AN INNOVATIVE PROGRAM TO ATTRACT HIGH SCHOOL WOMEN INTO ENGINEERING

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I. Introduction and Background

This program originated from a faculty discussion centered around the fact that engineering enrollments were declining or stagnating at a national level and that enrollment of women in engineering had leveled off. It was generally agreed that it might be possible to have some impact on the number of women enrolling in engineering if a program could be developed that addressed the issues of peer groups, role models, and the math/science question at a point where it was timely in the career decision process.

Further study and a review of several existing summer programs (for men and women) indicated that they could provide a much needed foundation[1,3]. Our program developed into two parts: Part one is a one week on campus summer program which serves as the foundation. Part 2 is a year long follow on program which fosters a peer group relationship making use of a computer network and introduces a set of role models.

A review of literature about women in engineering and math indicated that the early high school years were the crucial decision years[4]. One study of particular interest from NSF indicated that women and men perform about equally well in mathematics and science at the eighth grade level[1]. By the tenth grade level however, men out perform women by a significant margin.

II. Objectives of the Program

The objectives of the program are: 1) To encourage qualified high school women to consider engineering as a career objective. 2) To provide a peer group for high school women who are otherwise "loners" in their interest in science and mathematics. 3) To provide female role models in engineering so the high school participants and

their families see engineering as an acceptable career for women. Several studies indicate that role models are important to the career decision process[2,4,5].

Age Level:

The program is directed primarily at women who finish their Sophomore year (grade 10) in high school. Several studies have shown that the early high school years were the years in which the career decisions were being formed. Women on a "college track" in high school are all enrolled in the basic math and science courses as Freshman and Sophomores. The objective of the program is to keep these women in the math science track. The decision as to who got into the program was based largely on essays which the women wrote and on recommendations written by teachers and role models.

Program size:

The size of the program was dictated by the facilities and personnel available to participate. Each of the discipline specific teaching sessions consisted of 2 faculty members, a student assistant, and eight participants. The program was limited to a maximum size of 32 participants. These were spread over a two week period so that no more than 16 participants were in the on campus program at any one time. Social events and some group sessions involved all 16 participants. All instruction was done in groups of 8.

Role models:

The role model group consisted of working women engineers in the local community. Role models participated in some of the activities that took place during the on campus session including a panel discussion of family issues, a picnic, and staying overnight in the dorm. During the follow on session each role model agreed to take one or more of the participants to work with her for one day. The participants were directed to contact the role models and make arrangements to visit at least two of them during the year. Participants spent the day at work seeing what a working woman engineer did. All of this was conducted on a volunteer basis with the role models. Both the role models and the corporations where they worked were enthusiastic and helpful.

Instruction:

This program is not a remedial program. Instruction was therefore directed at presenting information about careers in engineering that would permit an informed career decision. It was impossible to cover all aspects of even a single career field. Instructors therefore

adopted a single specialty within their field and created a typical project to illustrate that area. The use of mathematics and science was encouraged. Instructors assumed that all of the participants had a working knowledge of algebra and geometry.

Some sessions were also devoted to teaching the participants how to use their laptop computers for communications on the network.

III. The On Campus program

The on campus portion of the program takes place during one week in June of each summer. Participants are brought to campus by their families and move into a dormitory. All participants are together on one floor with assigned room mates. Each day begins at 7:00 am with a common breakfast. Work sessions start at 8:00 am. A typical day consists of two work sessions of 3 hours 45 minutes each with a 90 minute lunch break. Dinner is followed in the evening with a scheduled evening session. The day work sessions teach the fundamentals of using a computer and provide details about Electrical, Mechanical, Civil, and Computer Engineering/Computer Science. One day in the middle of the week is reserved for plant trips.

Technical programs:

The engineering areas covered by the on campus portion of the program included Electrical, Mechanical, Civil, and Computer Engineering/Computer Science. These areas were chosen because these are the areas in which the school grants degrees and has facilities and expertise. Other areas (notably Chemical and Aeronautical Engineering) were covered by providing literature and references. Each of the four areas were allocated a four hour period in which to give instruction. Faculty for each of the sections were told to avoid long lecture periods and to concentrate on hands on skills that illustrated typical activities involved in the discipline.

The Electrical Engineering session divided the women into groups of 2. Each group received a radio controlled car in which the radio controller had been replaced with a microcomputer programmable from the participants laptop. The women programmed the cars to follow a flashlight.

The Civil Engineering session likewise divided the group of eight into four sets of two. Each pair then constructed a balsa wood bridge which was later weighted and broken. The Computer Engineering/Computer Science session concentrated on programming and graphics software running on the universities 486 networked machines. The Mechanical Engineering session had three separate

activities. In the first, the participants created name tags on a computer screen and had them formed by a programmable milling machine. In the second, they pulled apart aluminum samples in a tensile testing machine. In the third part they took data on a water driven turbine.

Plant visits:

During the one week on campus portion of the program one day was devoted to touring two plants to see the production and engineering going on. Plant tours were set up in advance to contain some student involvement. A tour of a local aluminum rolling mill included some hands on activity at the plants technical training center. A tour of a local power plant included a classroom like discussion of power plant energy flow.

Social aspects:

Social life in the program had two important goals. One goal was to create an atmosphere in which the participants felt comfortable with one another so that communication in the follow on program would be successful. A second goal was to make contact with the parents of the participants so that they too understood the objectives of the program.

The participants lived together on one floor of a dormitory. There was an adult supervisor (a female faculty member but not an engineer) who served as the assistant director of the program and lived with the participants. Two female engineering students also spent the evenings and nights in the dorm as assistants. Role models brought their families and visited during the evening hours. Some role models spent the night in the dorm and shared breakfast in the morning.

Evening activities were arranged to encourage working together in groups. One evening was devoted to a panel discussion in which several role models brought their husbands for a discussion of family life of a working engineer.

Contact was made with the participant's parents at the Saturday morning exit brunch. Participants in the program were invited to present a five minute discussion of some aspect of the week's activities. Role models and their families were present for this brunch. A objective of this brunch was to make the parents feel comfortable with the idea that their daughter could have a career in the male dominated field of engineering.

IV. The follow on program

The follow on program begins on the last day of the

on campus program and continues throughout the next school year. During the follow on program the participants remain in contact via the computer network. At six week intervals, the participants re-group on campus to assess what was done during the previous six weeks and to plan the next six weeks. Each six week session has a theme and typically requires some sort of problem solving and interaction. The objective is to maintain the peer group.

During the follow on program each of the participants are required to visit (on site) two of the role models. Role models post job descriptions on the computer network. Participants then schedule a visit with the role models which are of most interest to them.

The role models visits accomplish three objectives: 1) They establish a personal link between a working female engineer and the program participants. This link is vital in making the case that engineering is an acceptable career for women. 2) They show, first hand, the wide variety of work that is available in engineering. 3) They present engineering in a real life (non-academic) setting that is otherwise unavailable.

The computer network:

The computer network is a centerpiece in the program structure. This network makes the peer group possible and provides a way to personally maintain contact with the participants at a very low cost that is also convenient. The network runs on an IBM clone computer using software designed specifically for electronic conferencing. The software is called Caucus and comes from Camber-Roth of Troy, New York. It allows users to send private messages and to post public and semi-public items and responses as if an on going meeting were taking place. The system is relatively easy to use and required no more than two hours of instruction and practice to become adept.

Each participant in the program is loaned a computer and a 2400 baud modem for one year. The computers found other uses in the program. The participant computer selected for the first year of the program was a small IBM clone with a 286 CPU and a 20 Meg hard disk. The machines also had a 3.5 inch floppy and a VGA mono liquid crystal screen. The machines were battery operated and were easily portable.

V. Cost of the program

The program cost for the first on campus session was $963 dollars per participant (exclusive of computers). Each participant paid $150 dollars in tuition making the net cost per participant $813 dollars. The computers,

modems, and case for the computers cost about $1000 dollars per machine. The computers are expected to last for three years with some additional cost for ongoing maintenance. The actual cost of the computers is expected to be about $500 dollars per participant per year.

VI. Impact and conclusion

We will be unable to measure the real impact of the program for another year when the Sophomores who participated begin to make career choices. Anecdotal evidence suggests that the program has made a major impact in getting participants and their families to actively consider careers in science, math, and particularly, engineering.

References:

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