

AWE: A WORKSHOP FOR ATTRACTING MIDDLE SCHOOL GIRLS TO ENGINEERING

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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. Participants from 6th and 7th grades were selected from four neighboring counties. Novel hands-on experiments in the various fields of engineering with state of the art technology were used to boost the participants' interest in engineering. Experiments required cooperative and collaborative learning through teamwork. The participants interacted with departmental faculty, undergraduate engineering students and representatives from local industry. The workshop specifically focused on hands-on engineering laboratory experiments, field trips to local industries, seminars on engineering ethics, professionalism, gender sensitivity and computer training sessions. The workshop also helped motivate engineering faculty and students to become active mentors for women in engineering. Mentoring programs can have a major impact on encouraging and retaining women in science and engineering programs. A large number of educational institutes have started establishing mentoring programs for their incoming female engineering students. It is expected that such workshops will encourage young women to consider engineering as a course of study and/or a career, thereby attracting new and more diverse engineering talent to the workforce.

INTRODUCTION

Women constitute approximately half of the population and about 46 percent of the labor force in all occupations, but only 9 percent of engineers¹⁻³. 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

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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 school⁴⁻⁹. 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. Lebuffe⁴ 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 it³.

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. Mentoring workshops and programs at engineering schools/colleges are becoming more and more popular and necessary⁴. Mentoring is the process of counseling or advising an individual and directing/enriching their experiences. A review of research literature tends to show that mentoring has a tremendous positive impact upon the academic life of the students or mentees. Most of the literature confirms though that the current mentorship is focused on graduate students, where the professor serves as a mentor to the student. There are some NSF programs (RUI, REU, IDP) for enriching undergraduate students through research opportunities at high schools/colleges/universities. Industries are also participating in mentoring programs for high school students. However in order to increase female and minority participation in the science and engineering fields, the focus of the mentor programs must begin as early as possible even in their elementary education.

AWE WORKSHOP

A two-week innovative workshop for exposing female students from the 7th and 8th 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. In one classic study, the girls' decline in confidence preceded their lowered achievement. The exposure

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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. A review of research literature tends to show that mentoring also has a tremendous positive impact upon the academic life of students. Most girls currently enrolled in science and engineering programs indicate that they were strongly influenced either by a parent/guardian/siblings/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. Programs specifically focused on hands-on engineering laboratory experiments, field trips, design projects, workshops on engineering ethics, professionalism, gender sensitivity and computer training sessions.

Objectives of the Project

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 careers 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.

Funding

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. The EiF foundation is located in New Jersey.

Recruitment and Participant Selection

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A committee comprising of the principal investigators, the admissions office and the EEO/AA officer at Rowan was formed to identify target schools. Four neighboring counties (Gloucester, Camden, Salem, and Cumberland) were identified and an information package was mailed to a total of 36 area middle schools. Project AWE was publicized to the local schools by sending a letter and a flyer to the guidance counselor, principal and school superintendents. Arrangements were also made to give slide presentations on project AWE at certain schools. 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.

Project Staff

The workshop was administered by through the Department of Civil and Environmental Engineering at Rowan University. However, the workshop involved faculty from the chemical, electrical and mechanical engineering disciplines. All faculty are active members of the Society for Women Engineers. Four undergraduate female engineering students served as mentors and role models for the participants during the course of the workshop. The program format was designed to increase the participating student's confidence by exposure to other college students with similar interests. The experience also served to encourage engineering students to recognize the importance of mentoring throughout their lives.

Workshop Schedule

Students were initially given a tour of Rowan University and Rowan Hall, the brand new College of Engineering and the site of the workshop. Special trips were also made to the library and the student recreation center. Students were provided with a breakfast and lunch everyday. A lecture laboratory format, employing innovative educational methods developed by the instructors and industrial experts was used to demonstrate discipline specific engineering principles¹⁰. Computer lessons in spreadsheets, presentations, internet research were also an integral part of this workshop. 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. Speakers from 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

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NIST (National Institute of Standards and Technology) participated in these 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. Her seminar also focused on gender sensitivity and gender bias issues. The participants were also informed about available scholarships for pursuing careers in science and engineering.

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”*. Parents, the Rowan community and local schools were all invited for the team poster display.

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 from Parents

“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.”

Information Dissemination

A web site dedicated to project AWE has been established at Rowan to facilitate the rapid dissemination of the project. 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. 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.

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 relationship¹¹. 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.

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