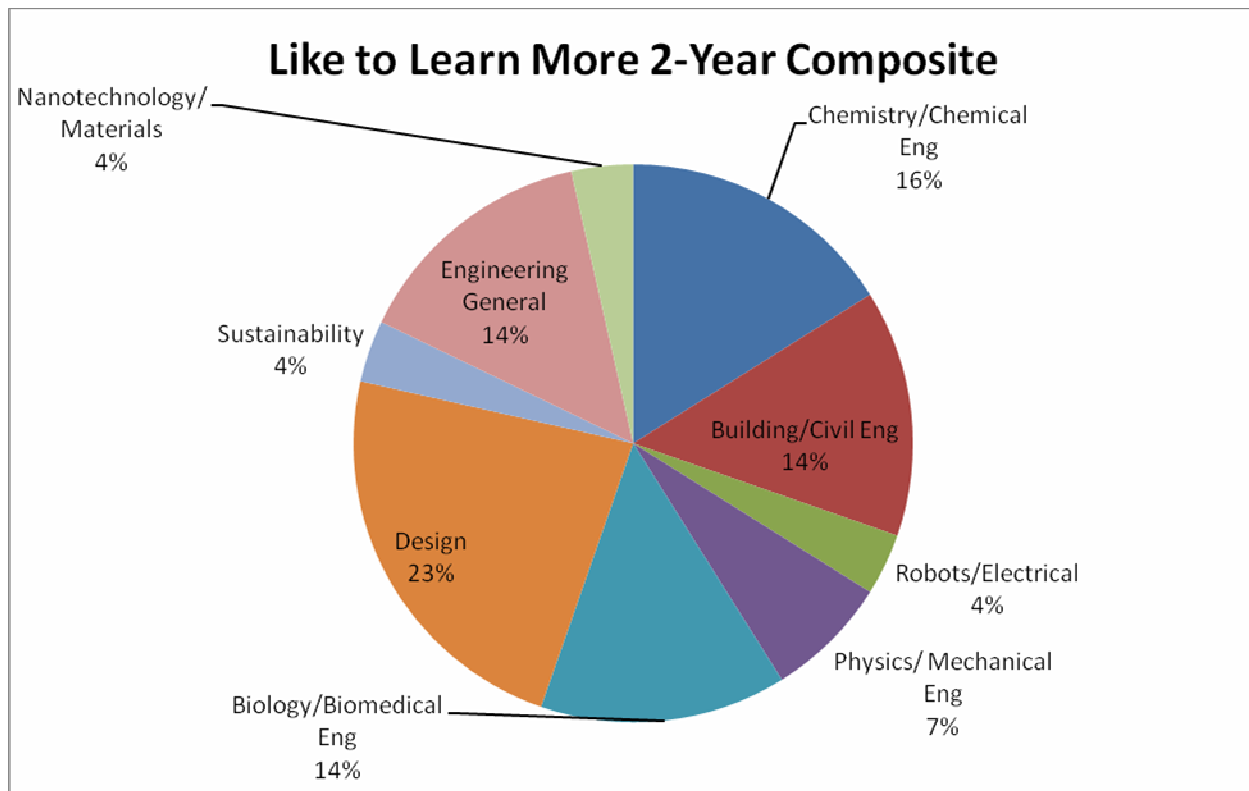


Figure 2- Participant responses to “What would you like to learn more about” composite of both years

Days of program length desired:

Like all programs which make demands on monetary, human, and facilities resources, STEP had a practical limit to the number of days of the program. For 2008 and 2009, the program was three days long. At the end of the session, the girls were asked if the program was “too short,” “too long,” or “just right,” and were invited to give a free response on how many days they would like to have for the program. The results are shown below. Data for free response of program length in days is shown only for 2008. The 2009 results are binned with 2008 responses at the level of 3 days (“just right”) and 5 days (“too short”) because 5 days was the most common free response in 2008 for girls who said the program was too short.

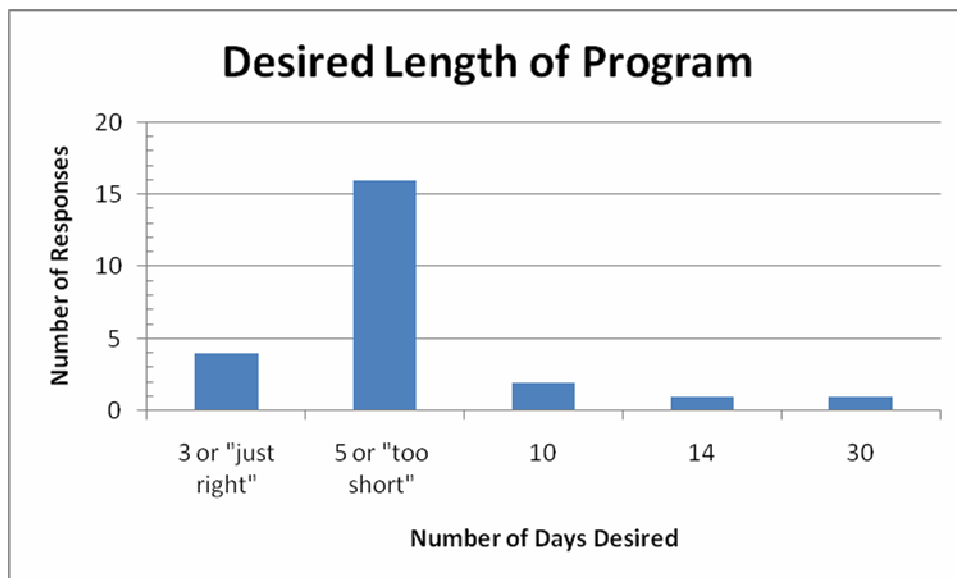


Figure 3 – Participant responses to the question of their desired length of the program

We can see that while some of the girls thought the 3-day program length was just right, many of the girls desire a longer program, such as one that lasts Monday-Friday, for the equivalent of one full week of traditional school classes. This length of a program may be within the reach of resources typically applied to STEP. Some participants even wanted a program that lasted over one week. These long program lengths are not currently feasible for STEP, but they are a positive reflection on the enthusiastic response of the girls who participated.

Role models:

In this section, we analyze the ratings of girls for their counselors—undergraduate and graduate engineering students—in the areas of friendliness, knowledge, willingness to help them learn, and enthusiasm. We also use interview responses, comments from the surveys, and anecdotal evidence to shed light on the impacts of the female role models on the girls.

The ratings for counselors on all items were extremely high. In 2008, girls rated the counselors an average of 5 out of 5 on friendliness, knowledge, and enthusiasm, and rated an average of 4.93 on willingness to help them learn. Similarly in 2009, participants rated counselors a perfect score of 5 out of 5 on friendliness, and averages of 4.92 on knowledge, 4.96 on willingness to help them learn, and 4.83 on enthusiasm. Considering all of the dimensions for both years, the counselors received an overall average rating of 4.95 out of 5.

Several responses of the girls in the comments section of the survey also reflect the positive interaction between girls and the counselors.

“I love LOVE LOVE Pam! She's the best!”*

“Samantha, Maryann, Susan, Karyn, and Linda were great mentors.”*

“The counselors were amazing and helped a lot and made me more enthusiastic about engineering.”

*Names have been changed.

Motivation and impacts for graduate and undergraduate student facilitators:

The motivations for undergraduate and graduate student facilitators (plus one high school volunteer) reflect factors related to increasing the participation of women in STEM fields, an affinity for working with middle-school aged children, and factors related to gaining relevant experience.

The most important motivators for the complete group of respondents (N=16) were: "I think it is important for jr. high girls to see women working in engineering" avg: 5; "I want to increase the participation of women and girls in engineering" avg: 4.875; "I enjoy working with middle school children" avg: 4.25; and "I want to gain leadership experience" 4.1875 (on a 5- point likert scale). The least important motivators were: "I want to earn money" avg: 1.625; and "My professor encouraged me to participate" avg: 1.87.

STEM Gender Gap:

An awareness of the gender gap in STEM fields and a desire to balance that gender gap persists in the responses of participants, including a report of increased awareness of such issues throughout the course of the program. Among the free responses of students asked to list their top three motivators, a desire to inspire girls to enter technical fields and to act as a female role model in the STEM areas were common, accounting for 21% of responses. The free responses of motivation are shown in Figure 4. Other related responses included those related to a desire to change attitudes and participation patterns related to gender (9% of responses), and a desire to have fun with other STEM-oriented women (9% of responses). Some quotes from the student facilitators include:

“I think it is important to be a role model & give girls information about engineering early on so that they can be motivated to look at the vast amounts of career opportunities in the engineering fields.”

“Help to dispel the myth that engineering and science are just for men”

“I wanted to increase participation of women and girls in engineering”

“Make a difference in changing the attitude towards women in engineering”

“Overall, this program allows young [women] to just come together and share their stories and successes and learn from one another.”

The prevalence of these responses was expected, since this is the heart of the issue that STEP was designed to address.

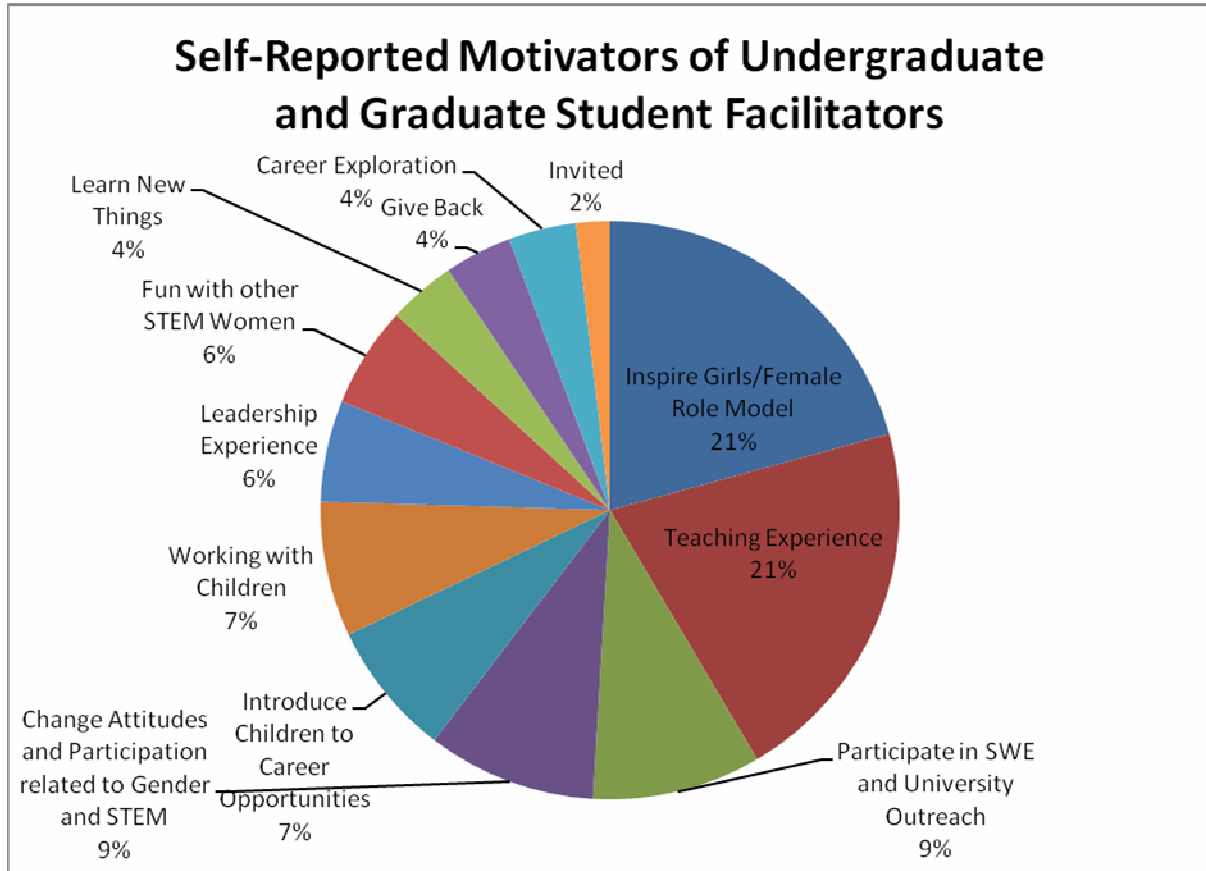


Figure 4- Self-reported motivations for participating as a facilitator

The authors thought it would be interesting to see if there were any impacts on the undergraduate and graduate student participants related to gender issues. When asked to rate their agreement with the statement “My involvement with STEP impacted my attitudes toward the participation of women in engineering,” the overall average response was only 3.43. However, among undergraduate students, the average response was 4 (UGrad avg 4, Grad avg 3.13). Some of the comments associated with high levels of agreement (4 or 5) include:

“I have learned a lot about the lack of women in engineering and why that is. I feel even more strongly now that we need more women in engineering, and want to work to increase the number through outreach programs. I also would like to do more research on how women's careers in engineering differ from men's.”

“It is always encouraging to see so many strong-willed, creative-minded female engineers, such as that are involved in a program like this.”

“I would definitely say that seeing all the young women who both taught & participated in STEP was really inspirational. It is nice to see that NU was able to reach out to that many young girls who were genuinely interested in science.”

“STEP has furthered my strong stance on encouraging women to participate in engineering & engineering outreach”

These responses indicate that involvement with STEP served to increase awareness and increase commitment of women engineers to encouraging other women engineers, which the authors believe is a really powerful impact.

Other responses indicated that some participants were already aware of such issues. The following are some responses related with ‘disagree’ responses of 1 or 2:

“I have a strong [belief] that women & men are equally competent in engineering and other technical fields. While my involvement with STEP did not alter this belief, it did highlight the fact that outreach programs geared towards girls are needed to encourage more women to pursue engineering careers.”

“My mom and sister are both IOE's”

Taken as a whole, it seems that STEP is an opportunity for women in engineering and science to participate in outreach which addresses an issue which is important to them: the balance of gender in STEM fields. Middle school girl participants responded strongly to the role models they saw in undergraduate and graduate student facilitators, which seems to be one key to the program’s success.

Professional development:

Personal and professional development through the program was another common motivator for undergraduate and graduate students. Undergraduate students were interested in gaining leadership experience (UGrad avg 4.71, Grad avg 3.63), and graduate students were interested in gaining teaching experience (Grad avg 4.25, UGrad avg 3.43). These differences reflect the different career goals and stages of professional development of undergraduate and graduate students. Many of the graduate students involved may be interested in academic careers, and were engaged in classroom instructional activities in STEP, whereas undergraduate students may be more oriented toward industrial careers. Responses related to gaining teaching experience accounted for 21% of the top three motivators free responses. Responses related to gaining leadership experience accounted for 6% of the responses. Other free responses related to professional development included a desire to learn new things (4% of responses), and a desire to explore careers (4% of responses).

The survey responses did not indicate strong and consistent impacts in the areas of career goals or research interests (averages of 3 and 3.68), but there were a few women who did report these impacts, and in general, responses reflected positive experiences of exposure to other areas of engineering and to the areas of outreach and education.

Facilitator responses were particularly strong when asked to rate the following impact: “My involvement with STEP gave me valuable experience that is not available within the classroom and/or research environment for my degree program.” The average response was 4.75. Some of the comments associated with these responses include:

“STEP helped me to realize how much I enjoy building rather than theorizing. Building is not available in much of the physics department unless students are involved in a few particular research labs.”

“The chance to do outreach and mentor prospective engineers is not available anywhere in my degree program. Also, learning how to teach and create lesson plans, or how to organize and run a very large event were very valuable skills I've learned.”

“Absolutely! I gained tremendous leadership and teaching opportunities from STEP. These were useful for me throughout the rest of my career at the University, and I have no doubt they'll be useful when I begin my job in management consulting.”

“One of the really great things I learned during my involvement with STEP was how to help foster motivation. Getting a group of students excited about the lesson material was not something I had encountered during my research or within my degree program.”

Overall, these responses indicate that participation as a facilitator in a program such as STEP is a rewarding and professionally valuable experience for undergraduate and graduate students.

Long-term Impacts:

It is challenging to make statements about long-term impacts or persistence of the participants and facilitators in science and engineering fields because the programs were so recent. Nevertheless, certain indicators of participants' and facilitators' continued interest in engineering can be described:

- Eight of the girls who participated in the summer 2008 program returned for the summer 2009. This demonstrates a continued interest in engineering among these girls.
- One of the 2008 program participants extended the mentoring relationship with one of the graduate student instructors by doing an independent study in Chemistry during the

academic year. This student went on to take college level Chemistry I at the local community college and earned an A grade in the course at age 13.

- Three of the undergraduate and graduate students volunteered for a second STEP experience in summer 2009 after having volunteered in summer 2008.
- The single high school volunteer who acted as a facilitator in the summer 2009 program has been accepted to the Engineering School at Northwestern University, and will be a freshman engineering student in fall 2010.
- Many of the graduate and undergraduate students who facilitated the STEP programs continue as graduate or undergraduate students, respectively, in their STEM degree programs at Northwestern University. Those who have graduated have gone on to work in management consulting and academia.

Conclusions:

STEP is a successful outreach program led by student members of the Society of Women Engineers at Northwestern University. Middle school girls enjoy the chance to learn about the exciting opportunities in engineering, and are eager to learn more. This program positively impacts not only the middle school aged participants, but also the women undergraduate and graduate students who lead the program.

Survey responses indicate that girls participating in the program would like a longer program of about 1 week in length, and that they appreciated the participation of strong female role models. Undergraduate and graduate women who participate as program facilitators increase their own awareness about the importance of reaching out to young women, and gain valuable experience that goes beyond their typical degree training.

Bibliography:

- 1 American Society for Engineering Educators Profiles of Engineering and Engineering Technology Colleges, 2008

Appendix 1- Middle School Participant Data

2009 Responses

Questionnaire Number	Class Sessions	Field Trip	Design Project	Lab Tours	Food	Friendliness
09-01	4	1	3	2	5	5
09-02	4	2	5	4	5	5
09-03	4	3	5	4	6	5
09-04	5	2	5	5	5	5
09-05	4	3	5	5	5	5
09-06	5	1	5	2	5	5
09-07	5	3	5	4	5	5
09-08	5	1	5	5	5	5
09-09	3	4	3	4	5	5
09-10	3	1	5	3	4	5
09-11	5	2	4	3	5	5
09-12	4	2	5	4	5	5
09-13	4		3	5	5	5
09-14	4	2	4	5	5	5
09-15	5	2	5	3	5	5
09-16	5	5	5	5	5	5
09-17	4	2	5	4	5	5
09-18	5	1	5	3	4	5
09-19	4	2	5	5	5	5
09-20	3	2	4	5	5	5
09-21	4	1	4	4	5	5
09-22	4	3	4	4	5	5
09-23	4	2	5	5	5	5

09-24	5	3	4		5	5
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Questionnaire Number	Knowledgeable	Willingness to help me learn	Enthusiasm
09-01	4	5	5
09-02	5	5	5
09-03	5	5	5
09-04	5	5	5
09-05	5	5	5
09-06	5	5	5
09-07	5	5	5
09-08	5	5	5
09-09	5	5	5
09-10	5	5	5
09-11	5	5	5
09-12	5	5	4
09-13	4	4	3
09-14	5	5	5
09-15	5	5	5
09-16	5	5	5
09-17	5	5	5
09-18	5	5	5
09-19	5	5	5
09-20	5	5	5
09-21	5	5	5
09-22	5	5	5
09-23	5	5	4
09-24	5	5	5

Questionnaire Number	What was your favorite activity in the program?	What would you like to learn more about?

09-01	Seeing the liquid nitrogen demonstration because it was really cool and interesting	green roofs
09-02	The robot thingy because of the soldering.	I think I learned what I needed to.
09-03	ring making and the robot building. I enjoyed it thoroughly because my new obsession is soldering.	the other types of engineering-we touched on it in the powerpoint at the beginning, but didn't go into it
09-04	Building the robot!	I would like to learn more about mechanical engineers and what they do.
09-05	Soldering was awesome. I loved the robot.	I think everything was pretty much covered.
09-06	I liked all of 'em, I can't choose.	Nanotechnology was not covered as much so I want to learn a little more
09-07	Soldering bec it was	Design Engineering
09-08	Everything. All was totally awesome.	I want to learn more about the stuff I did not leave
09-09	Robot because it was fun to make and to watch make.	Robot parts but we didn't have enough time

09-10	The robot design bec I liked making the robot, and how it could be useful.	design engineering
09-11	Making the robot bec it requires a lot of	Design Engineering
09-12	I absolutely loved the robot project!	I would like to learn about the biological part of engineering more.
09-13	tours bec it showed me what projects engineers were working on and how they do it. Also, the projects were really interesting.	Design Engineering
09-14	All of the activities we did had a lot of good information that was a good learning experiece. My favorite was the job tours, liquid nitrogen, and robots.	Chemical and design engineering
09-15	BME Project. I felt like a great doctor. I want to be a doctor.	The BME
09-16	lab tours, because we got to see what actually goes on in the engineering world. We got to experience it instead of being told about it.	design engineering
09-17	I liked when we worked in groups because we could have fun & interact with many people.	
09-18	My favorite was building the robots, bec I like soldering	I would like to learn more about medical engineering.

09-19	The game in the beginning bec I got to know everyone	I learned everything I expected. Thank you!
09-20	I really enjoyed creating the robot and the dream robot bec it allowed me to really think outside of the box.	what a engineer does at work bec it seems unrealistic that they just draw on posters
09-21	Everything	I learned everything I thought we would learn
09-22	Soldering bec you don't usually do that at home	More about mechanical engineering bec I like it. We learned a lot.
09-23	Almost everything execept field trip!	Everything
09-24	Nitrogen ball-just a really cool expierence! Learned a lot	Design Engineering and more real life application

Questionnaire Number	What didn't you learn that you thought you would?	What class sessions did you like?	What class sessions didn't you like?
09-01		green roof, one with sally, and the two with sue.	spring
09-02		BME	powerpoint

09-03		cornstarch/water and the 7up can that busted under pressur. Also I loved the nitrogen/bouuncyball one.	
09-04		They were all fun and exciting.	
09-05		I liked the greenroofs.	
09-06		Sally's, Kathy's Amanda and sue were all amazing!	
09-07		All	
09-08		I liked all	fieldtrip
09-09		I like the rubber ball session	different types of engineering one
09-10		nitrogen water	bio engineering
09-11		The one with Sally. I liked them all.	

09-12		I loved how Kathy and Sue explained things.	I didn't quite like the sessions with Sally.
09-13		the one with coke cans and the one where you designed the roof	
09-14	I thought we would do more on the computer. But I'm happy we did more	I liked when we used the liquid nitrogen and the corn starch and water.	powerpoint
09-15		The BME	The first class (w/ the intro)
09-16	manufacturing and mechanical engineering	material engineering class-I thought it was all very interesting	I can't think of a class session that I disliked
09-17			
09-18		I like all of them, I think they were all very interesting.	
09-19		The best was Sally!	I liked it all
09-20	what engineers do at work	green roofs, liquid nitrogen, the one where we learned about how coke cans are made and the video tape dissectiong.	mystery liquid one and the first one

09-21		I liked all of them except the first one	
09-22		Sally's, bec it was very hands on.	
09-23		Loved Sally's, Amanda-All were good just sort of long	
09-24		I loved material science and nitrogen ball, and also the garden roof top.	

Questionnaire Number	Did you get a feeling what engineering at this University is like?	If you become an engineer, what would you do? Would you consider going to engineering school?
09-01	Yes. Being in real classrooms, seeing presentations, and doing the projects gave me that feeling.	After this program, I have become more interested in engineering. I would probably become a design engineer.
09-02	Yes!	Bio-Yes

09-03	Yes, I can't exactly put it into words but I came into this program not knowing what it is.	
09-04	Yes	I would either be a mechanical, bio, or civil engineer, and yes I would consider going to engineering school.
09-05	Yes, pretty much.	I would like to be a medical or design engineer.
09-06	Totally and more!	Design engineering
09-07	Sort of	I don't know-Yes
09-08	no	I very much want to be a surgeon, but think that engineering (mostly design engineering) is awesome.
09-09	A fun, exciting field that involves science and math.	Design engineer, yes.

09-10	I did.	I would do design engineering.
09-11	Yes	A design engineer. Yes.
09-12	YES! I am VERY interested thanks to this program.	I would do medical engineering. Yes :)
09-13	Yes, the tours helped with that a lot.	I would most likely do design engineering and yes I would consider engineering school.
09-14	yes	I would consider doing chemical or design engineering.
09-15	Yes!!!	Design. Maybe.
09-16	Yes and no. I saw what engineers would do generally, but I didn't understand what projects they really worked on where do the projects go to use? How much do they actually participate? Etc.	I would like to become a bioengineer, design engineer, or mechanical engineer. I'm totally considering engineering school.

09-17	Yes definatly	
09-18	Yes, I think every activity gave a good explanation.	I would become a medical engineer, yes.
09-19	Yes!	Design and yes!
09-20	Yes	I would do prestetic limb engineering or design engineering. I would consider go to engineering school
09-21	YES	I would do design engineering.
09-22	Yes, and I think I would like it.	Mechanical. Yes at this University
09-23	Yes!	Bioengineering. Yes!

09-24	Amazing-fun-and the food is grat!	I would work on design or mechanics. Yes, I would consider going to engineering school.
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Questionnaire Number	What would you like to see more of?	What activity should we not spend as much time on?	Program Length	Day Length
09-01	The liquid nitrogen!	The activities all had good amounts of time on them.	too short	just right
09-02	Hand-on activities	IDK	too short	too long
09-03		powerpoints		too long
09-04	The material science was a lot of fun and I would like to work more with that.	Nothing each thing was well timed.	too short	just right
09-05	Design and medical engineering.	I think everything was pretty perfect	too short	just right
09-06	More activities and more time	the roof design	too short	too short

09-07	Everyting		too short	just right
09-08	liquid nitrogen!	liquid nitrogen activities	too short	just right
09-09	Videos	powerpoints	too short	too long
09-10	Nudges	Lectures	too short / just right	too long
09-11	Activities	Field trips	too short	just right
09-12	more explaining about the topic as well as the activity afterwards		too short	too long
09-13	different robotics and design engineering	powerpoints	too short	too long
09-14	Chemical Engineering	the field trip (go to a more exciting place)	just right	too long
09-15	The BME	The CCGT	too short	too long

09-16	The hands-on activities and direct references to engineering in our lives. Things like learning about the recycling of cans/plastics interested me.	I think we spent too much time on green roofs.	too short	too long
09-17				
09-18	What medical engineers do		too short	too long
09-19	liquid nitrogen!	field trip	just right / too long	just right
09-20	real work like situations	the mystery liquid one and the field tip we took	too short	too long
09-21	I would like to see more labs	I think we spent the right amount of time on everything	just right	just right
09-22	Explosions/breaking things	I don't know	too short	just right
09-23	more hands on	the field trip	just right	too long
09-24	the lab tours	the field trip	just right	too long

Questionnaire Number	Overall Program	Comments
09-01	4	
09-02	5	Awsome! Magical! Amazing! Zip! Incredible! Non-lame! Great! All-in-all A memory that will never be forgotten.
09-03	4	Maybe the dropoff time could be a less broad time and we could spend more time on other types of engineers.
09-04	4	
09-05	5	AWSOME!!! You should do this next year but it should also include 9th grade.
09-06	5	I love LOVE LOVE Pam! She's the best! Samantha, Maryann, Susan, Karyn, and Linda were great mentors. We need more people like them! We can SOLDER!!:)
09-07	5	
09-08	5	THIS WAS AWSOME

09-09	4	
09-10	4.5	I was surprised at the amount of fun I had here.
09-11	5	
09-12	4	
09-13	4	No
09-14	4	it was fun
09-15	5	I <3 this program. It is awesome!! It helped me a lot.
09-16	5	It was a lot of fun and I wish I could come back next year :(
09-17		

09-18	5	
09-19	5	None
09-20	4	I had so much fun but it was too short
09-21	5	I think highschoolers should be able to come
09-22	5	
09-23	5	Good Job!
09-24	4.99	So fun! I wish I wasn't graduating so I could do it again!

2008 Responses

Questionnaire Number	Class Sessions	Field Trip	Design Project	Lab Tours	Friendliness
08-01	5	4	5	5	5
08-02	5	5	5	5	5
08-03	5	4	4	5	5

08-04	5	5	5	5	5
08-05	4	3	5	4	5
08-06	2	3	5	4	5
08-07	5	5	5	5	5
08-08	5	5	5	5	5
08-09	5	5	5	5	5
08-10	5		4	5	5
08-11	5	5	5	5	5
08-12	5	3	5	5	5
08-13	5	5	5	5	5
08-14	5	3	5	5	5

Questionnaire Number	Knowledgeable	Willingness to help me learn	Enthusiasm
08-01	5	5	5
08-02	5	5	5
08-03	5	5	5
08-04	5	5	5
08-05	5	4	5
08-06	5	5	5
08-07	5	5	5
08-08	5	5	5
08-09	5	5	5
08-10	5	5	5
08-11	5	5	5
08-12	5	5	5
08-13	5	5	5
08-14	5	5	5

Questionnaire Number	What was your favorite activity in the program?	What would you like to learn more about?	What didn't you learn that you thought you would?
08-01	The Rube goldberg design project it was tight	Chemical engineering	

08-02	I didn't have a favorite I loved it all!	Biomedical Engineering	
08-03	I really liked making the magnet because I really understood how it worked so it was fun.	I would like to learn more about how engineers use their knowledge to build things. I thought we would learn this because building things I think is a key thing in engineering.	
08-04	The Rube Golodberg because I got to feel like and engineer	How to build better	
08-05	Rube Goldberg design project because we were able to express our imagination and creativity.	I don't know	
08-06	The rube goldberg so fun!!	More about Chemical Engineering	
08-07	The Rube Goldberg Project was very fun and I loved figuring out interesting ways to do the task.		
08-08	My favorite activity was the Rube Goldberg	I would like to learn more about civil engineering	
08-09	Hanging out with the teachers because they are fun		Nothing, I learned everything I thought I would
08-10	I really liked the class sessions. I learned a lot. And lunch, but I guess that doesn't count.		I really wanted to learn about biology. I didn't learn about physics.
08-11	Making slime because it was fun	I would learn more about chemicals	
08-12	When we made the slime because it's creative and fun	I would like to learn more about chemicals and civil!	
08-13	Shedd	more details about jobs for different types of engineers	

08-14	When we made the slime because it was fun playing with it.	I like to learn more about chemical and building.	
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Questionnaire Number	Did you get a feeling what engineering at this University is like?	If you become an engineer, what would you do? Would you consider going to engineering school?	Program Length	Day Length
08-01	Yess it was intensely awesome. I learn a lot.	engineering was chill. I really like chemical engineering. I would totally come here.	just right	
08-02	Totally	Biomedical Engineering, maybe	too short	
08-03	Yes, I was really able to understand what engineering is.	I would most likely do some kind of medical or electrical engineering. I really don't know if I want to go to engineering school or not.	too short	too long
08-04	Yes	I would design because I love to draw.	too short	
08-05		I'm not sure what type of engineer, but I would consider going to engineering school.	just right	too long
08-06	Yes its cool	I would be a chemical engineer	just right	just right
08-07	It seems really fun.	I would go to engineering school and become either a design or civil engineer.	too short	just right
08-08	Yes, a huge feeling!!! I learned so much	I might become a mechanical, design, or biomedical engineer	too short	just right
08-09	Yes	I would be a design engineer	too short	too long

08-10	Yes! Definitely.	After this, I would definitely consider it.	too short	just right
08-11	Yes	I would be a civil engineer	too short	just right
08-12	Yes	I would be a civil or design. Yes I would	too short	just right
08-13	yes	Design. Yes.	just right	just right
08-14	Yes	Maybe, and if I did I will go to chemical or designing	too short	too short

Questionnaire Number	Overall Program	Comments	Days desired
08-01		it was flippin tight!! Go sho!! Wikid classes!!	3
08-02	5	Mon-Fri	10
08-03	5	I really liked this program it was great!	10
08-04	5	Totally awesome want to come again	5
08-05	5	Awesome!	3
08-06	4	It was tight!	5
08-07	5	Awesome!	
08-08	5	The counselors were amazing and helped a lot and made me more enthusiastic about engineering.	
08-09	5	No it was perfect	
08-10	5	So much fun!	

08-11	5	It was terrific!	30
08-12	5	It was awesome!!!	14
08-13		great program!	3
08-14	5	I really like this and maybe it will be better if will would have stayed in some dorms	5

Appendix 2- Student Facilitator Responses

Number	Gender	Yr Involved	Yr in Degree	Activities Involved with	Primary Degree
1	F	2009	HS Volunteer	Classroom lecture & activities, field trip chaperone, design project facilitation	High school senior
2	F	2008	4th yr PhD	Research lab tours or demo, classroom lecture & activities	Chemical & Biological Engineering
3	F	2008	6th yr PhD	Classroom lecture & activities	Engineering Sciences & Applied Mathematics
4	M	2009	2nd yr MS	Research lab tours or demo	Mechanical Engineering
5	F	2009	Freshman	Research lab tours or demo, classroom lecture & activities, Program design, Field trip chaperone	Industrial Engineering
6	F	2009	1st yr MS	Research lab tours or demo, Classroom lecture & activities	MS for Engineering Design and Innovation

7	F	2009	3rd yr PhD	Research lab tours or demo, Classroom lecture & activities	Mechanical Engineering
8	F	2008	Sophomore & Junior	Program design, field trip chaperone, & design project facilitation or judging	Civil Engineering
9	F	2008	Senior	Research laboratory tours or demo, Classroom lecture & activities, Staff recruitment & selection, Program design, Field trip chaperone, Design project facilitation or judging, Program fund raising, OTHER: 2007-2008 Summer Programming Chair, Coordinated program for its first year.	Biomedical Engineering (MS)
10	F	2008	4th yr PhD	Classroom lecture & activities	Electrical Engineering
11	F	2008 & 2009	2nd yr PhD & 3rd yr PhD	Research laboratory tours or demo, Classroom lecture & activities, Field trip chaperone	Materials Science & engineering
12	F	2009	Freshman	Research laboratory tours or demo, Classroom lecture & activities, Field trip chaperone	Chemical & Biological Engineering
13	F	2009	2nd yr MS	Classroom lecture & activities	Plant Biology & Conservation

14	F	2008 & 2009	Sophomore & Junior	Classroom lecture & activities, Participant recruitment & selection, Staff recruitment & selection, Program design, Field trip chaperone, Design project facilitation or judging	Mechanical Engineering
15	F	2008 & 2009	Junior & Senior	Research laboratory tours or demonstrations, Classroom lecture & activities, Field trip chaperone, Design project facilitation or judging	Physics & Astronomy
16	F	2009	Sophomore	Program design & Field trip chaperone	Biomedical Engineering

Number	Secondary Degree	I enjoy working with middle school children.	I want to increase participation of women and girls in engineering.	I want to gain leadership experience.
1	N/A	5	5	5
2	Environmental Engineering	5	4	3
3	N/A	3	5	3
4	N/A	5	5	3
5	N/A	3	5	5
6	N/A	5	5	4

7	N/A	5	5	5
8	Economics	5	5	5
9	Materials Science & Engineering (BS)	4	5	5
10	N/A	5	5	4
11	N/A	5	5	4
12	N/A	5	5	4
13	N/A	3	4	3
14	Design Certificate	4	5	5
15	N/A	4	5	4
16	Global Health	2	5	5

Number	I want to gain teaching experience.	I want to earn money.	I want to express my creativity by designing learning activities.	My professor encouraged me to participate.
1	3	1	3	3
2	5	3	3	2
3	3	1	4	3
4	5	1	3	3
5	3	3	3	1
6	4	4	5	1

7	5	1	3	1
8	3	1	3	1
9	3	1	2	N/A
10	4	1	3	3
11	5	3	3	2
12	4	1	4	1
13	3	1	2	3
14	4	1	5	1
15	4	1	2	1
16	3	2	3	2

Number	I want to explore career opportunities related to education and outreach.	I think it is important for jr. high girls to see women working in engineering.	Motivation J (Other)
1	3	5	
2	5	5	
3	3	5	
4	5	5	
5	3	5	
6	4	5	
7	3	5	
8	1	5	
9	3	5	5 - To build upon the success of SWE's Career day for girls
10	2	5	
11	5	5	
12	3	5	N/A

13	3	5	4 - To show how else an engineering background can be applied to the sciences
14	5	5	
15	4	5	
16	4	5	

Number	Motivation K (Other)	Top 3 reasons - A
1		Learn more about real engineering
2		teaching experience
3		I wanted to encourage girls to pursue education in engineering
4		Contributing to U outreach
5		Be a role model for girls interested in engineering

6		I love teaching younger girls about engineering & encourageing them to pursue their interests
7		Giving young Americans motivation to learn and enjoy science & engineering.
8		To establish STEP as a sustainable program in SWE
9	5 - To inspire young women to consider engineering as a career.	I strongly believed the program addressed an unexplored opportunity for outreach at McCormick.
10		Motivate young women at an early age to pursue engineering as a career option
11		I wanted to increase participation of women & girls in engineering.
12		Make a difference in changing the attitude towards women in engineering
13		To help out women and girls in science programs, I love participating in these

14		Encourage girls to go into engineering
15		I believe it is important for girls to be exposed to futures involving science & engineering
16		I think it is important to be a role model & give girls information about engineering early on so that they can be motivated to look at the vast amounts of career opportunities in the engineering fields.

Number	Top 3 reasons - B	Top 3 reason C
1	Help younger girls to get excited about engineering	Gain some leadership experience.
2	explore career opportunities related to teach & outreach	important jr. high girls see women in engineering

3	I wanted to use my teaching skills to promote interest in scientific/engineering fields & to set a role model for young women	I thought it would be a fun exercise & a chance for interaction w/ other women in science & engineering -- and it was!
4	Contributing to equalizing gender spread in engineering	Gain teaching experience
5	Gain leadership experience	Learn new things about engineering for myself
6	I enjoy teaching & saw the program as a great opportunity to teach without an insane time commitment which would have been hard on my schedule	Programs like STEP are how I became interested & dedicated to science and so I want to encourage the growth & success of these types of programs in any way I can.
7	Encouraging young girls to pursue science & engineering related careers	Gaining leadership & teaching experience.
8	To introduce young women to the field of & opportunities within engineering	To be a camp counselor

9	N/A	N/A
10	Show young women that engineering is fun & exciting	Help to dispel the myth that engineering & science are just for men.
11	I wanted to explore career opportunities related to education & outreach	I wanted to gain teaching experience
12	enjoy the group learning/teaching experience	like to work as a role model
13	I was asked to help	I like working with girls who voluntarily sign up to participate in programs, as opposed to a school function where girls who are not interested also sign up
14	I wanted to be more involved with SWE	I enjoy working with kids

15	Outreach is my favorite part of being a college leader in the sciences	I like the topics covered in the program and I think they are important for young girls to learn/try.
16	This is a safe & great way to incorporate education along with meeting wonderful people and learning along the way. STEP is a safe place for girls to come together & enjoy the Sciences & Math without have[ing] to feel pressured by boys.	Overall, this program allows young woman [women] to just come together and share their stories and successes and learn from one another.

Number	My involvement with STEP impacted my career goals.	My involvement with STEP impacted my perception of engineers.
1	5 - I had thought about being an engineer for a while, but did not know exactly what kind of job that would correlate to. It was great to meet with real students who were learning along with me and were excellent role models to guide me and help me better understand.	3 - I have mentors from Northrop Grumman who are engineers, so I have known for a long time that being an engineer is a very respectable profession.
2	4 - More important than I realized to show role models. Might serve to keep me in engineering, definitely impact outreach activities I want to do as part of my career. Would consider a position in outreach	5 - I was surprised to hear girl participants say that engineers weren't necessarily nerdy, and then realized that I thought it was true myself. But some engineers ARE girly and many are not socially awkward. And this is okay.
3	3 - I have always considered a career in scientific education to be of strong interest.	3

4	4 - Improved teaching & explanation skills	3
5	2 - My involvement with STEP didn't change my career goals at all, but it reinforced my belief that I made the right choice by majoring in engineering.	4 - I already knew that engineers are a very diverse group of people. I think the more important thing was to communicate this idea to the girls.
6	3 - I wouldn't say it changed my goals in anyway, but my participation in STEP was definitely reflective of my previous commitment to encouraging science education for young women. Since I started teaching in my freshman year of undergrad @ Upenn I fell in love with programs just like STEP and will continue to foster these programs in my community for many years to come.	3 - Again I would say that STEP just reinforced my belief that engineering is not a boys club and if you are inquisitive & motivated anyone can be an engineering
7	5 - During graduate school, I was not able to serve as a teaching assistant, so part of the reason I decided to get involved with STEP was to gain some teaching experience. I learned that I truly enjoy teaching, and would very much like to continue with educational & outreach activities in my future career.	3 -- Many of the projects that the girls worked on were highly interdisciplinary. Working with them and explaining to the girls what engineers do reinforced my view that today's engineers need to be prepared to work in a variety of fields.
8	3 - It was interesting to hear the girls' reflections on what they thought they could do as an engineer -- very few mentioned construction. As I work towards starting my career, I hope to find outlets to show others the opportunities of construction from an engineering perspective.	3 - More importantly, I think the STEP program impacted the participant's perception of engineers!
9	4 - While the program didn't necessarily increase my desire to teach, I found that it was definitely a talking point during my job interviews. It was easy to convey passion for my involvement in STEP.	1 - I don't feel my perceptions changed.

10	4 - I have for a long time wanted to teach as my career, so participating in the STEP program only furthered my interest in teaching.	3 - It didn't really impact my perception of engineers because I have always had a very high regard for engineers, and the other engineers I worked with just helped to reinforce that feeling.
11	4 - My involvement with STEP reinforced the idea that I would like to be in a career where I can help spread positive views of science to the general community, and specifically to women, to encourage a broader interest and participation	3 - I already had a high regard for engineers
12	3 - One of my goals as a STEP counselor was to help girls to learn more about engineering and what they can do with an engineering degree	4 - The program presented many possibilities of professional engineering work.
13	2 - I am not in an engineering program, and my goals have not changed after participating	1 - I come from a family of engineers and I am the black sheep
14	5 - Being involved in STEP has changed my career goals in a drastic way. I now am very interested in a career involving engineering education, especially the K-12 set. Through STEP, I've learned about the lack of engineering based projects in America's school system and the lack of knowledge about what an engineer does. I strongly want to change the engineering stereotypes and the way American children think about engineers.	4 - Yes. Through my two years working with STEP, I've learned a lot more about all the different types of engineering. I've also learned how the different disciplines of engineering connect in so many interesting ways. I now think engineers are the 'can do anything' people, and share that with others when I do outreach.
15	4 - I feel more open to a career in teaching than I did before participating in the program because I enjoy mentoring young people to explore career opportunities that they would have otherwise overlooked.	4 - As a physics student rather than an engineering student I tend to forget how integrated all aspects of engineering are in society and STEP is a wonderful reminder of how important the future of engineering is to our world.

16	4	5
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Number	My involvement with STEP impacted my attitudes toward the participation of women in engineering.	My involvement with STEP impacted my research interests.
1	3 - I have always felt that women should be involved in engineering and should not be afraid to express an interest in math and science.	3 - I have always preferred working with actual people.
2	3	5 - I would like to pursue research projects and application of research concerning teaching techniques and skills relevant for advancing the participation of women in engineering & science
3	5 - STEP has furthered my strong stance on encouraging women to participate in engineering & engineering outreach	3
4	3	4 - More commitment to explaining highly technical fields to non-specialists.
5	3 - Again, I already knew that women are highly involved in engineering, but the program did reinforce this idea because I got to interact with so many great role models, from Pam the program coordinator to the older grad students.	1 - I'm an IE, which isn't a really research orientated discipline anyway, at least at the undergrad level, so STEP didn't really have this kind of impact for me.

6	4 - I would definitely say that seeing all the young women who both taught & participated in STEP was really inspirational. It is nice to see that U was able to reach out to that many young girls who were genuinely interested in science.	3 - I was already pretty decided in terms of what I wanted to research but STEP gave me a venue to share it with other young girls and hopefully spark some of their interests in prosthetics & orthotics
7	1 - I have a strong believe that women & men are equally competent in engineering and other technical fields. While my involvement with STEP did not alter this belief, it did highlight the fact that outreach programs geared towards girls are needed to encourage more women to pursue engineering careers.	1 - The STEP theme this year of sustainability was very timely. While my involvement with STEP did not impact my research interests, they do lie along similar lines since I am interested in reducing energy utilization and exploring new ways of generating energy.
8	5 - The STEP program strengthened my commitment to SWE & interest in supporting other women in engineering.	1
9	1 - I do not feel my perceptions changed.	N/A
10	4 - I have always felt very strongly about trying to increase the participation of women in engineering, and I also believe that it is important to begin this at an early age.	3 - I can't really say that my research interests were impacted, but in preparing my lecture I certainly gained an appreciation for how far I'd come since I started graduate school.

11	4 - It is always encouraging to see so many strong-willed, creative-minded female engineers, such as that are involved in a program like this.	3 - My research interests didn't really change because of this.
12	4 - Many girls from the middle schools still have the impresesion that engineering is a "male" field, so this presetned a good opprotunity to show them engineering is for both men and women.	3 - It impacted a little bit of my research interests.
13	1 - My mom and sister are both IOE's	2 - It was interesting to see what the girls found exciting about green roofs, and how different their prespective was from the leading technology
14	5 - I have learned a lot about the lack of women in engineering and why that is. I feel even more strongly now that we need more women in engineering, and want to work to increase the number through outreach programs. I also would like to do more research on how women's careers in engineering differ from men's.	5 - I am not invovled in any research at the moment, but STEP sparked my interest to research engineering education and more specifically women in engineering. I've talked to my professor who researches engineering education, and am very interested in learning more about it.

15	4 - As a high school student, I was never introduced to the idea of engineering as a career, but the more I learn about it, the more it seems like a female integrated field when compared to physics. It is inspiring to see strong women succeeding in a wide variety of engineering fields.	4 - The lab tours & projects the participants are exposed to also impact me as a counselor. Particularly, I am more open to the idea of bulding circuitry or other implements to perform research then before.
16	5	4

Number	My involvement with STEP gave me valuable experience that is not available within the classroom and/or research environment for my degree program.	Additional Comments
1	5 - They do not offer such wonderful programs at my high school this is an excellent continuation of my work at Northrop Grumman	N/A
2	5 - I had the chance to develop teaching modules for the middle school level	N/A
3	5 - It is very difficutl for women (adults) in engineering to find chances to encourage & education young girls about the possibilities & opportunities in engineering - this provided a valuable experience in that (and other) regards.	N/A
4	5	N/A

5	5 - Definitely! After sitting in the classroom all year long and being the student, it was really cool to have the tables turned and actually be the instructor.	STEP is an awesome program! I wish I would have known about it when I was in 8th or 9th grade. I'd love to come back and be a counselor again this summer.
6	5 - STEP is definitely a great avenue to be a teacher and contributed to the growth of women in the fiendls of science & engineering	STEP is really a great program and I hope it continues to grow for many years to come.
7	5 - One of the really great things I learned during my involvement with STEP was how to help foster motivation. Getting a group of students excited about the lesson material was not something I had encountered during my research or within my degree program.	Thank you very much for the opportunity to work with the STEP program! Programs such as this do great work towards fostering balanced gender representation in engineering.
8	5 - Absolutely! The STEP program has been one of the most rewarding & applicable experiences of my undergraduate career.	N/A
9	5 - Absolutely! I gained tremendous leadership and teaching opportunities from STEP. These were useful for me throughout the rest of my career at University, and I have no doubt they'll be useful when I begin my job in management consulting.	Let me know if there's anything else I can do to help!

10	4 - Participating in the program helped to remind me why I love to teach which is very different from the regular roles of graduate student teaching assistants.	STEP is an excellent program which I hope will continue for many years. I was honored to be a part of this program, which is a truly inspirational experience to many young women.
11	5 - It has been a wonderful to have the opportunity to teach, outside of TA-ing, and to be able to be personally involved in encouraging girls to become women in engineering.	Participating in this program has been a great joy for me, and I feel like this has strengthened my passion to be involved in public science and engineering education.
12	4 - The program presented a lot of interaction between the girls and the counselors, and it was not just the simple teaching and learning.	N/A
13	3 - I volunteer for Sisters4Science, so I work with middle school girls often, although typically in underserved & poor areas of the city.	This would be a lot easier to fill out in a different format.
14	5 - The chance to do outreach and mentor prospective engineers is not available anywhere in my degree program. Also, learning how to teach and create lesson plans, or how to organize and run a very large event were very valuable skills I've learned.	N/A

15	5 - STEP helped me to realize how much I enjoy building rather than theorizing. Building is not available in much of the physics department unless students are involved in a few particular research labs.	STEP is an amazing program and I am so happy to have been involved with it for two years. Of all the points of interest on my resume, STEP is the activity that I like to talk about the most.
16	5	STEP is a great program! I did not expect to learn so much as a STEP leader, but this program really gave me a lot of information about engineering and the vast opportunities it holds. It also allowed me to meet amazing girls that are studying engineering as well.