

A Summer Camp Program to Introduce Girls to Opportunities in Engineering

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Abstract

The Women in Engineering Program (WIEP) was introduced at Purdue University in 1969, with a focus on offering educational enhancement activities for women interested in pursuing engineering degrees. Programming has evolved over the past 38 years to include a K-12 outreach program, undergraduate recruiting, and faculty, graduate and undergraduate retention. To nurture young girls who are excited about engineering, a summer camp program was established in 2000 (Stwalley 2001) . This program has expanded to three, week-long summer camps targeting specific age groups. The over-arching goals of the program are for the students to progress through the sequence of summer camps, choose engineering as a college major, and matriculate to Purdue University's College of Engineering.

The Love Engineering at Purdue (LEAP) summer camps are targeted to 5th—8th grade female students who are motivated by using their imagination and creativity to solve interesting problems facing society today. The LEAP camps are led by female engineering graduate and undergraduate students who provide a positive female role model for the participants. They engage the campers in exciting hands-on engineering group activities. This teamwork-focused method resembles “real-life” engineering.

The Exciting Discoveries for Girls in Engineering (EDGE) camp is targeted to rising sophomores and juniors who seek challenging hands-on team-based activities to explore the various engineering disciplines. The team-based focus provides the participants an opportunity to solve interesting problems by developing, executing, trouble-shooting, and finalizing engineering projects, and then competing in team challenges. The EDGE campers are also introduced to several current female engineering students as well as engineering alumnae who share their stories of success in engineering. Purdue currently sees a matriculation rate of 25% from EDGE participants and 26% from eligible LEAP participants.

This paper will provide an overview of the structure of the Purdue University Women in Engineering Summer Camp Program, explore the participant demographics, and describe the effective practices that are utilized.

Introduction

It is well known that the number of undergraduate women studying engineering disciplines has grown substantially in the past 40 years from nearly non-existent to roughly 20% in 2000 (NSF,

2005). However, the latest reports from the Engineering Workforce Commission show that the number of women who earned baccalaureate degrees in 2007 (18.6%) was the smallest percentage since 1998. Unfortunately, this trend is seen throughout the majority of the STEM (science, technology, engineering and mathematics) disciplines. Since the early 1990s, the National Science Foundation has put much effort into addressing these issues (NSF 2003; 2006a; 2006b). The NSF Research on Gender in Science and Engineering program reported that in a study of 4th grade students 66% of girls and 68% of boys reported liking science. However, by the 8th grade, twice as many boys reported being interested in STEM careers than girls. This suggests that there exists a predominant “leak in the pipeline” in middle school where several female students lose interest in mathematics and science and, as such, do not pursue engineering majors in College.

Many institutions have been addressing this void by creating outreach programs directed towards middle school and high school aged girls (Lighty et al. 2004; Jeffers et al. 2004; Sontgerath et al. 2005). For example, the University of Utah’s Hi-GEAR program aimed at rising high school juniors and seniors has experienced a number of their participants matriculating after offering the program for only three years (Lighty et al. 2004). The Massachusetts 4 Schools for WIE (Women in Engineering) collaboration developed STEM Teams, an intervention system for middle school science classrooms (Sontgerath et al. 2005). They found that by having a female team of professional engineers, engineering faculty, engineering students, and middle school teachers present gender equitable engineering curricula in the middle school classroom has had a positive affect on girls’ attitudes towards math, science and engineering relative to the boys’. Jeffers et al. (2004) reviewed over 50 K-12 engineering outreach programs and identified the following common themes; increasing engineering enrollment, diversifying engineering, undergraduate student development, and Teach the Teacher programs. These themes can be accomplished in several ways including developing classroom materials, conducting outreach activities on the college campus or at the K-12 school, conducting engineering contests, offering service learning courses, and offering professional development for K-12 educators. They concluded that since technology is prevalent in everyday life, a technical education is extremely important and therefore, students must be introduced to engineering at an early age (Jeffers et al. 2004).

The Women in Engineering Program (WIEP) at Purdue University focuses on offering educational enhancement activities for women interested in pursuing engineering degrees. To that end, a summer camp program for middle and high school girls was established in 2000 (Stwalley 2001). Our desire is to provide an opportunity for girls in grades 5 - 10 to explore engineering through hands-on team-based activities. The over-arching goals of the program are for the students to progress through the sequence summer camps, choose engineering as a college major, and matriculate to Purdue University’s College of Engineering.

Summer Camp Program Description

Research shows that middle school aged girls learn better in situations where collaboration and hands-on learning techniques are emphasized in a “safe and nurturing” environment (Mann 1994; Allen 1995). The WIEP summer camp program consists of three camps focused on girls interested in using their imagination and creativity to explore engineering through hands-on

team-based activities. To achieve the goal of encouraging young women to pursue careers in engineering, a summer camp program for girls in grades 5 - 10 has been implemented. Three separate camps are offered to specific age groups; Love Engineering at Purdue (LEAP) I is a day camp for 5th and 6th graders, LEAP II is a residential camp for 7th and 8th graders and Exciting Discoveries for Girls in Engineering (EDGE) is a residential camp for 9th and 10th graders. By targeting specific age groups, the camps deliver age-appropriate curriculum and activities to challenge and inspire the participants. LEAP I, LEAP II, and EDGE are offered annually however, biennially scheduling allows for students to attend WIEP summer camps for 6 years and always have a new experience.

Participants are selected through an application process. All potential participants complete an application, write a 300 word engineering-related essay, and provide a letter of recommendation from a school science or math teacher. Since the camps are limited to 40 participants, essays and letters of recommendation are scored and the top 40 applicants for each session are invited.

The WIEP summer camps are organized and directed by the WIEP Associate Director however, the implementation is done with the assistance of female graduate and undergraduate students in the College of Engineering as facilitators, chaperones and hall counselors. Facilitators work with the camp director by aiding in the planning and implementation of each camp. They also run the daily hands-on engineering activities during the camps. Chaperones stay with the residential campers from dinner until breakfast the next morning. They also direct the evening activities and sleep in the dorm with the campers. Hall counselors reside in the residence hall from 10 pm to 8 am and are available for the staff and campers in case of an emergency.

The assistance of the student staff is vital to the success of camp for they act as role models and mentors to the campers. These interactions benefit both the campers and student staff alike. The student staff is selected through an interview process and they participate in training sessions to prepare for the camps. The staff receives both professional and personal rewards. Professionally, they receive a stipend, gain experience working with young students, have the opportunity to teach their specialty in age-appropriate terms, and gain leadership experience to add to their resume. However, in post-camp interviews, the staff states that the personal rewards they experience far outweigh the professional. They take advantage of this opportunity by making new friends in different engineering disciplines and expanding their peer networks. They develop a greater appreciation for their field as they are required to explain complex engineering concepts to girls as young as 10 years old. And perhaps most importantly, they gain the satisfaction of seeing young girls excited about engineering and leave camp knowing that they have made a impact on a young girls' life.

Whereas the camps differ in curriculum and activities, there are similarities in the general framework. Each camp begins with an overview for parents and participants, and ends with the Team Competition & Awards Banquet. The goal of orientation is to review camp policies, introduce the staff, and most importantly, educate the parents on careers in engineering. Research shows that the value a person places on different types of occupations leads to the gender gap seen in the physical sciences and engineering fields (Eccles 2007). These "tendencies" occur very early in life when girls tend to seek careers that provide "direct benefits to society". Unfortunately, engineering is not seen a career that would accomplish this goal. Also, research

suggests that middle school girls who perceive parental encouragement in math and science were more likely to find mathematics less difficult and gain higher levels of achievement (Clewell and Campbell 2002). Therefore, it is paramount to educate both the parents and their daughters on careers in engineering. To that end, the undergraduate and graduate staff shares their educational experiences and career choices during the orientation session. The parents and campers sit in awe as they hear about the amazing research being conducted by and the remarkable opportunities that are afforded to Purdue engineering students. This is a powerful portion of the orientation session and the parents typically respond by giving the staff a standing ovation. The Team Competition and Awards Banquet is the final event at all three camps. The primary goals of this event are to enable the campers to demonstrate what they have learned to their families, and to create a meaningful venue to recognize the achievements of the campers. Awards are given to the top three groups for each activity challenge as well as to the Outstanding Camper who is chosen by their peers. Also recognized are the participants who have attended more than one WIEP summer camp.

Love Engineering at Purdue (LEAP)

The LEAP summer camp is targeted for girls in grades 5 - 8 who are motivated by using their imagination and creativity to solve interesting problems facing today's world. LEAP I is a 4 day long day-only camp for girls who have completed 5th or 6th grade. The goal of LEAP I is to introduce campers to the wide array of career opportunities in engineering. The participants complete several 1 - 1.5 hour hands-on team activities in a variety of disciplines, and one large project that typically takes 4-6 hours to finish that incorporates several areas of engineering. The participants tour an engineering laboratory at Purdue and visit a local manufacturing site to see engineers at work. LEAP II is a 4-day, 3-night residential camp for girls who have completed 7th or 8th grade. The goal of LEAP II is to show the participants that engineering is a team-based, multidisciplinary, people-focused, problem solving career. Each camp is organized around a theme (i.e. Renewable Energy or Natural Disasters) and the team-based hands-on activities relate to that particular theme. Campers also tour at least one engineering laboratory at Purdue, visit a local manufacturing site, and hear a female engineering alum tell her success story.

Exciting Discoveries for Girls in Engineering (EDGE)

The EDGE summer camp is a 6-day, 5-night residential camp targeted to rising high school sophomores and juniors who are interested in careers in engineering and desire the opportunity to delve into a specific discipline. The goal is to reinforce the concept that engineers work in teams addressing important issues facing today's society. The participants work in teams to tackle 3 or 4 advanced issues, and over the course of several days, develop tools to address these problems. They spend one day at an engineering site touring the facilities and talking with on-site professional engineers. Participants will also select one particular area of engineering and spend a day with faculty and graduate students focused in that specific discipline.

Data

Demographic data has been collected since the inception of WIEP summer camps at Purdue University in 2000. To date, WIEP has hosted 450 campers over the past 8 years with 10%

attending camps over multiple summers. The total number of camp participants each year for both LEAP and EDGE is shown in Fig. 1. The goal is to have 40 participants at each camp for a total of 120 campers each summer. Originally, there was only one session of LEAP camp. In 2004, the two camp system was introduced with much success. However, due to unforeseen circumstances, only one section of LEAP was offered in 2007. In coming years, both LEAP I and LEAP II will be offered. The participation in EDGE camp has increased over the past 4 years and nearing the goal of 40 participants.

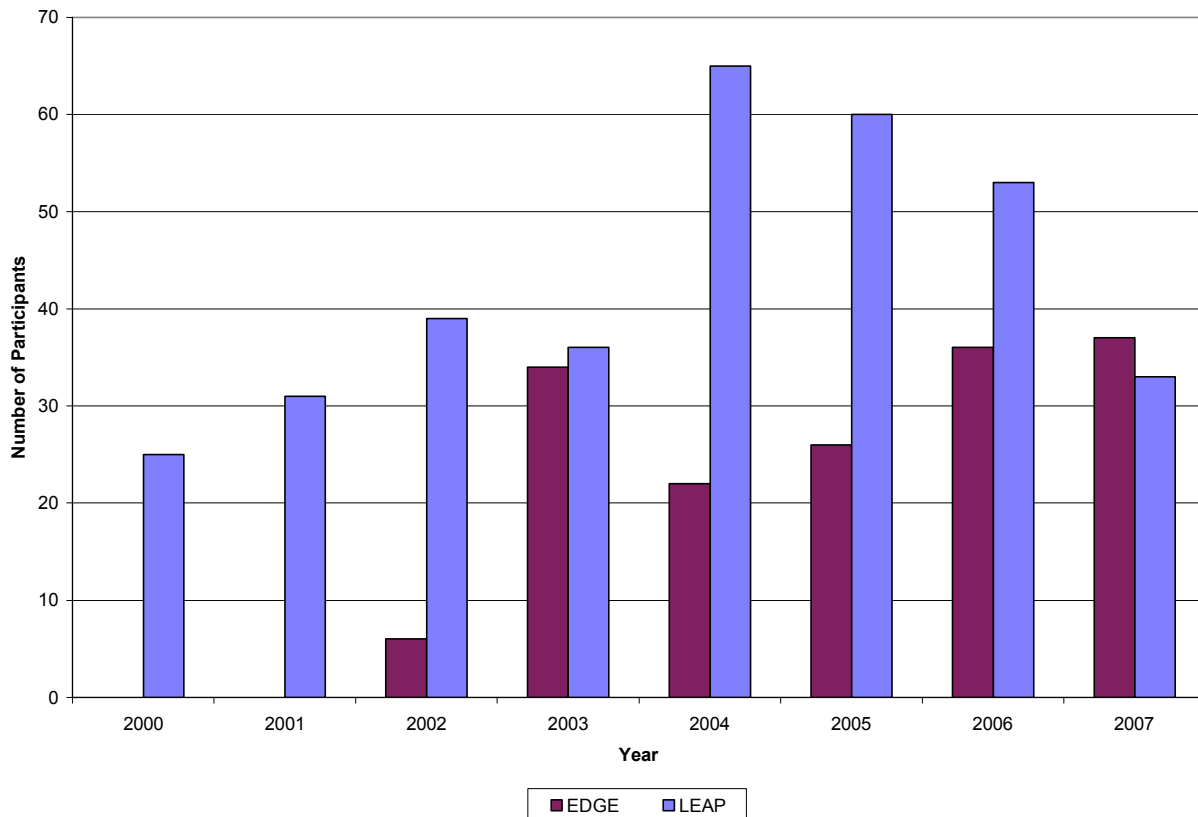


Figure 1. The number of LEAP and EDGE participants from 2000-07

The home state of all LEAP and EDGE participants is shown in Fig. 2. As expected, the majority of the participants come from the state of Indiana (the location of Purdue University), with the surrounding states of Illinois, Michigan and Ohio generating the next greatest numbers of participants. Over the 8 years, we have hosted participants from 26 other states, Washington DC, Puerto Rico and Canada.

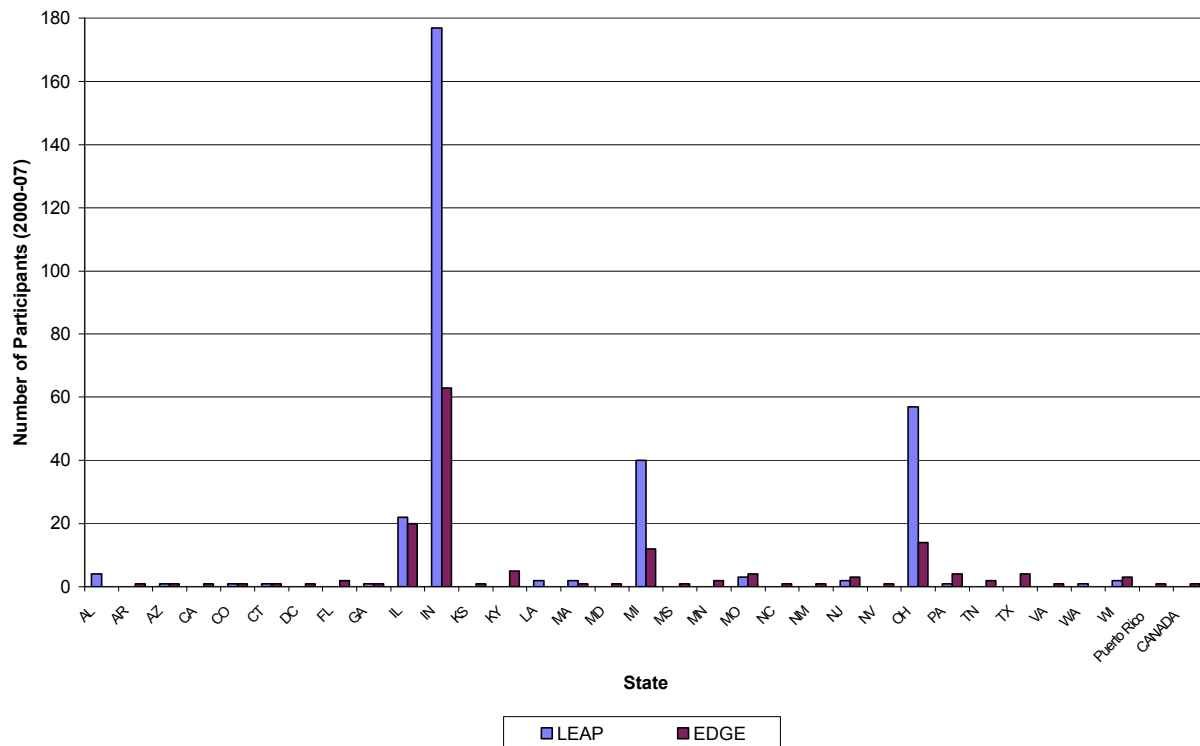


Figure 2: Home state of LEAP and EDGE participants from 2000-07

The self-identified ethnic diversity of the participants is shown in Fig. 3. The majority of participants in both LEAP and EDGE are Caucasian with a quarter of the participants African American. Asian American students make up 5 - 6 % of the participants. Only 8 Hispanic students and 1 Native American student have attended a WIEP camp in the past 8 years.

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Figure 3: Ethnic diversity of LEAP and EDGE participants from 2000-07

Discussion

A comprehensive summer camp program has been developed to encourage girls in grades 5 - 10 to matriculate to Purdue University to study engineering. While camps have been offered for 8 years, the current three camp system has only been offered the past 4 years. The majority of the participants attend one summer session of camp however, since the inception of the three camp system, 10% of the campers have returned for a second summer and 2% for a third summer. The majority of the participants come from the state of Indiana with the surrounding states of Illinois, Michigan and Ohio also providing a substantial number of participants. Due to mass mailing, word of mouth, and internet advertising, WIEP has hosted participants from 26 other states, Washington DC, Puerto Rico and Canada. The majority (55-65%) of the participants self-identify their ethnicity as Caucasian, with 25% selecting African American, 5-6% Asian American, fewer than 3% Hispanic, and less than 1% Native American.

Purdue has seen a 25% matriculation rate of the eligible EDGE participants and 26% of eligible LEAP participants. Of these students, 52% enrolled in the College of Engineering, 16% in the College of Science, 10% in the College of Agriculture and Forestry and the remaining into Pharmacy, Liberal Arts, and Education.

The Purdue University Women in Engineering Summer Camp Program has been in existence for 8 years and continues to evolve with the feedback from the participants, parents, and camp staff. Grouping the participants by age and limiting each camp to students in two grades has allowed for more effective implementation of the appropriate hands-on engineering activities and tours. Feedback received from post-surveys suggested that participant satisfaction level was related to their interactions with the camp staff. To this end, a comprehensive staff training program has been implemented and overall camper and staff satisfaction levels have increased. The WIEP summer camp program will continue to strive to reach the following goals; 40 participants for each camp, a camper return rate of 25%, and a matriculation rate of 40%.

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