Assessment Of An Engineering Technology Outreach Program For 4th-7th Grade Girls

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ABSTRACT

This paper describes a workshop led by female Engineering Technology students, with support from female faculty, to provide an introduction to Engineering Technology to 4th – 7th grade girls through a series of interactive laboratory experiments. This outreach program was developed to improve attitudes towards science and engineering in middle school-aged girls by making science tangible and fun. The workshop takes place on a college campus and makes use of four different Engineering Technology laboratories. Each lab activity includes a hands-on experiment, beginning with an overview of the engineering technology discipline and a brief description of the theories related to the experiment. The day culminates with a panel session between the participants and the college students. An ancillary outcome of the program is that it serves as a community building event for female Engineering Technology college students. Connections are developed between the students and between students and faculty in the college. The college students gain the satisfaction of influencing the attitudes of participants and develop critical communication skills. An attitude survey given to participants before and after the workshop shows that participation in these workshops results in a more positive attitude towards science and technology. College student volunteers were also surveyed after the workshop to determine the impact of their participation. A full workshop description is given in this paper as well as analysis of the assessment results for the participants and the college students.

Keywords: pre-college outreach; student retention; engineering education

INTRODUCTION

Need For Women In Engineering

Unless the U.S. can attract more students to science and technical fields, there will be a shortage of qualified workers for our increasingly technology-oriented society. The next generation of scientists and engineers will have to be innovative to quickly adapt to emerging technologies. Participation in the development of innovative technologies requires diverse perspectives (Brophy, Klein, Portsmore, & Rogers, 2008). Increasing the number of female engineering and engineering technology graduates is one way to increase the number of qualified workers for the future. In 2007, women accounted for 46 percent of the workforce, yet only represented 20 percent of “engineering and related technologists or technicians” and 11 percent of engineers. The percentage of women in engineering increased from 5 percent in 1983 to 11 percent in 2007. The number of women in “engineering and related technologist or technician” jobs only increased from 18.4 to 20.3 percent ("Current Population Survey, 1994–2007," 2007a; Current Population Survey, 1994–2007," 2007b). The percent of Bachelor’s Degrees in Engineering awarded to women increased from 15 percent to 20 percent during the 1990s, but since then there has been no increase, and even a slight decline as shown in Figure 1. The effort described in this paper responds to the need for a more diverse work force by addressing both retention of Engineering Technology college students and encouraging more young women to consider Engineering Technology as a career.

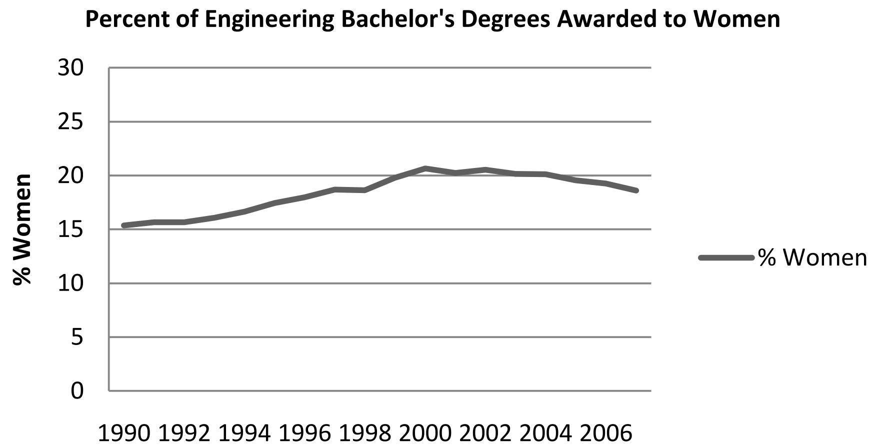

Figure 1. Percent Of Bachelor's Degrees Awarded To Women: 1990-2007
(National Science Foundation; NSF-Women, Minorities and Persons with Disabilities in Science & Engineering," 2006).

Despite efforts to attract and retain more women to engineering careers, they continue to be underrepresented in most traditional engineering disciplines. Studies have shown that a major factor in why females leave engineering programs is that the content does not align with their personal values and goals (Vanasupa, Chen, & Breitenbach, 2008). Female students are drawn to careers they see as "helping." They see engineering as impersonal and individual. Research suggests women tend to enroll in programs where they see they can make a contribution to society such as teaching and nursing (Worell, 2002). Even engineering disciplines that have a more obvious connection with improving the human condition, such as Industrial and Biomedical Engineering, have much higher enrollments of women than the traditional engineering disciplines like Electrical and Mechanical. Stereotypes must be corrected to show that disciplines such as Electrical and Mechanical Engineering Technology can be rewarding. These disciplines involve positive impacts on the world and working in teams to solve complex and rewarding technical projects (Ribu, 2006).

In this article the terms "Engineering" and "Engineering Technology" are used. Therefore, it is necessary for these terms and their use to be clarified. The Engineering Technology and Engineering programs discussed are both four year Bachelor of Science programs. As defined by the Accreditation Board of Engineering and Technology (ABET) and the American Society for Engineering Education's (ASEE) Engineering Technology Council both engineering and engineering technology programs encompass the same foundations of knowledge with differing areas of emphasis and depth. (*ABET | Accrediting College Programs in Applied Science, Computing, Engineering and Technology*; Holling, 2003; *Home: American Society for Engineering Education*; Kelnhofer, Strangeway, Chandler, & Petersen, 2010) The engineering program's traditional emphasis are program outcomes that focus on engineering theory, while the engineering technology program's traditional emphasis are program outcomes that focus on practical applications of engineering.(Holling, 2003) Graduates of both programs receive the job titles of "engineer" upon employment. (Richardson, Stratton, & Valentine, 2004; Stratton, 1998) In today's highly dynamic technical environment which set of skills is more valuable to industry and the larger environment? Both skill sets are necessary for the benefit of industry and the overall society. (Holling, 2003) Therefore, this paper reviews a program that attempts to attract females to engineering and engineering technology programs. Engineering /engineering technology programs are very similar programs that do not compete but complement each other. The engineering/engineering technology programs provide valuable and specialized skills in using the mathematical and physical sciences to address the challenges facing industry and society. For that reason, the term engineer or engineering is used to represent graduates of both of these programs and the work they accomplish upon graduation. The term engineering technology will be used when referring to that specific program.

While the number of female graduates of Engineering Science programs in the U.S. is close to 20 percent, women graduates of Engineering Technology programs remains stable at 11.7 percent of the workforce

(*TechTrends*). At the Rochester Institute of Technology (RIT), the number of women in our Engineering Technology programs is below the national average as shown in Figure 2.

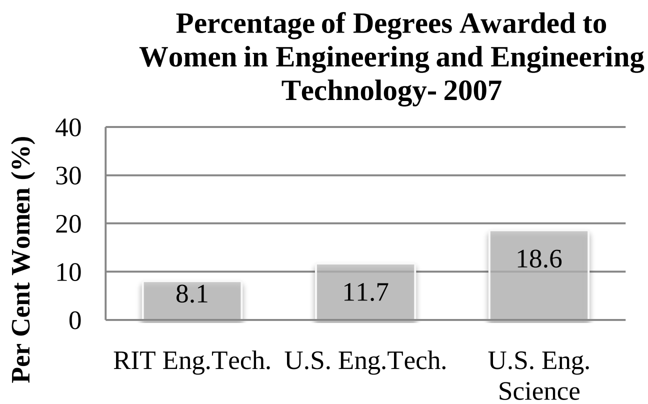

Figure 2: Percentage Of Women In Engineering Technology Programs At RIT Compared To U.S. Engineering Technology Programs and U.S. Engineering Science Programs

While RIT has made a successful effort to attract more female students, the number of female students in the Engineering Technology programs languishes at just below 10 percent (see Figure 3). Recent improvements have contributed to an increase in the percentage of women in ET from 7.7 in 2004 to 9.8 percent in 2009.

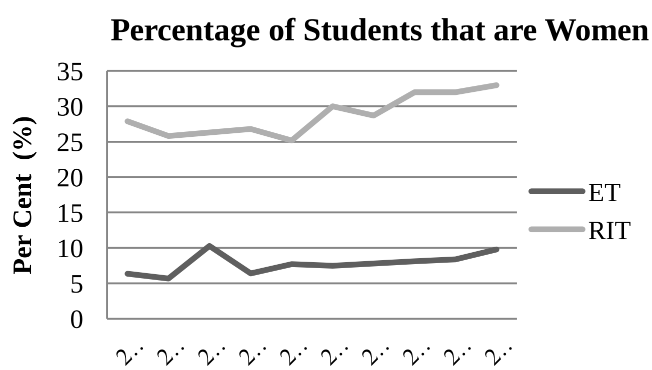

Figure 3: Percent of Female ET Students Compared with the average of Female RIT Students

Outreach To Girls

Research has shown that middle school is a critical time to engage students, especially girls, in science and engineering outreach programs (Hill, et al; 2010).

If girls lose interest in math and science in middle school, when social pressures and gender difference become more pronounced, they typically won't find their way back to the subjects (Cromer, 2005).

Middle school is a critical transition period. It is where decisions are made that will open or close career options. Math and science are the keys to careers in engineering and technology. If students decide not to pursue these subjects in high school, they are essentially closing the doors to certain professions. Thus our main challenge is attracting middle school students to science and engineering (Richards, Hallock, & Schnittka, 2007).

A decrease in interest in science and engineering at this critical age may indicate that there is a problem in the way young girls are exposed to these fields. Best practices for outreach programs for young girls include hands-on interactive activities. The National Center for Women in Information Technology-Promising Practices states that the essential ingredients for a successful outreach program for girls are: ensure the girls are with their friends or can otherwise feel a sense of belonging in the group to which they are assigned, keep talk to a minimum and action to a maximum, connect the things they are doing to things they already know or care about and employ experienced volunteers that can relate well to the girls and create a fun atmosphere (Barker, 2007-2008). Similarly, girls excel in learning situations that involve hands-on cooperative strategies with same-sex peer groups, which alleviate the feeling of isolation (Powers, Graham, Schwob, & Dewaters, 2003). Activities should be gender friendly and involve “learning by doing” ("Girls Go Tech Booklet," 2003; Koppel, Cano, & Heyman, 2002).

ENGINEERING TECHNOLOGY OUTREACH PROGRAM

Background

Women In Technology (WIT) is a group that was formed at RIT by female faculty in four engineering technology departments: Mechanical and Manufacturing Engineering Technology, Electrical, Computer and Telecommunications Engineering Technology, Civil Engineering Technology and Packaging Science. The group was formed in response to input from female students in Engineering Technology indicating they did not feel an association with any group on campus. In the classroom, they were outnumbered by their male classmates while other campus groups for women engineers excluded them because they were in Engineering Technology and not Engineering Science. It has been shown that female engineering students are more likely to stay in engineering when they feel part of a larger community of engineering (Goodman Research Group, 2002). WIT programming was designed to provide social and academic support to female students in these engineering technology majors, thus increasing retention and graduation rates. Once the foundation was put in place, students were polled as to what kind of activities they would like WIT to provide. The results of the poll indicated that 72 percent of the students active in WIT (approximately 42 percent of the female engineering technology students) said that they would like to be involved in an outreach program that involved Girl Scouts. From that response the Girl Scout outreach program, named “Girl Scouts in Technology” was initiated.

Student interest was one reason the outreach program was developed. The potential for an impact on student retention was another reason the workshop was developed. Research has indicated that students who feel they are part of a community are more likely to persist in their program of study (Hill, et al, 2010). Social support is critical to persistence in STEM disciplines. Persistence in engineering programs is related to support received from other students, faculty advisors, and mentors. Women are often less confident in their ability to succeed in careers in the STEM fields. The self-confidence gained through a support network is a critical factor in degree completion (Goodman, 2002; Chesler & Chesler, 2002).

Planning for Girl Scouts in Technology was completed by the female students to give them a sense of ownership for the program. Faculty and staff’s only involvement is in administrative details. It was found that many of the students involved were former and life-long Girl Scouts who had better ideas than the faculty members on how to reach girls in the middle school age group. It was decided that each of the four engineering technology departments represented would develop a hands-on experiment to be conducted in one of their laboratories. The program was first offered in February of 2008 to a troop of nine girls and has been offered seven times since then. Each time the workshop is offered, the students involved update and change the experiments to keep it interesting for themselves and to reflect the interest levels demonstrated by the Girl Scouts to the various activities. Modifying and coming up with new experiments is part of the attraction to this program for the female students. As one student expressed, “It has allowed me to creatively explore my own major to come up with different activities for the Girl Scouts.” Each of the four engineering technology departments has a core group of students who plan and organize their experiment with other volunteers from the department helping with facilitation of the event.

Funding for the Girl Scouts in Technology Program was made available through a grant from the Rochester Area Community Foundation. The grant money covered the cost of supplies, website development, faculty stipend and pay for student volunteers.

Program Details

Giving consideration to the essential ingredients for a successful outreach program for girls mentioned above, the Girl Scouts in Technology program was carefully developed.

- Ensure that the girls were with their friends or could otherwise feel a sense of belonging in the group to which they were assigned. Knowing that this is an age when girls are very concerned about where they fit in with the group, we did not want this concern to distract them from fully participating in the day's events. The solution was to promote the program as a troop activity so that the girls could participate with their friends with whom they were already comfortable. The girls in a troop were used to working together to achieve other goals so there were no barriers to them focusing their attention on the experiments, many of which involve partners.
- Keep talk to a minimum and action to a maximum. While it was felt that some amount of theory needed to be presented, the majority of the time in each lab was spent with the girls performing hands-on experiments. Instead of a long presentation given before the experiment, the explanation of theory was interspersed in the activity in an engaging and interactive manner. The experiments were designed so that the girls perform as much of the experiment as possible, including the use of tools and safety equipment within the engineering technology labs. Allowing the girls to complete their own experiments from start to finish had a two-fold advantage. First, they learned proper use of some of the tools and safety precautions, such as the use of rubber gloves when handling chemicals and safety glasses when working with concrete. Secondly they felt a greater sense of accomplishment that they did it all themselves and nothing was "pre-done" for them.
- Connect the things they were doing to things they already knew or cared about. When working with girls from diverse social and economic backgrounds, this proved to be a challenging task. Adding to the challenge was the differences in exposure to and interest in science that each girl arrived with. Guidance was given to the female students developing the experiments to best represent the connection between engineering and objects in everyday life. Wherever possible, the supplies for the experiments were materials purchased in regular department and/or hardware stores to further show that science and engineering can be easily accessible.
- Employ experienced volunteers that could relate well to the girls and create a fun atmosphere. This ingredient was easily achieved by having the program run by female engineering technology students. This is one of the key aspects of the program. The volunteers' passion for their chosen engineering technology fields and their enthusiasm for sharing it with the Girl Scouts is contagious with the girls. Because many of the girls arrived with the preconceived notion that an engineer is a socially awkward individual in a white lab coat as stereotyped by the media, spending the day with female college students whom they perceive as "cool" often changed their perception of who can be an engineer. When one Girl Scout was asked why she felt it was better to have students rather than teachers lead the experiments, she replied, "The students are so enthusiastic about the experiments it's hard not to have fun doing them. Adults always make experiments seem hard, but the students make them easy."

In order to provide each Girl Scout with the greatest amount of individual attention, registration was limited to four troops at a time, with each troop in a different lab during each one-hour time slot. The volunteer response to this program was so great that the ratio of volunteers to girls was typically one to three. A low volunteer to participant ratio is ensures engagement between the participants and the student volunteers. If the girls have to wait for help and become frustrated, they will form negative feelings about the experiment. The student volunteers are able to respond to questions quickly. Some girls may feel uncomfortable asking questions in front of the entire group but feel comfortable in a small group setting.

In the Civil Engineering Technology experiment; the girls learned about concrete, made their own batch of concrete, and smashed previously-made concrete cylinders. The concrete was made utilizing precision measuring instruments so the participants made use of the same tools employed by engineers and technologists. The purpose of the smashing portion of the experiment was for the girls to correlate cure time and core material with strength. For the girls, wearing a hardhat and swinging a sledge hammer fully immersed them in the experiment.

Bridge construction was also explored in the Civil Engineering Technology laboratory. Using uncooked spaghetti and various sized marshmallows, the girls were challenged to construct a bridge that would support as many toy cars as possible. The student volunteers offered tips along the way, but ultimately allowed the girls to complete the bridges on their own. After the bridges were tested under load, the volunteers discussed the pros and cons of the girls' designs and used the materials provided to demonstrate various construction techniques.

Since most girls in this age group did not know what an electrical engineer does, the session in the Electrical and Computer Engineering Technology lab started with an overview of what Electrical and Computer Engineers do. The experiment performed in this lab involved building a motor from a battery, a magnet, and a coil of wire. Initially, when the girls looked at the materials in front of them they could not make a connection between them and a motor. The great "ah-ha" moment and thus the connection came when their coil spun on its own. The sense of accomplishment and excitement was seen in their reaction to the successful end product. An important aspect of this activity was that it demonstrated that an engineering experiment does not have to involve expensive parts and equipment and that science is all around us.

One of the most important things that the girls (and their leaders) learned in the packaging engineering experiment was that Packaging Science is a possible career field. The packaging laboratory had displays of antique and modern packages including packages from products the girls were familiar with. Design considerations, including cost, functionality and sustainability were discussed with the girls. Computer Aided Design software and an automated cutting table were used to demonstrate to the girls how a flat two-dimensional design is drawn, rendered in three dimensions and then cut out with a robotic arm. Each girl was given one of the cutouts and instructions on how to fold it into a 3-dimensional "package." The packages were picked to be seasonally relevant. For example, a haunted house for Halloween, a heart-shaped box for Valentine's Day and a basket for spring. To spark the participants' imaginations, stickers, decorations, and markers were provided for them to creatively embellish their package. Not only did the girls learn about packaging, they also discovered that science and creativity are not mutually exclusive.

The Mechanical and Manufacturing Engineering Technology session centered on plastics, to again to make the connection between science and objects in their everyday life. Theory regarding polymer chains and plastics was presented and then recycled take-out food containers were used to make plastic charms that shrunk when exposed to elevated temperatures. This experiment involved data collection and comparison. High precision calipers and a scale were used to measure and weigh the charms prior to and after shrinking. The second part to the plastics experiment was the creation of a polymer from white glue, water, and Borax. This popular "slime" experiment was not only fun but was performed with common household ingredients, thus further enforcing that science is all around us.

The day concluded with all of the troops gathering with the volunteers in a panel discussion. The Girl Scouts and their leaders were encouraged to ask any questions that they may have had regarding engineering or college life. Typically, the student volunteers were asked to share their stories of how and when they decided to become an engineer, how they were influenced by teachers and involvement in activities such as Girl Scouts, and some of the challenges they have faced being a female in engineering. An example of the impact that this discussion had on the girls was observed in the following: as one of the Girl Scouts was walking out with her mother she excitedly told her, "Mom, two of the girls said that they decided to go into engineering because when they were my age they liked to take things apart – just like me."

Participant Assessment

To assess any attitude changes that the program may influence, the Girls Scouts were given a short survey at the start and at the end of the day. The following data was gathered over 259 program participants from 2007-2009. Table 1 lists the participant and volunteer participation history for the program through 2010. Each of the first five questions had four responses as shown in Table 2. The qualitative answers were transformed to a 1-4 quantitative scale to allow analysis of the data. The summary statistics for each question are shown in Table 2.

Table 1. Girls Technology Workshop Past Participation History

Academic Year	# of Girls Technology Workshop Offerings	Participant Count	Volunteer Count
2007	1	31	18
2008	3	109	36
2009	3	119	41
2010	1	44	20
Total	**8**	**303**	**115**

Table 2. Participant Before Program Responses

Key:	I think science is:	I think science is:	I know what an Engineer does	Most Engineers and Scientists are:	I'd like to become a Science or Engineer	Someone I know is an Engineer or Scientist
1	very hard	Boring	I don't know	Men	Definitely not	No
2	sometimes hard	Neither boring nor fun	I'm not sure	women	I don't know	Not sure
3	Neither hard nor easy	Sometimes fun	I think I know	I'm not sure	Maybe	Yes
4	Easy	Always fun	I definitely know	Anybody can be an engineer or scientist	Definitely yes	
1	1.31%	1.31%	9.15%	11.76%	12.42%	27.34%
2	47.06%	1.96%	15.03%	0.65%	27.45%	44.53%
3	39.87%	53.59%	59.48%	10.46%	50.98%	46.88%
4	11.76%	43.14%	16.34%	77.12%	9.15%	

As noted in Table 2 most participants perceived the difficulty of science as either "sometimes hard" or "neither hard nor easy." The mean participant rating was 2.62 with a slight negative skewness of 0.57. Most participants rated science as "sometimes fun" or "always fun" with a mean participant rating of 3.386. The participant knowledge before the program of what an engineer does was lower, with the most common rating of "I think I know." Most participants were open to considering engineering or scientific careers as seen by the common "maybe" and "I don't know" response in this career option, and the perception that these career options are available to both men and women. A positive correlation (Pearson's correlation coefficient of 0.40) was found between how the girls perceived science as being boring or fun and their interest in becoming a scientist or engineer. A smaller positive correlation (Pearson's correlation coefficient of 0.19) was found between how the girls felt about science being hard or easy and their interest in becoming a scientist or engineer. For those girls who reported knowing someone that was an engineer or scientist, no correlation was found (Pearson's correlation coefficient of 0.03) to an interest in becoming a scientist or engineer. A slight positive correlation (Pearson's correlation coefficient of 0.25) was found between those girls who knew a scientist/engineer and knowing what an engineer does, as would be expected due to increased exposure to a scientific professional. These findings differ from a first year study of engineering freshman conducted by Anderson-Rowland which indicated that students who had a family member or friend who was an engineer were more likely to have selected an engineering career earlier than without such a role model. The Anderson-Rowland report indicated, "One of the best ways to influence a student to study engineering as their major field is for them to have a family member or know a friend who is an engineer" (Anderson-Rowland, 1996). In fact, 44 % of the 89 female engineering graduates surveyed in one study indicated a male engineer role model in their family played a role in their decision to study engineering (Cordova-Wentling & Camacho, 2006). These differing findings between this study and the Anderson-Rowland, and Cordova-Wentling studies may be due to the significant differences in the ages of the survey participants. The Girl Scout participants (4th – 7th grade girls) in this study were significantly younger than the college freshman and college graduates in the previous studies. Therefore, the use of this workshop to influence the attitude of the participants may depend significantly on the ages of the participants.

Overall, from the before program data analysis the authors concluded that the girl participants did not have a very strong negative or very strong positive perception of science or their abilities to enjoy science, and were open to considering careers as scientists or engineers. This represents a group of participants that, with an effective program, could show improvements in their perception of science and an increase in wanting to become an engineer or scientist.

Upon completion of the program the survey was again administered to assess the change in perception that had occurred due to the program. The summary results are shown in Table 3. As noted in Table 3, most participants perceived the difficulty of science as "neither hard nor easy" with a significant increase in respondents answering easy as compared to the pre-survey. Utilizing a T-test (alpha 5%; 95% confidence) for this respondent question we can conclude that the mean participant responses changed from pre-program to post program for this question. In other words, the program had a statistically significant effect on changing the girls' perception of science on the hard-to-easy scale. Figure 4 shows graphically the change in responses. Similarly, for all of the other questions T-tests showed statistically significant changes (alpha 5%; 95% confidence) for the girls' responses in the post survey as compared to the pre-survey. A similar positive correlation (Pearson's correlation coefficient of 0.41) was found in examining the post survey between the girls' opinion of science (boring to always fun) and their attraction to becoming a scientist or engineer. In other words, when the girls found science engaging, interesting, and enjoyable they were more interested in a career as a scientist or engineer. The previous literature supports the findings that the choice of a career was greatly attributable to the participant's perceived ability and interests (Lent et al., 2002). As noted by Cordova-Wentling, a student's decision to pursue engineering was most strongly influenced by their enjoyment and success in STEM courses in high school (Cordova-Wentling & Camacho, 2006). Graphs displaying the change in attitudes are displayed in Figures 4, 5, and 6.

Table 3. Participant After Program Responses

Key:	I think science is:	I think science is:	I know what an Engineer does	Most Engineers and Scientists are:	I'd like to become a Science or Engineer
1	very hard	Boring	I don't know	Men	Definitely not
2	sometimes hard	Neither boring nor fun	I'm not sure	women	I don't know
3	Neither hard nor easy	Sometimes fun	I think I know	I'm not sure	Maybe
4	Easy	Always fun	I definitely know	Anybody can be an engineer or scientist	Definitely yes

1	0.00%	0.63%	0.63%	5.63%	5.63%
2	31.88%	3.13%	5.63%	0.00%	17.50%
3	44.38%	32.50%	39.38%	2.50%	62.50%
4	23.75%	63.75%	54.38%	91.88%	14.38%

Change from Pre-Post

1	-1.31	-0.68	-8.53	-6.14	-6.79
2	-15.18	1.16	-9.41	-0.65	-9.95
3	4.51	-21.09	-20.10	-7.96	11.52
4	11.99	20.61	38.04	14.75	5.22

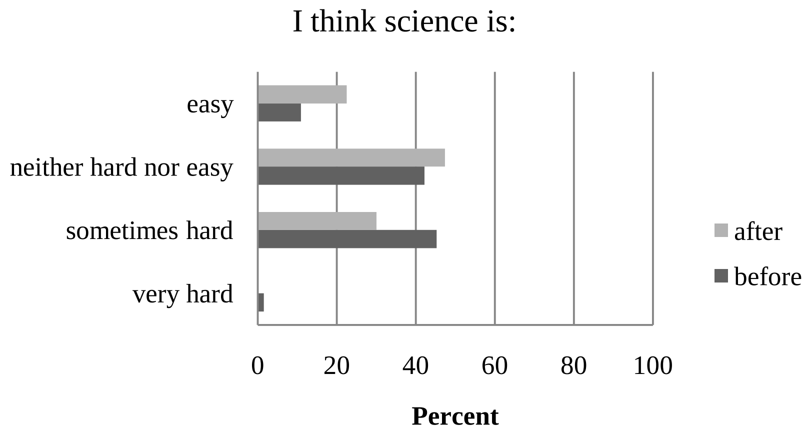

Figure 4. Before And After Responses For Perception Of Difficulty Of Science.

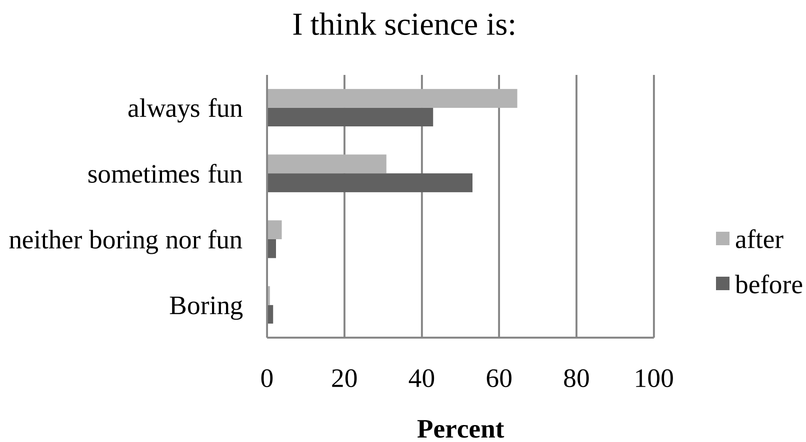

Figure 5. Before And After Responses For Perception Of Science As Fun Or Boring.

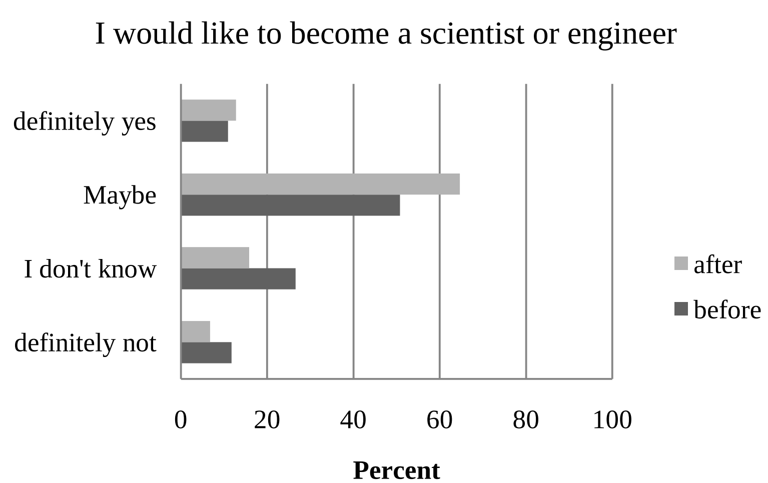

Figure 6. Before And After Responses For Interest In Becoming A Scientist Or Engineer.

A residuals plot of the linear regression between these variables shows decreasing variation in residuals for those that had a more positive view of science (always fun) and wanting to become a scientist or engineer. In other words, if the girls perceived science as being engaging, enjoyable, or fun they were more likely to want to consider becoming a scientist or engineer. Those girls that felt science was "less fun" had an increased variability on their willingness to consider a scientific or engineering career. This study also identified participants to pair pre and post workshop surveys to minimize the confounding of other noise factors in the difference test analysis. The paired difference test showed that statistically significant (alpha 5%; 95% confidence, paired T-test) differences existed in the girls' view of science being engaging, enjoyable, fun; the knowledge of what a scientist/engineer does as a career and the girls' willingness to consider a career as a scientist or engineer.

Overall, the post analysis found a statistically significant change in the girls' perception and interest in science/engineering as measured by the assessment and through the program of making science approachable and engaging. The increased positive perception in science correlated to an increased willingness to consider a career in a scientific or engineering field as compared to the girls willingness before the program. Therefore, it is important to educate young women about science/engineering careers and to demonstrate that technical careers can be engaging, fulfilling careers and regularly reinforcing these concepts through outreach programs.

Student Volunteer Assessment

While the Girl Scouts in Technology outreach program was originally conceived and conducted as an outreach program aimed at making science fun for 4^{th} to 7^{th} grade girls, it was found that the student volunteers who organize and run the event benefit equally from their participation. To quantitatively analyze the positive effect that participation has on the female Engineering Technology students, a survey of all volunteers was administered. The survey began by asking the students what their goals were for participating in the events. From this information it can be ascertained what students were hoping to gain from a program that they took part in during their precious free time. The results of this survey can be seen in Figure 7.

These results are consistent with what has already been theorized about what attracts women to a career. A study by WGBH Educational Foundation for Extraordinary Women Engineers showed that females seek careers that are enjoyable, have a good working environment and where they feel they can make a difference (*Extraordinary Women Engineers*, 2005). Similarly, Turner, Bernt and Pecora found that an internal motivation for women towards choosing a career in technology is the desire to make a difference (Turner, et al 2002). The work of Eccles suggests that occupational choice is influenced by a person's value as well as their expectancy for success (Eccles, 1994, 2006). Doing work that benefits society is valued more by women than it is by men thus women prefer work with a clear social purpose (Lubinski, 2006). As seen in Figure 7, eighty-seven percent of the respondents volunteered because they wanted to make a difference. These results also show that the female students are interested in meeting other females with whom they had something in common (department or engineering technology). This can certainly be expected of female students in a male-dominated environment. The high percentage of women with a goal of meeting other females along with the 87 percent who wanted to feel more a part of women in technology corresponds to the literature that reports that women look for careers that involve camaraderie and opportunities to help others (Konrad, 2000, Hill, et al, 2010).

Along with knowing why the students chose to participate, it was important to assess the outcomes of the program for the volunteers. The results are summarized in Table 4.

Table 4. Percent Response To Survey Questions

	Agree	Neutral	Disagree
I have made a connection with one or more females in my department	83%	17%	0%
I have made a connection with one or more females in another Engineering Technology Department	65%	26%	9%
I have made a connection with one or more female faculty members	67%	13%	0%
I have a better understanding of my major	48%	48%	4%
I plan to participate again	95%	5%	0%
Participating was a positive experience for me	96%	4%	0%

The response to the last two questions substantiates that the students felt that participation in this event was a worthwhile activity for them. It can be concluded that this program is meeting the goals of the students as seen in Figure 7. The students' excitement about the program is evident in the comments they provided. When asked to provide an (optional) comment on how participation has benefitted them the most, 96% of the respondents chose to provide feedback. Approximately one-half of the comments revolved around giving back to the community and influencing the Girl Scouts: "I just like volunteering and giving back - it makes me feel right at home,"

I feel like we've made a difference in how the Girl Scouts we've worked with view engineering," and "Participating in the WIT Girl Scout events is a chance to help young girls realize the possibilities they have if they decide to pursue a future in the technological field.

The other half of the comments were about the camaraderie that developed among the students, many of whom did not know each other previously: "This has given me a chance to meet girls in different years than my own, something that I probably would not have been able to do otherwise" and "It was nice to be in a relaxed setting with other females in my major. We bonded and made instant friendships. It helped me find friends in my major."

The comments provided, along with the responses to the first two questions, "Did you make a connection with one or more females in your department?" and "Did you make a connection with one or more females in another department?" highlight a very important benefit that this program provides to the student volunteers.

Retention of students in postsecondary education, especially females in STEM fields, is a goal of universities today. An important component to postsecondary retention is non-academic factors, such as social integration and connections to others. Studies have shown that college retention programs need to address and include both non-academic and academic models (Covington, 2000). The ever expanding research on best practices and programs to improve student retention indicates that an important non-academic model includes meaningful connections with people, places or programs on campus. This beneficial sense of connection has been categorized as involvement (Astin, 1993), engagement (Kuh, 2001) and integration (Tinto, 1987). Students who feel like a part of their college both in and out of the classroom have an increased likelihood of remaining in their degree program and graduating. This important connection can be developed both through learning-centered interaction and social contact with faculty, academic peers and staff, along with involvement in student organizations (Braxton & McClendon, 2002).

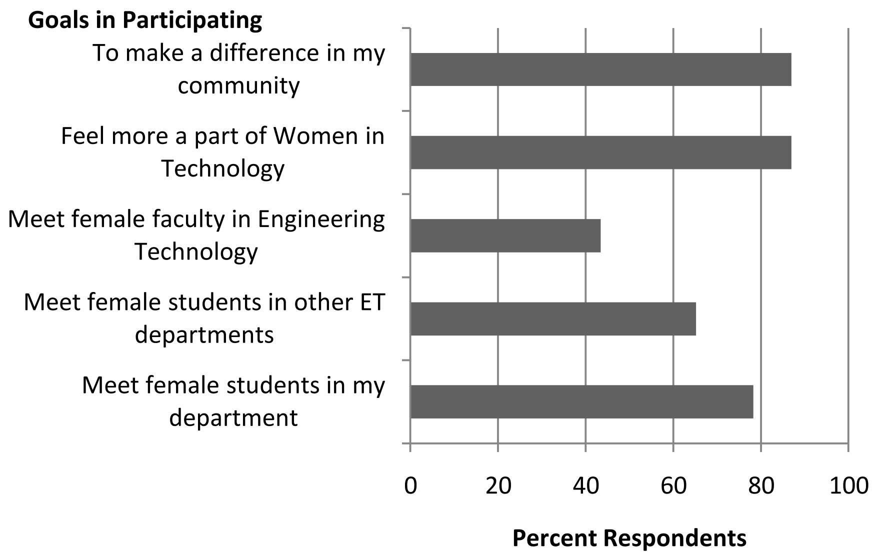

Figure 7. Percent Respondents For Goals Of Volunteering For Girl Scouts In Technology

While the data in Figure 7 shows that less than 50 percent of the students had a goal of meeting faculty in Engineering Technology, the results in Table 4 indicate that 67 percent of the students made a connection with a female faculty member. As mentioned previously, connection with a faculty member is a key dynamic in college retention. Tinto (1987) reported that student interaction with campus personnel can positively influence a student's chance for retention, while poor integration with the college community and isolation may lead to dropping out. Kuh, & Associates (Kuh, et al 2005) have identified meaningful interactions between students and their teachers as one of five effective educational practices. These interactions are vital to student success. One type of contact between students and faculty that they have identified as being essential to a high-quality learning experience is working with faculty members on activities other than coursework. This program provided an outlet for students and faculty to work together in a non-academic setting. Although the students were not necessarily looking to make a connection with a faculty member, participation in this program provided an opportunity for these important relationships to be formed. It has been shown that increasing the amount of contact a student has with a faculty member increases their chances of graduating (Pascarella & Terenzini, 2005).

Based on the research, the students' responses appear to predict an increase in retention for those females who continue to participate in this program. As this program has only been in existence for three years, this hypothesis cannot yet be proven. Retention data to date shows that the average attrition rate of females in engineering technology at RIT was 42% for the years 2000-2006 (before the introduction of this program). The average attrition rate for the years 2007-2009 fell to 27%. The increase in retention is encouraging and may be partially linked to participation in this program. However, during this time period there have been many activities and initiatives by WIT to increase community building and faculty interaction, so no single program can account wholly for the improvements seen.

CONCLUSIONS AND FUTURE WORK

The Girl Scouts in Technology Workshop, led by female students in Engineering Technology has proven to be a successful program for both recruitment and retention of women in engineering and technology. As an outreach program for 4^{th}-7^{th} grade girls, it serves to recruit more females to consider engineering as a field of study. Participants in the program have shown a statistically significant increase in interest in engineering careers. Both objective and subjective results indicate that this program can influence a young girl's attitude towards science and technology and to view science more positively. For the students who volunteer their time, this program may play a critical role in their persistence in college. The program builds a community of women in departments where they are an underrepresented group. Research has shown that these types of community bonding experiences lead to increased retention rates for women. Recruiting and retaining more women in engineering technology programs will increase the number of engineering technology graduates which lead to a more diverse engineering workforce.

To date, the workshop described has been offered exclusively to Girl Scout troops. The decision to work with troops was made to provide a group of participants that may or may not already have an interest in science and engineering. Additionally, previous studies have indicated that girls are more fully engaged when they attend activities with friends. In 2011, a workshop will be held for girls in 4^{th}-7th grade through an open enrollment. Assessment results will be analyzed to determine if girls who enroll through open enrollment are predisposed to be interested in science and engineering compared to the Girl Scout participants. Post assessment will provide insight as to whether an increased interest generated in science and engineering is affected by whether or not attendees participate with their friends.

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