

ECOES
EXPLORING CAREER OPTIONS IN ENGINEERING AND SCIENCE:
A NATIONAL SCIENCE FOUNDATION YOUNG SCHOLARS PROGRAM

Susan Staffin Metz

Stevens Institute of Technology
Hoboken, New Jersey

Program Profile

In the summer of 1989, ECOES introduced forty high school women from 20 states to major aspects of engineering and science. All participants completed their junior year, were enrolled in advanced math and science courses, averaged 1260 on their SAT/PSAT scores and averaged in the top 3% of their class (12 out of 40 students were 1st in their class). Participants spent four weeks in residence at Stevens. ECOES offered students intensive exposure through a broad range of activities to fields that are rarely discussed in a high school classroom. Students also had the opportunity to meet other young women with similar interests and abilities.

Planning for the 1990 ECOES program is currently underway.

Recruitment

The primary recruitment method is direct mail to students. Through participation in the Student Search Program sponsored by the Education Testing Service, we are able to identify eligible students who have indicated an interest in engineering and science. Other recruitment approaches include the admissions office and the NSF Young Scholars Program Directory.

Program Components

We depend largely on our faculty, staff, undergraduate and graduate students, local industry and cultural environment. The richness of these resources enables us to design an informative and enjoyable program. Institutions in a rural area need to be more creative, although the support and involvement of the faculty, staff and students can make up for a lack of other resources.

Research Projects. As part of the academic experience, each student, working with a lab partner, conducts two research projects, one in engineering and one

in science. These activities, closely supervised by Stevens faculty or Ph.D. candidates, show students how to work with advanced equipment to solve the kinds of problems that confront professional engineers and scientists. The students spend approximately twenty hours on each project. The instructors give careful consideration to the project design to ensure that it is geared to the students academic level, is an interesting problem, and shows how solutions to such problems can provide significant contributions to society.

For example, in mechanical engineering, students design a robotic arm that picks up a pencil. In physics, students experiment with lasers to answer the question "is light a wave or a stream of particles?" In chemistry students examine cholesterol levels in various meat products, and in civil engineering students design a low-income housing project.

Students are required to collect and analyze data, write a lab report and give an oral presentation. Workshops are given during the program to prepare students for these requirements.

Exploration Labs. Students have the opportunity to learn about other science and engineering disciplines through the exploration labs. Students attend an hour and a half session which includes a brief discussion by the instructor of what the discipline involves and the professional opportunities available. This discussion is followed by a hands-on lab to give the students an idea of the problems and equipment used by professionals in the field. As a result of participating in these labs, many students discover an interest in a different engineering or science discipline.

Exposure to Female Role-Models. ECOES offers students several targeted panel discussions with practicing engineers, women in science, women in other non-traditional careers, science educators and graduate and undergraduate students. At these sessions, participants ask questions ranging from "Do engineers deal more with people or machines?" to "What is the difference between engineering and science?". Panelists discuss their careers, personal experiences and strategies for success.

When choosing speakers, it is important to identify individuals with a variety of academic and professional backgrounds. Sometimes students are intimidated when they hear only from "superstars".

Team Projects. This project instructs a team of five to work together to design a park. The students are assigned roles such as engineer, budget manager and public relations director. They design this park using certain parameters that are identified by a civil engineer who is

supervises the project. Students learn how engineers interact with other departments and work in teams to accomplish their task. At the end of the week, students present their project.

On-Site Visits. Students see engineers and scientists at work during field visits to industry. At one company, students observe a manufacturing and packaging plant in operation. At another, electrical and mechanical engineers show students some of the latest developments in defense and guidance systems. Students learn about applications of new communications technology at a third facility. Other interesting tours have included an underground tour of a subway being constructed and a manufacturing facility where household products are produced.

Career Guidance. Several career guidance and college information sessions are offered to help students make informed decisions about their futures. In panel discussions, participants learn that there are a variety of career paths to which an engineering or science students can aspire. With the help of the Strong-Campbell Interest Inventory and the Career Development Inventory, students begin to match their interest with various technical professions and to identify possible college majors. Additional presentations include the "College Admissions Process", "Financing a College Education", and "Cooperative Education and Job Placement".

Leadership and Ethics. Students explore leadership styles and skills through various exercises. In one session, students assume the role of a manager who must lay off seven people in her department because of a retrenchment in the company. In "Pins and Straws", different leadership styles are videotaped and evaluated. Here, students assess the varying levels of effectiveness of authoritarian, democratic, and laissez-faire managers as they build structures with pins and straws. Students are also able to examine the economic repercussions of leadership decisions with the aid of computer simulations.

Ethical issues are addressed throughout the program. Discussions about ethics focus on research methods, gender issues, implications of the information age and others.

Social Activities. Many activities are planned throughout the four weeks to foster relationships among the participants, undergraduate and graduate students, faculty and staff. On campus activities such as ice-cream and pizza parties, Sunday brunches, Saturday night movies and various sporting events, create an informal and comfortable atmosphere. Off-campus activities include visits to museums and the beach.

Logistics/Policies and Procedures

It is important to have adequate supervision in the dormitory. ECOES employs four undergraduate students who serve as resident assistants. These students live in the dormitory with the participants and have responsibility for ten students. In addition, an adult is hired as dormitory director to live in the dorm. The dormitory staff is critical to the program. Careful selection and training of the dormitory staff will help ensure a good experience for everyone.

A reasonable set of program policies and procedures are necessary so that the program directors can spend their time educating rather than disciplining. Participants and their parents should be made aware of the program policies before they arrive and the ramifications of ignoring these rules. The major issues that ECOES addresses are drinking, drugs, leaving the campus without permission, curfew and getting overly involved with the young men on campus.

Planning every detail prior to the program is critical. This includes working with instructors to provide an adequate understanding of the group with whom they are working so they can target their teaching properly. Developing working relationships with the housing and dining departments, security, other staff who will be involved with the program is also necessary. It is a good idea to inform your campus community about your program in advance so participants will be welcomed. Through this type of communication you will be pleasantly surprised to find that a faculty or staff member will offer their assistance or participate in some unique way.

COMPARING ECOES AND STEVENS ONE-WEEK PROGRAM

The Stevens Women in Engineering and Management Summer Program (WIEMSP) has been part of our annual programming since 1978. Providing a comparison between ECOES and WIEMSP may assist program directors in determining which type of program is best suited for their institution and program goals.

Program Profile. ECOES includes forty students attending for a one-month period. WIEMSP includes forty students attending for a one-week session. Stevens conducts four, one-week sessions, involving 160 students. ECOES provides students with an academic and career guidance program, whereas WIEMSP is basically a hands-on introduction to various aspects of engineering without the research component.

Goals. The primary goals of ECOES are 1) to provide students with a research experience in engineering and

science; 2) to clarify and strengthen students' interest and knowledge in engineering and science; 3) to support and encourage students to pursue study in engineering and science; and 4) to build an interest in going to graduate school.

The major goals of WIEMSP are 1) to introduce students to major aspects of engineering; 2) to increase students' interest and knowledge of engineering; and 3) to support and encourage students to study engineering in college.

Target Group. WIEMSP invites rising sophomores and rising juniors with ability and interest in math and science to apply. The application includes information about SAT/PSAT scores, high school courses taken and grades. We request that a guidance counselor sign the application, and in that way, recommends the student and confirms the information on the application. WIEMSP students generally average 1100 on the SAT/PSAT and average in the top 10% of their high school class.

ECOES invites only rising juniors with strong high school records and strong ability in math and science to apply. The application includes a personal statement, a letter of recommendation and a high school transcript. As indicated before, ECOES students tend to be academically exceptional.

Activities. ECOES and WIEMSP offer many of the same activities, that in our experience, promote an increased awareness and knowledge of engineering. Role models are incorporated throughout each program in many capacities. Stevens faculty and administration also take an active part in encouraging students to consider engineering and science. Exploration laboratories, field visits to industry, and the "Design a Park" project are incorporated in both programs. Social activities are also important aspects of ECOES and WIEMSP.

The primary difference is ECOES is more academically oriented and rigorous since it includes two research projects requiring oral and written presentations. In addition, there is some "homework" assigned to the students in order to be prepared for the sessions the following day.

Logistics. The planning for ECOES is more extensive since activities need to be developed for a one month period, without repetition. In addition, plans must be made for weekends. We include many creative sports and social events, both technical and non-technical in nature. ECOES students become more familiar with their surroundings and therefore may require more supervision.

Although the planning does not need to be as extensive for WIEMSP, it is sometimes difficult to find faculty and staff who are willing to repeat their

presentation several times depending upon the number of sessions that are conducted. Consequently, the one-week session is probably not as interesting for instructors since they do not go into depth and do not develop strong relationships with the students. However, the impact that the instructors and the WIEMSP program has on the students is greater in terms of their increased knowledge, commitment and understanding of engineering.

Cost. The direct cost for ECOES is about \$325. per week or \$1300. for the month. WIEMSP participant cost is approximately \$300. These figures do not include indirect costs or administrative salaries. The host institution should be strongly encouraged to provide the overhead and even a portion of administrative salaries. Corporate contributions can be secured for partial administrative expense, scholarships and money to reduce the direct cost. Charging program fees is a viable alternative to a high level of external or institutional funding. Stevens charges \$275.00 for students to attend the one-week program. For the most part, families consider this fee extremely reasonable. Financial aid is provided for those who can not afford the fee.

To keep costs down, it is important to take advantage of volunteers and in-kind contributions from corporations such as field trips, buses, speakers and career guidance literature.

Evaluation. Evaluation is a major component of all Stevens Women's Programs. Participants in ECOES and WIEMSP complete pre and post program evaluations and a follow-up evaluation one year after they participate. Over 92% of the participants in both programs rate the overall effectiveness as "excellent" or "very good" in terms of offering "needed encouragement, information and support" for high school students interested in pursuing careers in engineering and science.

An interesting difference between ECOES and WIEMSP is the students' profile with regard to their knowledge and commitment to engineering. Table 1 shows a self assessment of knowledge of engineering pre and post programs.

TABLE 1.
SELF-ASSESSMENT: PARTICIPANTS' KNOWLEDGE OF ENGINEERING

	<u>PRE</u>		<u>POST</u>	
	<u>High</u>	<u>Low</u>	<u>High</u>	<u>Low</u>
<u>One-Week Program</u>	21%	79%	92%	8%
<u>Four-Week Program</u>	82%	18%	98%	2%

ECOES students come with a greater degree of knowledge than WIEMSP students. Therefore, the impact the program has on the students change in degree of knowledge of engineering is minimal for ECOES students and quite strong for WIEMSP students. Similarly, there is little change for ECOES students in terms of degree of commitment they have in becoming an engineer or scientist after participating. WIEMSP students' degree of commitment in becoming an engineer changes dramatically after participating. This outcome is expected since the goals of the programs are different.

ECOES is only in its second year and therefore, the first follow-up survey has not been completed. The follow-up survey for WIEMSP is conducted the summer before the students' freshman year in college. Table 2 identifies the post high school plans of WIEMSP students over an eleven year period. 85% (1278) of the students responded to this survey.

TABLE 2.
COLLEGE MAJORS OF WIEMSP PARTICIPANTS 1978-1988

Engineering	78%
Related Fields	9%
Unrelated Fields	12%
Undecided	1%

The percentage of WIEMSP students who are "definitely" committed to a career in engineering prior to participating in the program is 11%. Therefore it is particularly noteworthy that 78% of these students enroll in engineering programs.

In addition to formal participant evaluations, it is important for directors to determine the success of a program while it is occurring and give feedback to the instructors. WIEMSP offers the opportunity to change subsequent weeks based on the first week experience. ECOES is more difficult to alter once it begins, since many components are not repeated.

Summary. Programs such as ECOES and WIEMSP benefit the students as well as the host institution. Capable high school students benefit from the opportunity to explore careers in engineering and science in an exciting environment. The host institution benefits because potential freshmen are becoming familiar with the campus, a supportive environment for women is being fostered, and relationships are being developed with local corporations.

