

AWE: An Outreach Workshop for Middle School Girls

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Abstract

A two-week, EiF Foundation and Rowan University sponsored workshop designed to introduce middle school girls to engineering careers was held at Rowan University during the summer of 1999. This target audience was selected to expose young girls to the importance of focusing on mathematics and science in their middle school years. Participants from minority populations were strongly encouraged to apply. Innovative hands-on experiments in the various fields of engineering with state of the art technology were used to spark the participants' interest in engineering. Experiments required collaborative learning through teamwork. The program consisted of a two-week on-campus session at Rowan University wherein students interacted with departmental faculty, undergraduate engineering students and representatives from local industry. The workshop also experiments, field trips, workshops on engineering ethics, professionalism, gender sensitivity and computer training sessions. The impact of the workshop was very encouraging and positive. Such workshops can encourage young girls to consider engineering as a course of study and/or a career in their high school years.

Introduction

Women constitute approximately half of the population and about 46 percent of the labor force in all occupations, but only 9 percent of engineers [1,8,9]. According to the US Department of Labor predictions, between now and the year 2000, nearly two-thirds of the new entrants into the work force will be women. The current low level participation of women in science, mathematics and engineering will be a major deterrent in precluding them from the future job market. Girls still do not enter the field of engineering or other professions requiring strong backgrounds in science and mathematics in large numbers. There is still considerable "math anxiety" and many girls choose not to continue with mathematics and science beyond the required courses in high school. As a result, they often close themselves out of professions they might wish to enter later.

Specifically, engineering and sciences continue to show an underrepresentation of women. Lebuffe [2] in her annual survey of engineering enrollments and degrees for the Engineering Workforce Commission of the American Association of Engineering Societies, found that roughly 16 percent of all bachelor degrees in engineering were awarded to women in 1993. In 1993, women received only 9 percent of the doctoral degrees in engineering. The future does not seem to be brighter either. In January 1994, only 2.9 percent of all women entering college planned to major in engineering and only 1 percent planned to enter technical fields (compared

to 11.8 and 5.4 percent of men, respectively) (National research Council, 1994). Some writers have begun to argue that science today is so antagonistic to women that it must be radically changed before women can comfortably participate in it [3].

Most studies suggest that environmental and social influences are responsible for this underrepresentation of women. Environmental factors including masculinity and femininity, education, self-efficacy, female role models, and perceptions of engineering are considered to be the major factors.

A two-week innovative workshop for exposing female students from the 7th and 8^h grades to the challenges and excitement of engineering was conducted at Rowan University. These middle school girls were targeted for a number of reasons. In their middle school years, girls show a drop in math and science confidence and achievement. The exposure to challenging careers in science and technology should be started much earlier than the high school years to keep girls motivated in science and math classes. Literature indicates that mentoring also has a tremendous positive impact upon the career choices of students. Most girls currently enrolled in science and engineering programs indicate that they were strongly influenced either by a parent/guardian/sibling/friend/ teacher or counselor. Therefore the AWE workshop focused on exposing engineering careers to local middle school girls. The program consisted of a two-week on-campus session at Rowan University wherein students interacted with departmental faculty, undergraduate engineering students and representatives from local industry. The workshop also included engineering students from Rowan University to act as mentors for the participants. It is important for students in engineering to understand the importance of mentoring early in their careers so that they can be role models for future generations.

AWE Workshop

The AWE workshop was funded by a generous donation from the EiF Foundation (\$35,521) and matching funds from Rowan University. The total workshop cost was \$50,056. Major expenses for the workshop included salaries for participating faculty and student mentors, stipends for participants, travel, supplies, information dissemination and food. While the main goal of the workshop was to establish a program for middle school outreach, there were a number of important objectives.

The overall objectives of the AWE workshop were to:

1. Recruit talented, economically disadvantaged preferably minority female students for a two week summer workshop at Rowan University,
2. Expose selected students to laboratory and field experiences directly related to the practice and profession of engineering,
3. Provide direction, motivation, support and encouragement for students to pursue carriers in science and engineering,
4. Address issues such as gender sensitivity, sexual harassment, professional ethics that will affect students directly as future professionals in the 21st century,
5. Provide an open, honest and respectful forum for debating ideas through collaborative learning and teamwork,

6. Create an atmosphere of intellectual growth, self-esteem and empowerment,
7. Prepare students for a successful completion of their high school program, and
8. Provide a model workshop that is easily adaptable by other institutions.

Recruitment and Participant Selection

A committee comprising of the project team, the admissions office and the EEO/AA officer at Rowan was formed to identify target schools. Four neighboring counties (Gloucester, Camden, Salem, Cumberland) were identified and an information package was mailed to a total of 36 area middle schools. The information package contained flyer and application forms. Slide presentations on project AWE at certain schools were also an integral part of the recruiting efforts. A total of 150 applications were received from 24 of the targeted schools. Students from rural areas who may not have had exposure to science and math and minority students who are typically underrepresented in engineering were encouraged to apply. Applicants were asked to write a one-page essay on the problems facing the world and suggest some solutions to these problems. Each essay was read and evaluated thoroughly. A total of twenty finalists were selected for the workshop. Participants had a good representation of diversity and ethnicity as indicated in Figure 1.

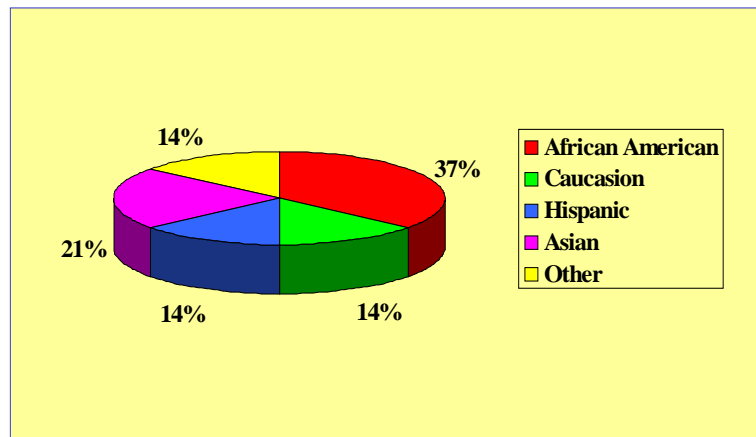


Figure 1: Ethnic Information on AWE Participants (14 responses out of 18)

Project Staff

The workshop was administered through the Department of Civil and Environmental Engineering at Rowan University. Faculty from the civil, chemical, electrical and mechanical engineering disciplines participated in conducting the workshop. Drs. Jahan (AWE Project Director), Sukumaran, Keil and Head supervised the program activities. They are all active members of the Society for Women Engineers and represent various engineering disciplines at Rowan University. Four undergraduate engineering students served as mentors and role models for the participants during the course of the workshop.

Workshop Schedule

The workshop duration was two weeks from 9:00AM to 3:00PM and was held from July 26 through August 6, 1999. On the first day participants were given a tour of Rowan University and Rowan Hall, the brand new College of Engineering and the site of the workshop. Students were provided with a breakfast and lunch everyday. The program activities included aspects of engineering derived from all disciplines. A lecture laboratory format, employing innovative educational methods developed by the instructors and industrial experts was used to demonstrate engineering principles. Computer lessons in spreadsheets, presentations, internet research were also an integral part of this workshop. A list of laboratory activities is presented in Table 1.

Table 1: Discipline Specific Laboratory Activities

Civil and Environmental Engineering	Electrical Engineering
<i>Teaching Civil Engineering</i>	<i>Electrical Circuits</i>
<i>Measurements through Bridges/</i>	<i>Reverse Engineering of Common</i>
<i>Computer Software: The Bridge Builder</i>	<i>Appliances such as an alarm clock,</i>
<i>Learning Water Treatment through</i>	<i>hairdryer, coffee-maker</i>
<i>Portable Water Purification Systems/</i>	
<i>The Jar Test/ Water Quality Sampling</i>	
<i>Building Sandcastles</i>	
Chemical Engineering.	Mechanical Engineering
<i>Food Processing: Ketchup</i>	<i>AutoCAD/ Flying Airplanes</i>
<i>Manufacturing and Slime</i>	
<i>Processing/Water Treatment using</i>	
<i>Membranes</i>	

Field trips, seminars and extracurricular activities were also an integral part of this workshop. Field trips included a trip to the Sony Music Company located in Pitman, and the Washington Township Municipalities Authority Water Treatment Plant. The Sony Music. Co. is a compact disc manufacturing facility. Participants were given a tour of the facility and free CDs.

Speakers from local industry were invited to address the participants to provide an overview of engineering practice. Representatives from DuPont, Pennsylvania Department of Transportation, Septa, Mannington Mills and NIST (National Institute of Standards and Technology) participated in these interactive seminars. Dr. Janet Lindman, Professor of History and the Director of Women Studies at Rowan University also presented a seminar on the history of women in science and engineering. The participants were also informed about available scholarships for pursuing careers in science and engineering. A list of seminars and speakers is presented in Table 2.

Table 2: Seminar Topics

Speaker	Seminar Description
<i>Dr. Anne-Marie Jeffrey, NIST</i>	<i>The Need for Standards in Engineering</i>
<i>Ms. Elaine Elbich, P.E. and Ms. Lucia Chan, P.E., SEPTA</i>	<i>PENDOT: Women in Transportation Engineering</i>
<i>Dr. Drucilla Knutsen, CEO, Mannington Mills</i>	<i>Vinyl Flooring Processing</i>
<i>Dr. Karen Gentle, DuPont</i>	<i>Careers for Chemical Engineers</i>
<i>Dr. Janet Lindman, Director Women Studies, Rowan University</i>	<i>History of Women in Science and Engineering</i>
<i>Rowan University Public Safety Officer</i>	<i>Safety Issues on Campus</i>
<i>Dr. Kauser Jahan, P.E.</i>	<i>Scholarship for women in Science and Engineering Gender Issues Facing Women</i>

Participants also focused on fun team activities such as the *EGG DROP* and *JENGA* tower building contests. Free time was also set aside for the mentors to interact with the participants.

The final days of the workshop focused on a team poster presentation. Students were divided into teams of four or five and were assigned to a project focusing on the inquiry of design. Topics of focus included design of a water treatment plant, a cable suspension bridge, a chemical processing plant for slime manufacturing and a circuit for an electronic keyboard. These projects were designed specifically “*to spark and ignite the creativity and imagination of the participating students*”. There is evidence in literature indicating that girls have a difficult time in envisioning technical inventions [3, 5, 6]. Girls’ technological fantasies tend to be more about household helpers, contact bringers, machines that offer companionship or devices that could broaden their social and personal networks. On the other hand, boys fantasize about extensions of instrumental power, often thinking up tools that could make other technological objects overpower natural constraint [7].

Parents were invited on the last day of the workshop for attending the poster presentations and a formal luncheon. A keynote speaker was also invited to address the parents and participants. The AWE keynote speaker was Ms. Debra P. DiLorenzo (a Rowan alumni), President of the Chamber of Commerce Southern New Jersey. Participants were given stipends and certificates for successfully completing the AWE workshop.

Project Evaluation

It is important to have a means to measure the success and impact of a particular project. Participants were asked to rate the individual components of the workshop every day. This evaluation was extremely successful in assessing the impact of the project topics. At the conclusion of the workshop the participants were further asked to rate the overall workshop on

how the components of the entire project came together. All participants strongly agreed that they had a better understanding of engineering careers. Most participants also agreed that they understood the importance of learning science and mathematics.

In addition to the participant feedback, a survey was also given to the parent(s)/guardian of the participants. All questions on the survey received very positive responses. Some responses to one of the most important questions on the survey are presented below:

Survey question: Do you feel that your daughter has benefited from this Workshop?

All parents strongly responded by saying YES.

Comments

“My daughter came home so enthused about the program. From day one she wanted to be an environmental engineer and attend Rowan.”

“I appreciate the fact that my daughter has been exposed to different kinds of occupations in science. I also feel that because it was orchestrated by women, she could see herself as an engineer.”

“My daughter is now more aware of the various types of engineering careers. She is also more knowledgeable about the program of study she must pursue to enter the field of engineering.”

Participants were also asked about their engineering student mentors. All of them agreed that having the mentors made their experiences more enriching and fun. The undergraduate engineering students who participated in this workshop had a different experience as compared to the faculty. The workshop helped students build up their leadership and social skills, which are entirely different from academic skills. This was a major realization for all the student mentors. Some of their mentoring experiences are outlined below:

“This mentoring experience was very educational for me. The entire experience of organizing and conducting the workshop was extremely enriching. The workshop was very well planned due to strong organizational skills of the project team (both faculty and students). However, I subconsciously during the application/selection procedures placed the participants into a certain pre-assigned mold. I was expecting certain girls to show up with a certain type of demeanor.”

“We as mentors had to find a median between being an authority figure and being a friend to these workshop participants. I had very little patience with some participants in the beginning, but I settled down as the workshop progressed. I realized I was enjoying the experience. If I felt that the girls needed to be reprimanded for something, I would be stern, but also listen to an explanation if one was given. I really feel like they respected me for being straight with them. I tried to treat them more like peers if I felt like they could handle the responsibility. “

“This was a great opportunity for these young girls and I tried to help them get as much out of it as possible. The AWE workshop has given these girls a better understanding of what

engineering is and I had something to do with that. It's a wonderful feeling to help people by sharing your knowledge. I have grown as a person through this whole experience and I feel like I am a better responsible person because of this experience. I would do it all over again."

Surveys will also be sent out to the students during their freshman, sophomore, junior and senior years in high school to determine the impact that the program may have had on their career plans. Electronic email is also being used to communicate with the participants on a routine basis in order that the project staff may be able to provide valuable guidance, assistance and encouragement to the students throughout their high school years.

Information Dissemination

A web site dedicated to project AWE has been established at Rowan to facilitate the rapid dissemination of the project. The site address is <http://sun00.rowan.edu/special/awe/awe.htm>. This web page will also be used to communicate with the participants on a routine basis in order that the project staff may be able to provide valuable guidance, assistance and encouragement to the students throughout their high school years. In addition a video highlighting the AWE workshop will be distributed to the local junior high schools along with informational booklets and training materials.

The AWE workshop was also publicized through local newspapers and television. The overall impact of the project on local students, their parents/guardians and the community was extremely positive. The results of the workshop are being presented also at the SWE¹ and WEPAN² Annual Conferences and local ASEE meetings [10-11].

Conclusions

The impact of project AWE has been extremely positive. There was an overwhelming response during participant recruiting. Parents were extremely grateful for having such a program for their daughters. Many times they mentioned how they never had such opportunities in their times.

AWE was designed to allow us to focus our educational efforts on our own individual disciplines. Each professor was given the opportunity to introduce aspects of engineering and science by setting up a project that demonstrated how those aspects were applied. As faculty participants of the AWE workshop, there was ample opportunity to serve as a mentor to the engineering freshmen students as well as the workshop participants. One of the unique features of the workshop was in having the three-tier mentoring relationship. The engineering students as well as the middle school girls benefited from it. Assigning workshop participants to engineering students closer to their peer group eased student communication. The engineering freshmen students received advice and mentoring on handling middle school participants. There was a perceptible improvement in their handling of the disciplinary problems as well as in the guidance they provided to the middle school participants as the workshop progressed. They also showed significant leadership skills during the workshop. These skills will serve them well in the future.

The project team hopes that this workshop will be a gateway for funding opportunities from industry, government and other foundations. The success of project AWE in 1999 is instrumental in seeking funds to continue this type of activity in the future. The Rowan College

of Engineering has shown an extraordinary sense of commitment to the future of women in engineering. It is rare that four female faculty in engineering can come together and form such a project team! The College is making honest efforts in placing female faculty in all four engineering disciplines so that they can act as role models and mentors for the incoming engineering students. The college currently has seven female faculty out of a total of 28. Furthermore, the faculty are encouraged in having an active role in the SWE chapter here. The current female faculty have also been instrumental in encouraging and motivating female high school students to pursue engineering during their high school recruiting efforts.

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Authors:

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