Increasing the Support Network of Female Engineering Students Through Society of Women Engineers (SWE) Activities

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Abstract

This paper discusses the diverse activities of the student chapter of the Society of Women Engineers (SWE) at Indiana Univ./Purdue Univ. Ft. Wayne (IPFW) over the last three years to promote a sense of community, self-confidence, and mentoring among women engineering, technology, and computer science students. Descriptions and schedule of some activities are included.

Introduction

Comprising a majority of the U.S. workforce, women make up only 8.5 percent of the nation's engineers. A number of programs have been launched over the past decade to recruit more women into the field, and while women now represent 20 percent of all engineering students, they remain more likely than men to switch out of the field, particularly in the first two years of college. A recent study concluded that women engineering undergraduates with a sense of community are more likely to persist in obtaining engineering degrees and to enter the workforce as engineers.[1]

For the past three years, the Society of Women Engineers (SWE) student chapter at Indiana Univ./Purdue Univ. Ft. Wayne (IPFW) has been active in a number of functions to increase the sense of community, self-confidence, and mentoring among female engineering, technology, and computer science students. They have been active in recruiting a wide range of students, including both traditional and nontraditional female engineering, technology, and computer science students. Entering freshmen have been targeted through introductory letters, visibility during the orientation/registration process, and classroom visits. SWE activities, including picnics, guest speakers, plant tours, career days for area middle schools and high schools, and workshops designed for the participation of Girl Scouts, have been geared to appeal to a wide audience. Specifics of the activities are described below. First, however, a brief explanation of the structure of the engineering and technology departments at IPFW is provided to facilitate understanding of the SWE student organization there.

IPFW is a regional campus offering degrees from either Indiana University or Purdue University, depending on course of study. The organization chart of the IPFW School of Engineering, Technology, and Computer Science is given in Table 1. Students in these courses of study earn Purdue degrees.

SWE is an organization whose mission is to stimulate women to achieve full potential in careers as engineers and leaders, expand the image of the engineering profession as a positive force in improving the quality of life, and demonstrate the value of diversity. Student membership is open to anyone pursuing an undergraduate or graduate course of study towards a degree in engineering or related field in a

recognized college or university and is carrying at least half the courses required of a full-time student. Table 2 identifies IPFW SWE membership by discipline. The trend in increased membership each year is perhaps evidence of the effectiveness of the SWE programs. The large increase in membership for the 2002-2003 academic year is attributed to the offer of an expense paid trip to the SWE National Conference in Detroit, MI, with paid student membership fees.

SOAR registration

For entering freshmen, IPFW has an orientation/registration program known as SOAR (Student Orientation Advising Registration). Each SOAR session includes a resource and organization fair to expose new students to the many student organizations at IPFW. Student organizations are encouraged to participate in this event, with the format of a career fair, in which student groups representing diverse interests ranging from professional societies and Greek organizations to recreational and religious groups, converge with a common goal of attracting new recruits. Each group is allocated a booth for a display. SOAR participants are encouraged to visit the booths to learn about organizations that interest them. SWE took advantage of this forum to make initial contact with incoming freshmen and prospective members. The SWE booth contained a tri-fold display including photos of SWE activities. SWE volunteers manned the booth, distributing fliers to visitors and recording contact information such as phone numbers and email addresses. The flier can be found in the Appendix.

Civil & Architectural Eng. Technology	Computer Science	Electrical & Computer Eng. Technology	Engineering	Manufacturing Technology
Architectural Engineering Technology	Applied CS	Electrical Engineering Technology	Mechanical Engineering	Industrial Engineering Technology
Civil Engineering Technology	Information Systems	Computer Engineering Technology	Electrical Engineering	Mechanical Engineering Technology
Interior Design				
Construction Engineering Technology				

Table 1. Department of Engineering, Technology, and Computer Science (ETCS) Organization chart at IPFW

Academic major	Academic Year			
	1999-2000	2000-2001	2001-2002	2002-2003
AET	0	2	2	1
EET	1	1	2	4
IET	1	1	0	2
MET	1	1	1	0
EE	1	2	3	7
ME	2	2	3	3
CS	0	1	2	3
TOTAL	6	10	13	20

Table 2. SWE paid membership by discipline

Introductory letters

Each year at the conclusion of spring semester classes, SWE has its final meeting for the year and elects new officers for the following year. The new officers then plan the schedule of events for the upcoming academic year. A letter of invitation detailing this calendar of activities is subsequently compiled and mailed, prior to the start of fall semester classes, to all female students enrolled in engineering, technology, or computer science curriculums at IPFW. The schedule for the 2002-2003 academic year is given in Table 3, and a copy of the invitation letter can be found in the Appendix.

Classroom visits

On occasion, SWE members have visited classrooms, especially freshmen engineering classes to promote the society. Additionally, they have provided individual engineering/technology professors with fliers promoting SWE sponsored events with the request that they distribute them to their female students.

Date	Scheduled Activity
August 13, 2002	Picnic at pavilion on IPFW campus 6 p.m.
September 24, 2002	Pizza meeting with guest speaker Nancy Ridenour of ITT 7 p.m.
October 11, 2002	Attend SWE National Conference in Detroit, MI. Leave IPFW 6 a.m.
November 16, 2002	YES SHE CAN Girl Scout program Featuring Dr. Sally Ride 8:30 a.m.-3 p.m.
December 15, 2002	Lego League Robotic Competition 9 a.m.-4 p.m.
February 19, 2003	Engineer's Week High School Career Day 9:30 a.m.-12:30 p.m.
March 4, 2003	"What is an Engineer?" program for middle school students 9:30 a.m.-12:30 p.m.
April 4, 2003	Plant tour
May 13, 2003	Dinner meeting and election of new officers 6 p.m.

Table 3. SWE schedule of activities for the 2002-2003 academic year

Guest Speakers

Every year SWE sponsors a female speaker, currently working as an engineer, to talk to the society about her real world experiences. In addition, a female engineering alumnus is invited to participate in the middle school and high school career days. Furthermore, keynote speakers participating in SWE sponsored Girl Scout workshops have been inspiring and renown. A summary of speakers for these events is shown in Tables 4 and 5. Perhaps the two most notable were Margaret Ringenberg and Dr. Sally Ride. Ms. Ringenberg, a Women's Air Force Service Pilot (WASP) veteran from World War II featured in Tom Brokaw's best selling book *The Greatest Generation*, spoke of her pioneering experiences in the early days of flying when "girls couldn't be pilots." Dr. Sally Ride, the first American woman in space, spoke of her experiences on the space shuttle. Both of these renown speakers encouraged the Girl Scouts in attendance to follow their interests, regardless of what they are told the cannot do. There was a question and answer session following both of the speakers. Ms. Ringenberg fielded questions for approximately 15 minutes, and written comments from participants that day indicated a desire to see this time extended. Dr. Sally Ride answered questions from the mostly Girl Scout audience for approximately 45 minutes following her presentation.

Year	Speaker	Job Title	Topic	Number Students Attending
2000	Deb Bergman	Engineer, GM	Work/school experiences	11
2001	Dolores Bredemeyer*	Engineering Manager, GM	Not applicable*	12
2002	Nancy Ridenour	Space Software Engineer, ITT	Work/school experiences	15

* No show

Table 4. SWE sponsored guest speakers

Date	Event	Speaker	Job Title	Topic	Number Students Attending
March 23, 2001	"What is an Engineer?" MS career day	Christine Douglas	Quality Engineer, Zimmer	Design of a nozzle	400 MS students 7 SWE members
Nov. 10, 2001	"Yes She Can" Girl Scout program	Margaret Ringenberg	WWII pilot	*Girls Can't be Pilots*	150 Girl Scouts 7 SWE members
Jan. 24, 2002	"What is an Engineer?" HS career day	Christine Douglas	Quality Engineer, Zimmer	Design of artificial joints/limbs	97 HS students 6 SWE members
March 5, 2002	"What is an Engineer?" MS career day	Angie Marshall	Master Black Belt, GE Motors & Controls	Six Sigma methodology of problem solving	250 MS students 6 SWE members
Nov. 16, 2002	"Yes She Can Girl Scout program	Dr. Sally Ride	First American Woman in space	*Reach for the Stars*	450 Girl Scouts 8 SWE members

Table 5. SWE sponsored guest speakers for middle/high school career days and Girl Scout workshops

Engineering Career Days

Each academic year, SWE sponsors, as two separate events, both a middle school and a high school engineering career day for Ft. Wayne area schools. These events are well attended, necessitating limiting registration to 225 student participants. The event is structured to provide exposure to a wide variety of engineering and technology disciplines. The program begins with introductory remarks from a representative of IPFW admissions as well as from the president of the SWE student chapter. An age appropriate film is then shown that explains the broad aspects and applications of the engineering profession. The film, "Who are engineers? You?"[2] appeals to their age group because it incorporates applications such as design of the Giants football stadium, the Statue of Liberty restoration project, 3D medical imaging, and the Mattel gloveball designed for use with the Nintendo Super Gloveball game. Following this brief introduction, the students are divided into 6-8 groups with each group assigned an IPFW engineering student escort. These student escorts are members of SWE or one of the other engineering technical societies, such as the American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronics Engineers (IEEE), the American Society of Heating, Refrigeration, and Air Conditioning (ASHRAE), the Society of Manufacturing Engineers (SME) or the Society of Automotive Engineers (SAE). In addition to the obvious benefit of efficiently navigating the campus, they have immediate rapport with the middle/high school students and act as "flesh and blood" role models. Each group is rotated to the various technical sessions on 20 minute intervals. These presentations are provided by faculty and/or students and vary from year to year, subject to availability. "Hands-on" activities are encouraged. Topics of past presentations have included demonstrations on astronomical imaging, surveying, bridge building, circuit design, Lego robots, an industrial pick and place robot, the wind tunnel, stress visualization, and engineering senior design. A female engineering alumnus is always included in the program to provide the "post university" perspective. A sample schedule for this event is provided in Table 6.

Having attended the full range of technical sessions, the middle/high school students are then regrouped for lunch, usually consisting of pizza, punch, and cookies. In the past, the IPFW student government has funded the lunch. Following lunch, the students depart to return to their respective schools.

Time	Activity
9:00 a.m.	Students arrive
9:00 a.m.-9:15 a.m.	Welcome to IPFW–Introduction by Charity Hein, president, SWE, and Laura Harman, IPFW admissions
9:15 a.m.-9:30 a.m.	View film "Who are Engineers? You?"
9:30 a.m.-11:30 a.m.	15 minute rotations to the following presentations: 1. Angie Marshall, Master Black Belt, GE–Six Sigma methodology of problem solving 2. Kris Krummen and Brian Walker, IPFW CAET students–bridge building and soil 3. Kevin McGuire, IPFW ME student–wind tunnel demo 4. Charity Hein, IPFW EE student–digital logic circuit design 5. Prof. Wilson Liang, IPFW MET professor–pick and place robot demo 6. Dan McCoy and Alex McQuillan, IPFW CAET students–Lego robot demo 7. Dr. Steve Cain, IPFW EE professor–astronomical imaging 8. Prof. Bruce Franke, IPFW CET professor–surveying
11:30 a.m.-12:00 noon	Lunch in Walb ballroom, IPFW campus
12:00 noon	Students depart

Table 6. Schedule of career day events, March 2002

Career Mentoring

SWE members are encouraged to obtain summer engineering internships. In the future, more emphasis will be devoted to this very important aspect of career development. An IPFW representative from career and counseling spoke at SWE's first formal meeting of fall semester 2002 to discuss resume writing and co-op/internship opportunities.

Plant tours to local industry are a consistent part of the SWE agenda and typically generate high attendance. Past tours included visits to GM and GE in Ft. Wayne. A plant tour to ITT Industries is scheduled for the 2002-2003 academic year.

In October 2002, thirteen students accompanied by their faculty advisor attended the SWE National Conference in Detroit, MI, where they had an opportunity to network with student and professional engineers from all over the country. Feedback from the students indicated that they benefited from the Conference's technical sessions as well as the Open Technical Exchange and the Career Fair.

Social activities

In addition to the mentoring, service, and career development activities, SWE has social events, including picnics and dinners, providing members the opportunity to mingle in an informal setting. A picnic is usually scheduled for late summer prior to the start of fall semester classes. Because many of the IPFW students are nontraditional and have heavy family and/or work responsibilities, the picnic is scheduled prior to the start of classes to encourage maximum participation. A photo from the August 2002 picnic is shown in Figure 1. At this event, the SWE officers announced the schedule of events for the remainder of the academic year and encouraged participation.

Similarly, each year, a dinner meeting at a local restaurant is scheduled at the conclusion of Spring Semester final exams. After dinner, election of new officers takes place.

Figure 2. Summer 2002 SWE picnic

Workshops for Girl Scouts

SWE has sponsored several Saturday workshops in which area Girl Scouts are invited to the IPFW engineering labs to experience "hands-on" engineering activities. The SWE student members are the sole demonstrators at this event. Two such programs have been developed for the participation of Girl Scouts—"She's the Engineer" and "Yes She Can."

There is no charge for the "She's the Engineer" program, which is open to 10-14 year olds. This program runs from 9 a.m.-noon and starts with an introduction and presentation by the SWE student president. A Power Point presentation provides an overview of engineering disciplines. A film titled "She's the Engineer,"[3] is then presented which promotes the virtues of engineering with appealing and fast paced delivery. Following this brief introduction, the group is divided into four groups of 6-15 students each. These groups are then rotated on 20 minute intervals to the various labs, each of which is staffed with at least two SWE student volunteers to demonstrate an aspect of engineering. A snack of cookies and punch, funded by SWE, is offered to the guests. The program varies from year to year, subject to the technical disciplines of the SWE participants. A typical program consists of computer programming, circuit design, a wind tunnel demonstration, dissection of a water pump, and architectural layout. Each of these is described below in more detail.

The computer lab is one stop on the tour. There each Girl Scout is appropriated a PC. A simple Java program is presented, and the girls type in the program, then compile and run it. Upon execution, the interactive object oriented program opens a window and prompts the user to enter her age in years. The program then computes and prints the corresponding age in days. The Girl Scouts are challenged to modify the program to calculate and print their age in terms of hours or minutes rather than days. They learn that modifications of the program require recompilation prior to execution.

The circuits lab is also included in the "She's the Engineer" program. There students work in groups of 2 or 3. Each group is provided with a breadboard, resistors, and various colored light emitting diodes (LEDs) in addition to the equipment at their lab bench. Basic concepts of circuit design are presented. Students learn how to interpret the color coded bands on a resistor to determine the resistance value according to industry standards. This is reinforced using a digital ohmmeter to measure resistance values. The students learn that current in an LED flows in only one direction, and it must be correctly placed in the circuit for proper operation. Safety is emphasized and students are taught to disconnect the power supply prior to rearranging circuit components. The difference between series and parallel circuit design is investigated. The students learn how to configure on a breadboard a series circuit consisting of a 5 V power supply, resistors, and an LED. They enjoy experimenting with various resistance values and LEDs.

The wind tunnel lab is very popular with "She's the Engineer" participants. There the Girl Scouts get an explanation of the use of a wind tunnel to measure drag and lift. By far the most popular experience of the program involves allowing the girls to feel the force of 100 mph winds at the rear of the tunnel. A photo is shown in Figure 2. After the wind tunnel demonstration, the students are directed to workbenches within the same lab to dissect a small water pump. Using a screwdriver, they are advised to disassemble and then reassemble the pump, upon which they test it by attaching it to a battery powered drill and a water hose. When properly assembled and connected to the water hose, they observe that the output water is at higher velocity than that of the input.

An additional typical demonstration in the "She's the Engineer" program involves an introduction to architecture. Using visual aids, students are shown a layout of a commercial building and then encouraged to design a house floor plan of their own.

In addition to the "She's the Engineer" program, SWE is actively involved in the "Yes She Can" event for Girl Scouts. This program requires advance registration and fee payment of $7 per person, charged and collected by the Girl Scouts. SWE does not receive any compensation. Girl Scouts in 1st-6th grade participate in the morning session; 7th-12th graders attend lunch followed by the afternoon session. The sessions are designed to be "hands-on" with students rotated on 20 minute intervals similar to the "She's the Engineer" program. However, speakers for "Yes She Can" are not solely engineers, but also women in other non-traditional careers. One recent program included a firefighter, chemist, physician, veterinarian, civil engineer, and electrical and mechanical engineering students. Margaret Ringenberg, a World War II pilot featured in Tom Brokaw's best selling book, *The Greatest Generation*, and author of

her own book, *Girls Can't be Pilots*, gave an inspiring speech to the 7th-12th grade Girl Scouts as well as SWE student members during a box lunch in the 2001 program. In lieu of a speaker, a magician performed for 1st-6th graders the first 20 minutes of their morning session during which time a light snack was served. Astronaut Dr. Sally Ride provided the keynote address for the November 16, 2002 "Yes She Can" event.

Figure 2. Girl Scouts experiencing the wind tunnel

Conclusions

SWE has developed a well-structured organization that strives to serve all IPFW female engineering, technology, and computer science majors. Its goal is to develop a sense of community and self-confidence in its members for scholastic retention and graduation in the short term as well as life long career development and fulfillment. The trend toward increased SWE membership over the last four years is perhaps a measure of the effectiveness of the programs. Future efforts to document effectiveness should include graduation and attrition rates as well as surveys of graduates regarding their life long career development.

Bibliography

1. Goodman, Irene, et. al.., "Final Report of the Women's Experiences in College Engineering (WECE) Project," Goodman Research Group, April 2002, Cambridge, MA, http://www.grginc.com/WECE_FINAL_REPORT.pdf.

2. "Who are Engineers? You? " film produced in 1992 by IBM for the National Society of Professional Engineers.

3. "She's the Engineer" film developed by Cornell University and produced by Insights Video in 1992.

Biography

ELIZABETH A. THOMPSON, PH.D., has been an assistant professor of Electrical Engineering at Indiana Univ./Purdue Univ. Ft. Wayne (IPFW) since Fall 1999 after receiving her Ph.D. in electrical engineering from the University of Dayton. She teaches courses in Digital Signal Processing, Computer Architecture, and Computer Graphics, and conducts research in the area of functional Magnetic Resonance Imaging.

APPENDIX

IPFW Student Chapter of the Society of Women Engineers

- The IPFW SWE Chapter frequently provides Saturday morning workshops for Girl Scouts. These workshops are intended to inform girls in our area about the opportunities available to them at IPFW and to encourage them to develop an active interest in science and engineering. We also sponsor a day for High School students and a day for Middle School students to come to IPFW and learn about careers in Engineering. We have guest speaker events and plant tours annually for our membership. It is a great opportunity to meet other students, faculty, and professionals in industry. We hope you plan on attending.
- Mission Statement: The Society of Women Engineers stimulates women to achieve full potential in careers as engineers and leaders, expands the image of the engineering profession as a positive force in the quality of life, and demonstrates the value of diversity.

Events for the 2002-2003 year:

August 13 – Potluck Picnic
September 24 – Membership Drive and Guest Speaker
October 9-12 – SWE National Conference in Detroit
November 16 – "Yes She Can!" Girl Scout program
December 15 – Lego® League Competition
February 19 – Engineer's Week, High School Career Day
March 4 – Middle School Career Day
April 4 – Plant Tour
May 13 – SWE Dinner and Election of Officers

Officers for the 2002-2003 year:

Charity Hein, *President*
Annita Arispe, *Vice President*
Jodi Kimmerly, *Treasurer*
Suchita Samant, *Secretary*
Dr. Elizabeth Thompson, *Faculty Advisor*

Contact Information:

IPFW Student Chapter of SWE Homepage – http://www.etcs.ipfw.edu/~swe/
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August 1, 2002

Erica Stull
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Dear Erica,

We, the student section of the Society of Women Engineers (SWE) at IPFW, invite you to join us for an exciting year of activities. The benefits of such affiliation are numerous. You will be stimulated to achieve your full potential in engineering and technology careers. Your membership in SWE enhances your resume, provides opportunities for networking and scholarships, permits access to a national job database and supplies you with a monthly magazine. In addition, your participation allows you to meet other women in engineering/technology professions and perform community service.

Join us for an informal picnic at 6 p.m., Tuesday, August 13, 2002 at the pavilion between Walb Union and the Gates Sports Center on the IPFW campus. We especially encourage incoming freshmen and other students who have not previously participated to become acquainted with the active members prior to the start of fall semester classes. Bring a covered dish to share. In the event of rain, we will meet in the lobby of the Engineering Technology building. Please email Annita Arispe at hope319@hotmail.com to let her know whether or not you are planning to attend and if so, what you will be bringing.

The first formal meeting after the start of classes is scheduled at 7 p.m., September 24, 2002 in SB G11 on the IPFW campus and will be a membership drive with a guest speaker. Nancy Ridenour, a space software engineer at ITT, will share with us her engineering experiences and insights. In addition, career counselors from IPFW will speak to us about internship opportunities. Pizza will be provided. Our annual national membership dues are $15 and may be paid at that time. However, you are welcome to join us for the meeting whether or not you decide to join SWE.

This year the IPFW student chapter looks forward to attending the SWE National Conference in Detroit, Michigan. This is a fantastic opportunity to mix and mingle with over 3,000 female engineers, both fellow students and professional engineers. The conference will include a career fair where hundreds of companies recruit summer interns, co-ops, and full-time employees. It will also include sessions on professional development, interviewing skills, networking skills, and how to choose the right job offer. A tentative schedule of events for the year is enclosed.

Please join us in making this a fun and informative year! For additional information, check out our website at www.etcs.ipfw.edu/~swe.

Sincerely,

Charity Hein, president, student section