

Board 135: Reflecting on 20 Years of the Attracting Women into Engineering (AWE) Workshop

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Ms. Melanie Basantis (Director, Engineering Outreach Office) earned her MBA from Widener University and dual degrees in Industrial Engineering and Business Management from The Pennsylvania State University. Ms. Basantis spent 15 years in industry at the Boeing Company working as an Engineer on projects related to defense aircraft including the V-22 Osprey and CH-46 and CH-47 tandem rotor helicopters along with being a Composite Manger on the 757 and 767 commercial aircraft programs. Ms. Basantis has experience in the development and implementation of new and innovative technologies in the manufacturing processes associated with revolutionary, new assembly methods and concepts for aircraft application. She is experienced in the utilization of lean manufacturing, total quality management, and ISO concepts and specifications in the implementation of these processes. As Engineering Outreach Director, Ms. Basantis collaborates with industry on initiatives that include, but not limited to professionalism, internship experience, job placement, student development and enrichment, as well as concentrated faculty research. Ms. Basantis provides leadership to The College of Engineering's STEM initiatives and has done so for the past 10 years. Middle and High school camps and field experiences are held under her guidance and expertise.

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Kauser Jahan, is a Professor of Civil and Environmental Engineering at Rowan University. She received her B.S.C.E. from the Bangladesh University of Engineering and Technology, an MSCE from the University of Arkansas, Fayetteville and a Ph.D. from the University of Minnesota, Minneapolis. Her passion as an educator and mentor has been recognized by many professional organizations over the years. She is the recipient of the Gloucester County Women of Achievement Award, Lindback Foundation Teaching Award, the NJ ASCE Educator of the Year award, the Gary J. Hunter Excellence in Mentoring Award, the ASEE Environmental Engineering Division Meritorious Service Award, the ASEE Women in Engineering Division Sharon A. Keillor Award and the WEPAN Women in Engineering Initiative Award. She has been instrumental in establishing the Attracting Women into Engineering, the Engineers on Wheels and Engineering Clinics for Teachers programs at Rowan University. She has served as the Institutional Representative and Advisory Board Chair for the Women's Professional Network at Rowan University for six years and currently is an advisory board member of the New Jersey Chapter of the American Council on Education (ACE) Office of Women in Higher Education (OWHE). She received a Fulbright award in 2015.

Reflecting on 20 Years of the Attracting Women into Engineering (AWE) Workshop

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Abstract

Women have become increasingly visible in business, health professions, and law, yet they are still underrepresented in science, technology, engineering, and mathematics (STEM) professions. According to the U.S. Department of Commerce's 2017 Women in STEM Update, women constituted 47% of all U.S. jobs in 2015 but held only 24% of STEM jobs. The gender disparity in STEM is caused in part by the lack of exposure girls have to STEM education during formative K-8 years as well as the lack of women role models present in these fields. To encourage more girls in STEM, the Attracting Women into Engineering (AWE) Workshop was founded in 1998. The AWE Workshop is a summer program that strives to introduce middle school girls to engineering careers via one-day sessions. Participants have the opportunity to interact with women faculty members and undergraduate/graduate students during hands-on engineering experiments while also learning about various engineering disciplines. Our mission is to negate preconceived stereotypes about engineering, to cultivate girls' interest in STEM, to expose girls to the diverse career paths that engineers can pursue, and to foster an environment of intellectual growth, self-esteem, and empowerment. The workshop celebrated its twentieth anniversary in summer 2018. Here, a reflection on the lessons learned from running the program for the past 20 years is provided. The AWE Workshop is impactful in young girls' exploration of not only engineering but also other STEM fields.

1.0 Introduction

1.1 Attracting Women into Engineering (AWE)

Summer camps or programs strive to provide an outlet for children to interact with each other. Traditional goals include teaching participants certain skills but these camps aim to do so in fun, engaging ways [1]. The Attracting Women into Engineering (AWE) Workshop is a summer program hosted by the Henry M. Rowan College of Engineering at Rowan University. The AWE Workshop strives to introduce girls from local schools to engineering and associated opportunities and careers via one-day sessions. Participants have the ability to interact with engineering faculty members and undergraduate students while participating in hands-on engineering activities. The program reaches on average over 100 middle-school-aged girls annually, bringing them to Rowan's campus to explore engineering through hands-on projects and demonstrations. This applied approach to learning, a hallmark of Rowan Engineering, introduces AWE participants to various engineering disciplines and careers and provides an opportunity to connect with like-minded peers and current engineering undergraduates as mentors and advisors. AWE was established in 1998 and has hosted over 2,000 middle school girls and has served as a model for additional outreach programs hosted at Rowan University.

1.2 Why Girls?

Women constitute nearly half the workforce in the United States but only 24% of STEM (science, technology, engineering, and mathematics) jobs [2]. The target audience, middle school girls, was selected as this period of time is known to result in a decrease of girls' self-esteem as they enter adolescence [3]. 66% of fourth grade girls report that they enjoy their mathematics and science classes; however, by college, only 18% of engineering majors are female [4].

Various studies suggest that social influences are responsible for the underrepresentation of women in STEM fields. Social influences include those propagated by social media, negative stereotypes regarding engineers and scientists, and lack of female role models.

1.3 Mission

The overall goal of the AWE program is to provide exposure to girls about the possibilities associated with careers in engineering via hands-on learning. The AWE program hopes to cultivate girls' interest in engineering, inform girls about the diverse career paths and opportunities that can be pursued by engineers, and to spark and ignite young girls' imaginations. The AWE program provides a setting for girls to meet like-minded female peers as well as identify possible role models and mentors. Each AWE session fosters an environment of intellectual growth, self-esteem, and empowerment.

1.4 Participant Recruitment

During AWE's inception, four neighboring counties (Gloucester, Camden, Salem, and Cumberland) were specifically targeted and information regarding AWE was mailed to local middle schools. More recently, information about the AWE Workshop has been disseminated

electronically via e-mail to local middle school STEM teachers. Students from rural areas who may not have had exposure to science and math and minority students who are typically underrepresented in engineering are especially encouraged to apply. Now, AWE attracts students from numerous counties all over New Jersey as well as Pennsylvania, Maryland, and Connecticut.

1.5 Workshop Staff

The AWE Workshop has involved the entire College of Engineering, which includes the biomedical, chemical, civil and environmental, electrical and mechanical engineering disciplines. The program format was designed to increase the participants' 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. This workshop therefore served a dual purpose by helping engineering students build their confidence, communication and leadership skills. Undergraduate engineering students serve as mentors and guide participants throughout the workshop.

1.6 Project Evaluation

Participants were asked to rate the individual components of the workshop everyday for the past twenty years the AWE Workshop has been offered. This evaluation has been extremely successful in assessing the impact of the program. 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. Over the years, participants have strongly agreed that they had a better understanding of engineering careers. Most participants have also agreed that they understood the importance of learning science and mathematics. During the early years of the program, in addition to participant feedback, a surveys were also given to the parent(s)/guardian(s) of the participants.

2.0 Hands-on Engineering Activities

The AWE program provides exposure to engineering disciplines via hands-on activities that are led by engineering faculty in addition to undergraduate and graduate students in engineering laboratories as well as the Experiential Engineering Education (ExEED) Outreach Lab. The ExEED Outreach Lab is a dedicated room for outreach programs hosted by the Henry M. Rowan College of Engineering Outreach Office.

Our activities focus on biomedical engineering, chemical engineering, civil and environmental engineering, electrical engineering, and mechanical engineering. Specific activities for each discipline are outlined below. The activities offered over the course of the twenty years in which the AWE Workshop has run have evolved and new activities have been developed and employed in the program. This is because engineering is a rapidly changing field and we strive to provide our participants with the most current overview of engineering. A combination of activities from each discipline is selected for the AWE program each year. Students complete an exit survey at the end of the day, indicating which aspects of the program they liked/disliked. A sample schedule is provided below in Table 1.

Table 1: Sample AWE Schedule

Time	Event/Activity
9:00-9:20 AM	Registration & Welcome
9:20-9:30 AM	Team Building and Ice Breaker Activity
9:30-10:15 AM	<u>Civil Engineering</u> <i>Building Concrete Canoes, Bridge Builder</i>
10:15-11:15 AM	<u>Mechanical Engineering</u> <i>Designing & Launching Bottle Rockets</i>
11:15-12:15 PM	<u>Environmental Engineering</u> <i>Water Quality Assessment, Using Portable Water Purification Systems, Algae as a Biofuel</i>
12:15-1:00 PM	Lunch & Presentation by student chapter of Rowan University Engineers without Borders
1:00-2:00 PM	<u>Chemical Engineering</u> <i>Hydrogels and Cross-Linking Reactions, Manufacture and Entrepreneurship of Lip Gloss, Consistency of Chocolate Coated Oreo Cookie Production</i>
2:00-3:00 PM	<u>Electrical Engineering</u> <i>Programming with Arduinos, Optics with Jell-O, Music Engineering, Robotic Arm Demonstration</i>
3:00-3:30 PM	<u>Biomedical Engineering</u> <i>Modeling an Aneurism, Exploring Fluid Flow, How to Fix Broken Bones</i>
3:30-4:00PM	Q & A Session & Exit Survey

2.1 Biomedical Engineering

Activities associated with biomedical engineering include modeling an aneurism, understanding the Coanda effect, and learning how to fix broken bones. To understand the Coanda effect, which is the tendency of a fluid jet to stay attached to a convex surface, each participant is given a bendable plastic straw and ping pong ball [6, 7]. Another activity includes a focus on how broken bones are fixed and utilizes chicken wings.

2.2 Chemical Engineering

Activities associated with chemical engineering include creating hydrogels to understand cross-linking reactions and how to manufacture lip gloss. Participants use sodium alginate to prepare their own jump ropes and bouncy balls. Our popular lip gloss module includes each participant preparing her own lip gloss from beeswax and understanding the numerous steps associated with product development. This is achieved as the participant selects a flavor/scent, color(s), whether they would like to add mica to make their lip gloss shimmer, what type of oil to use, and what type of container to place the resulting lip gloss in.

2.3 Civil and Environmental Engineering

Civil engineering activities include designing and testing miniature concrete canoes as well as learning how to build bridges. Participants typically design and prepare miniature concrete canoes in the beginning of the AWE session and later return at the end of the day to test the efficacy of their design. Participants explore bridge building by using Jenga blocks to build various types of bridges and learn about the concepts of compression and tension as well as using Bridge Builder software [8].

Environmental engineering activities include assessing water quality and using a portable water purification system. Participants collect water from the Rowan Pond, located behind our engineering building and they then conduct jar tests to understand how chlorination is used by water treatment facilities.

2.4 Electrical Engineering

Electrical engineering activities include programming Arduinos to create a traffic light controller, learning about optics using Jell-O, and exploring music engineering using Little Bits kits [9, 10]. A demonstration using a robotic arm from the Department of Electrical Engineering is typically included.

2.5 Mechanical Engineering

For mechanical engineering, participants design and launch their own bottle rockets under faculty supervision and guidance from undergraduate mentors. Participants learn about parametric design as they use a 2-liter soda bottle, foam board, and duct tape to design and test their bottle rockets [11].

3.0 Twentieth Anniversary Reflection

The AWE program celebrated its twentieth anniversary in July 2018. As such, it is critical to reflect on the lessons learned. The program initially focused on hosting 50 participants per each one-day workshop. However, we now limit our program to 25 participants per day. This enables our undergraduate mentors to provide careful attention to each participant.

A testament to the AWE program's success and value of its mission includes the return of AWE alumna, Dr. Sarah Bauer, to the Henry M. Rowan College of Engineering as an assistant professor in the Department of Civil and Environmental Engineering in 2018. Bauer first attended AWE while a middle school student and then returned as an AWE mentor while studying civil and environmental engineering at Rowan University.

3.1 Participant Feedback

At the conclusion of each day, participants are asked to rate the individual components of the workshop as well as the workshop overall. This evaluation method has been successful in indicating the reception of our hands-on activities. Participants have consistently indicated that

AWE is effective in helping their understanding of the importance of STEM. The most popular hands-on activities include designing and launching bottle rockets, hydrogels and cross-linking reactions, manufacture and entrepreneurship of lip gloss, and programming with Arduinos. These activities have consistently ranked as the favorite activities among our participants.

4.0 Conclusion

Ultimately, the help of numerous faculty, engineering staff, and student mentors has ensured the success of the AWE Workshop over the past twenty years. The AWE program has significantly evolved from when it was first established in 1998. Based on feedback from participants, the AWE program has been tailored to best appeal to girls' interest in engineering as well as other STEM fields. The AWE Workshop provides a memorable experience for girls and is effective in kindling and fostering interest in not only engineering but also STEM, which is one of the core goals of the program. AWE was the original motivation and model for Rowan University's other outreach programs, such as Boys' Engineering, Science, and Technology (BEST) Workshop, Rowan's Introduction for Students to Engineering, weekly STEM Engineering Experiences offered to local elementary and middle schools, and initiatives carried out by Rowan University's STEM Center. The everlasting impact of AWE on young girls' perception of engineering as well as other STEM fields is unquestionable. For two decades, the Henry M. Rowan College of Engineering has encouraged and promoted gender diversity and equality in engineering as well as other STEM fields.

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