

Undergraduate Women Students and Engineering Outreach

Pamela Wolting, Katrina Sanders, Gretchen Hein, Chris Anderson

Undergraduate Student, Department of Civil & Environmental Engineering/ Undergraduate Student, Department of Biomedical Engineering/ Department of Engineering Fundamentals/
Special Assistant to the President for Institutional Diversity, Michigan Technological University, Houghton, MI

Abstract

How do women engineering students get girls interested in engineering and create positive examples of women in engineering? Michigan Tech's Chapter of the Society of Women Engineers (SWE) has been working through on-campus events and the community to help girls in junior high and high school become interested in math, science, and engineering.

Each year, SWE members work with a local Girl Scout troop on an engineering related activity. They volunteer at the Michigan Tech Get WISE! Event. The goal of the Get WISE! (Women In Science and Engineering) program is to prompt girls to consider careers in science and engineering, along with Engineering Olympics, an engineering competition for high school students. Annually, the chapter selects girls throughout the region to be awarded with a Certificate of Merit where graduating high school seniors receive recognition for their academic performance and service to their community. For the past 17 years, SWE members have gone to local fifth grade classes to help students learn about the assembly process by building a Big Mac dinner (burger and fries). Through these events, the SWE members maintain contact with local pre-college students who not only learn about engineering, but also learn about the interesting things women are doing as college students and as engineering professionals. In addition to working with students, the SWE members are working on their second, knitted blanket, for the Warm Up America program. They annually paint pumpkins, and make and deliver Easter baskets and Halloween pumpkins to local senior citizen homes. This paper, where the first authors attend Michigan Tech and are SWE executive board members, will describe the various activities that the SWE members annually complete, along with their motivations with respect to the organization, career development, and community outreach.

Introduction

The Michigan Technological University (Michigan Tech) Chapter of the Society of Women Engineers (SWE) began in 1976. Over the years, active membership has grown to approximately 60 students with many more students attending activities and contributing to the organization. SWE was founded in 1950 as the first organization "dedicated to the career guidance, advancement, and recognition of women engineers". (Walter P. Reuther Library) As a national organization, SWE has strong interest in service, particularly in encouraging women and other groups to become interested in engineering as a career opportunity. The ASPIRE program, in particular, "strive to diversify the field by encouraging girls in grades K-12 to capture the spirit of innovation and open their eyes and minds to a rewarding multi-faceted profession." (SWE

ASPIRE) Within this website girls, and others, are encouraged to learn more about engineering. The site contains general information about engineering and activities that teachers and engineers can use to introduce the exciting aspects of engineering to children.

In the Michigan Tech section, college students learn about engineering opportunities and the wide range of engineering careers. Additionally, the SWE members are actively involved in university and community service. This paper will outline the wide range of service activities that the SWE members routinely do and the benefits, with respect to career and personal development, that the student members gain.

Why Service?

Many women and underrepresented groups in engineering choose this career because they want to help others or contribute to society. (Coyle, Jamieson, Oakes, 2006) This choice parallels the goal of the National Academy of Engineering (NAE) which is to change how engineering is presented to K-12 students such that children learn that engineering is not just for people who are “good at math and science”. (National Academy of Engineering, 2008)

Historically, women have served the community. In the past, much of this service has been through volunteering. When many women worked at home, they spent some of that time at their church, their children’s schools and other community organizations. This interest was passed on to their daughters who not only wanted to help through service, but also through their career choice. (Wilson, and Musick, 2003) Throughout history, women have organized fundraisers and community projects.

The SWE members have many outreach programs that encourage K-12 students to explore the opportunities in engineering, along with math and science. These programs allow the university students to interact with the community and show K-12 students what being an engineer is really about, while presenting the students with a wide variety of different people who chose to pursue engineering This interaction is very positive. The median annual income in Houghton and Keweenaw Counties (the region where Michigan Tech is located) is slightly above \$28,000. (US Census, 2007) This is much lower than the average annual income in the United States of approximately \$50,000 (See Table 1). Due to the low income, many children have limited opportunities to learn about careers other than what their parents do.

Table 1. Community Education and Income Levels for the Counties including and near Michigan Tech (US Census, 2007)

County	2000 Median Household Income	Population	Education Level	
			High School	Bachelor or Higher
Houghton	\$28,817	36,016	84.6%	23%
Keweenaw	\$28,140	2,301	83.7%	19.1%
US Average	\$50,046		80.4%	24.4%

Many of the children come from homes where either one or no parent has attended college or completed little or no secondary education. (US Census, 2007) The region exceeds the national average for high school completion, but is lower than average for completing bachelor’s degrees.

The data for Houghton County is probably over-predicting the education level of households because Michigan Tech faculty and staff predominantly live in this county. Because approximately 20% of the homes have adults with only a high school education, many of these children not only need role models, but they need to learn what career paths and options are available to them. When college students interact with these children, the younger students begin to see that they can go to college or look into post-high school education. The K-12 students see something beyond an engineer when the members interact with them. They see a person who is energetic, interesting and fun. They learn that “smart” does not equal “boring”. They learn that engineers are not just people who work at computers and do math. They learn that engineers enjoy being with and working with others. Engineers enjoy talking about their career choice and the courses they took or are taking. Engineers do more than just go to work and do science projects. It is this information that will encourage many of these children to explore and possibly select engineering as a career.

SWE Chapter Engineering Outreach

The SWE members at Michigan Tech are open to assisting and organizing many engineering outreach activities. These range from campus-sponsored activities to ones initiated by the SWE members. Through these programs, the university students help K-12 students to learn more about engineering and help college students to learn more about the engineering profession. Table 2 shows major engineering oriented service activities that the members either organize or participate in, and Figure 1 includes photos from some of them.

Table 2. Michigan Tech SWE Chapter Engineering Outreach

Activity	Organization	# Students	# SWE Volunteers
Engineering Introduction	Girl Scouts	30	5
GetWISE!	Michigan Tech Youth Programs	300	10
Western Upper Peninsula Science Fair Festival	Western UP Center for Science, Mathematics and Environmental Education & Michigan Tech Omega Chi Epsilon Chemical Engineering Honor Society	360	5
Engineering Olympics	Michigan Tech Department of Engineering Fundamentals	300	10
Certificate of Merit	Michigan Tech SWE Chapter	350	20
Big Mac		200	20
Evening with Industry	Michigan Tech SWE Chapter & University Career Center		



Figure 1. SWE Engineering Outreach Projects (GetWISE!, Science Fair Festival, Engineering Olympics, Big Mac, Evening with Industry)

Annually, the SWE members organize an engineering activity for the Girl Scouts. This year it was making slime and racing cars constructed from candy bars. GetWISE! is an annual event for area middle school girls. Girls from several middle schools come to Michigan Tech and spend their day learning about engineering. This event is sponsored by the Michigan Tech Youth Programs. This past year, over 300 girls participated in the program. SWE members volunteer to work with the girls on their activities and answer their questions about engineering and life at university. Many SWE members stay throughout the day and interact with the students. (College of Engineering, 2007)

Each spring, the Western Upper Peninsula Science Fair is held at Michigan Tech for students in fourth through eighth grades. Not only are student projects judged, but various Michigan Tech student organizations participate in the Western Upper Peninsula Science Fair Festival. The Festival provides the elementary and middle school students with the opportunity to complete hands-on engineering and science experiments. This spring, SWE helped the children make slime. Slime is made from Elmer's glue, borax, and food coloring. It is a multi-chained polymer and is similar to materials used in engineering and biomechanics.

Another annual event at Michigan Tech is the Engineering Olympics where high school students come to the university to compete in engineering design, build and test activities. The students come from Wisconsin, Minnesota and the Upper Peninsula of Michigan for this one day event. Engineering Olympics excites high school students about the engineering profession and provides them with opportunities to apply scientific and mathematical principles to the "real world". SWE members have assisted with the mousetrap car event for the past seven years. They ensure that the vehicles comply with the design constraints, measure the vehicle performance and record the team results. Last year, the competition involved driving a payload up a ramp without

going off the ramp. Additionally, the high school teams had to provide a spreadsheet analysis of their vehicle and predict the performance of their design.

The furthest reaching program SWE sponsors is the Certificate of Merit program. This program awards 11th and 12th-grade girls nominated by their school with a certificate of achievement in math and science, in addition to providing them with additional information about careers in engineering, math, and science. Over 200 schools across Michigan, Wisconsin, and Minnesota currently participate in the program. (Michigan Technological University Society of Women Engineers)

Each semester, SWE members go to local schools and introduce fourth through sixth grade students to engineering through the Big Mac Program. (Michigan Technological University Society of Women Engineers) Students learn about engineering, teamwork, and efficiency by creating an assembly line to assemble Big Mac orders with felt burger pieces. For the event, the students are divided into teams and given the materials for a Big Mac meal (burger, lettuce, tomato, fries, wrappers, etc.). They are given an order to fill and the team who fills the order first wins. The first time the team builds a meal, there is no order or organization. The team just has a pile of materials. Then the SWE members explain that the process would work better if the materials were lined up in the order that the meal is prepared. For example, the materials for the burger are in the order that they would be put into the Big Mac. The fries are adjacent to the container for the fries. The bag is at the end of the line for the meal components to be placed into. Once again, the students assemble an order. This time the order is completed faster. The SWE members talk with the students about the importance of the assembly process. They discuss the relevance of each person working with the team to accomplish a common goal. They answer student questions about engineering and college. In the Spring 2009 semester, SWE did the Big Mac program with each of fourth and fifth grade classes at Lake Linden-Hubbell Elementary, approximately 100 students. K. Kumpala, a fourth grade teacher sent the following in an e-mail:

The Big Mac lesson did go well with the fourth grade! ...We all had a good time and learned a little about the many different types of engineers, too! Thanks for sending them!

A fifth grade girl mentioned: "Some cool girls came to school and told me that engineering is fun." The son of one of the authors, a fourth grader, said: "Mom, you're an engineer. Why aren't you as cool as them?" All of the students enjoyed the competition and learning about engineering from engineering students. The comments from the fourth and fifth grade students illustrate the importance of engineering students reaching out and serving as advocates for the engineering profession. The college students are perceived as interesting which, in turn, could mean that engineering is interesting. (National Academy of Engineering, 2008)

A major on-campus event that the SWE members organize annually is Evening with Industry (EWI). EWI is a professional dinner and social event where students can meet with industry representatives and recruiters regarding student internships, co-op positions and full-time employment. It is held the day before the University Career Fair so it gives the student attendees and industry representatives a chance to meet and discuss opportunities in a relaxed setting. Additionally, the students gain experience in meeting with potential employers and the interview process. They learn more about the work environment and employment opportunities. In 2008, over 60 companies and 100 students attended this event. (Michigan Tech SWE)

For the first time this year, SWE made a donation to two campus organizations that were nominated by active SWE members. These student organization included the Huskey Pep Band (because a large number of SWE members are involved within this organization that brings school spirit throughout the cold winter months at Tech) and the new student leadership organization, National Society of Leadership and Success, as they start to establish roots within the Michigan Tech campus.

SWE Chapter Community Outreach

In addition to the engineering service, the SWE members find community service to be rewarding. Table 3 summarizes many of these activities and photos of the activities are shown in Figure 2. The students have actively sought ways to interact with the local and global community while creating and maintaining a community within the SWE chapter.

Table 3. Michigan Tech SWE Chapter Outreach and Community Service

Activity	Organization	# People Impacted	# SWE Volunteers
Knitted/Crocheted Blanket	Warm Up America	N/A	25
Halloween Pumpkins	Local Senior Citizen/Assisted Living Homes	20	10
Easter Baskets		20	10
Raked Leaves	Make a Difference Day	N/A	10



Figure 2. SWE Community Outreach Projects (Easter Baskets, Warm Up America Blanket, Halloween Pumpkins, Make a Difference Day)

For the past two years, the SWE chapter has knit and crocheted a blanket for the Warm Up America project. Two of the SWE meetings during the academic year focus on beginning squares for the blanket. As part of this activity, members can learn to knit or crochet. This is a very social and interactive activity. Many women find the creation of something, whether it is

knitting, crocheting, painting, quilting, etc to be rewarding. (Minahan and Cox, 2007) The National SWE website has a group where SWE members can discuss topics that interest them. The intent of these chat groups was to provide members with a discussion avenue related to their careers. Instead, there are career related groups, family/work balance groups and special interest groups which range from athletics to crafts. This broad range of groups is indicative of the type of person who selects engineering as a career. (Brown and Cox, 2005) The meetings where the students work on the blanket are collaborative and dynamic. The women discuss life issues, not what their homework is or when their next test is. Like many women, the good discussions seem to occur while doing something else. (Minahan and Cox, 2007)

The SWE members have a strong commitment of involvement, not in just K-12 outreach. Over the past several years, the group has begun to interact with the elderly in the area. Three times during the academic year the SWE members make something at their General Meeting. At Halloween, they decorate pumpkins; and for Easter, they make Easter Baskets. The following Saturday, the gifts are delivered by SWE members to a local Senior Citizen or Assisted Living Facility. The members go beyond just taking the gifts to the elderly. They typically visit with the people and learn what the residents did when they were young. Each year, SWE members participate in Make A Difference Day where they perform some type of community service. This fall, they raked leaves for the Baraga-Houghton-Keweenaw Child Development Center in Houghton, MI.

In addition to the activities discussed, the SWE section donated \$1,000 to the Relay for Life organization for Breast Cancer Research through selling t-shirts. The t-shirts were sold first to the members, then the members volunteered their time to sell them at the Memorial Union Building and at Spring Fling.

Conclusions

The Michigan Tech chapter of SWE has found numerous ways to interact with the university and local community. The SWE members have shown that to provide service, all a student group has to do is provide the people to do it. They have shown many K-12 students that engineering is a good career choice and that interesting people choose it. They have illustrated the experimental nature of engineering through interactive projects with children from the third grade up through the high school level. Additionally, the student members have actively sought opportunities to meet with people in the local community. Through the completion of a knit blanket, making cookies, Easter baskets and decorating pumpkins, they have created a network of support for their members, along with providing an opportunity to interact with the elderly. Through these projects, the members are meeting the goal of the SWE organization and the National Academy of Engineering to show the positive aspects of engineering to the community at large.

Acknowledgments

The authors would like to thank the 2008-9 SWE Officers, Megan Cook, President, Katrina Sanders, Vice President; Pamela Wolting, Secretary; Elizabeth Haibel, Treasurer; and Melanie McQueen, 2nd Vice President for Membership, and Victoria Rankine, Historian for their help in

obtaining the information for this paper. The Michigan Tech College of Engineering was instrumental in supporting the students traveling to the WEPAN Conference.

References

Walter P. Reuther Library, Wayne State University. November 18, 2008, Society of Women Engineers Historical background, <http://www.reuther.wayne.edu/node/3403>.

Society of Women Engineers ASPIRE Program. <http://aspire.swe.org>.

Coyle, E.J., L.H. Jamieson, and W.C. Oakes. January, 2006. Integrating Engineering Education and Community Service: Themes for the Future of Engineering Education. *Journal of Engineering Education* 7-11.

National Academy of Engineering. 2008. *Changing the Conversation*. National Academies Press.

Wilson, J., and Musick, M. Summer, 2003. Doing Well by Doing Good: Volunteering and Occupational Achievement among American Women. *The Sociological Quarterly*, <http://www.jstor.org/stable/4120714> Vol. 44, No. 3: 433-450.

US Census. 2007, United States Census Data. <http://factfinder.census.gov>.

College of Engineering, GetWISE!. 2007, <http://www.doe.mtu.edu/news/feb13-2007.html>.

Michigan Technological University Engineering Olympics, Department of Engineering Fundamentals. <http://www.geneng.mtu.edu/olympics.html>.

Michigan Technological University Society of Women Engineers. <http://swe.students.mtu.edu/outreach/>.

Tech Today, February 6, 2008. <http://www.admin.mtu.edu/urel/ttoday/previous.php?issue=20080206#4>.

Western UP Center for Science, Mathematics and Environmental Education. http://wupcenter.mtu.edu/news/science_fair.html.

Minahan, S. and J.W. Cox, 2007. Stitch'nBitch: Cyberfeminism, a Third Place and the New Materiality. *Journal of Material Culture*. <http://mcu.sagepub.com/cgi/content/abstract/12/1/5> 12:5.

Brown, S.D., and R.W. Cox, 2005. *Career Development and Counseling: Putting Theory and Research to Work*. John Wiley & Sons. pp. 253-255.

Warm Up America Foundation. <http://www.warmupamerica.com/home.html>.