

Approach to Increasing the Representation of Women in Nontraditional Professional Fields

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Women in Engineering, Science, and Technology (WEST) will be established at New Jersey Institute of Technology to facilitate the transfer of women from 19 community colleges in New Jersey to engineering, science, and technology programs at 4-year colleges and universities on completion of their 2-year curricula. During its first year, the WEST office will work with some of the community colleges with which articulation agreements already exist. Special efforts will be made with urban-based colleges with a high percentage of minority and economically disadvantaged students. After its first year of operation, WEST will expand its efforts to include other community colleges in the state. The goal is to recruit at least 200 women per year to the career days and seminars. Fifty-two of these recruits will later be enrolled in the telecourse offered by the Center for Precollege Programs and Distance Learning or in the Educational Opportunity Program. The objectives are to increase by 10 percent each year the number of community college women transferring to 4-year colleges and universities to pursue majors in engineering, science, and mathematics; to encourage women with undeclared majors at community colleges to select preengineering and science curricula; to help the community colleges recruit more entering women students to the preengineering and science curricula; to evaluate the model after its first year for the purpose of improvement and dissemination to other 4-year colleges during its second year; and to expand the scope of activities of the WEST program to other community colleges after its first year of operation.

In December 1989, the Task Force on Women, Minorities, and the Handicapped published its final report, *Changing America: The New Force of Science and Engineering*. This report and the Task Force's interim report published in September 1988 systematically document the startling lacunae in the nation's science and engineering work force and educational pipeline. Briefly stated, the United States faces an increasing shortage of engineers. In the past, white males have traditionally dominated all engineering and science fields. Not only do fewer white males enroll in engineering degree programs, but the significant gains in female enrollment during the early 1980s have stagnated and, in fact, the number of women in these fields is now declining. In essence, these trends reflect the waning interest of American students in engineering, technological, and scientific disciplines.

It would be incorrect to blame these trends on any one factor; they result from a combination of demographic and cultural factors. First, the traditional population entering these fields is primarily white males. As the Department of Labor's

Workforce 2000: Work and Workers for the 21st Century documented, this population is declining and by the turn of the century will represent only 15 percent of new entrants to the work force. Second, other segments of the population such as women and minorities have been discouraged from entering these fields because of tradition, lack of information, and prejudice. Finally, many students are not receiving preparation at the elementary and secondary levels that would allow them to pursue such careers.

The 1990 National Science Foundation (NSF) report, *Women and Minorities in Science and Engineering* (WMSE), provides documentation and statistics similar to those found in the Task Force report, but in a more detailed format. Both reports echo the findings of *Workforce 2000*, published in 1987. Besides emphasizing that 85 percent of all new entrants to the labor force will be women, minorities, and immigrants, the authors of WMSE carefully examine the economy's needs for training and education in areas in which these groups are traditionally underrepresented. Taken together, these reports offer a cogent analysis and a blueprint for action that will change the face of America's scientific, engineering, and technical work force over the next decade.

Workforce 2000: Work and Workers for the 21st Century makes note of several important economic trends including the proliferation of advanced technologies. The technological areas of growth that are listed in the report include computer science, advanced telecommunications, advanced materials, biotechnologies, and superconductive materials. All these areas of employment require postsecondary education or training. Many require advanced degrees or continuing education. Other areas of concern in *Workforce 2000* include the retraining of the work force and the need for flexibility in the future on the part of the labor force and the employers.

DEMONSTRATION PROJECT

New Jersey Institute of Technology (NJIT) plans to explore how more women and minorities can be recruited into careers in engineering, science, and technology. One part of the Institute's effort will take shape in the form of a demonstration project entitled "Women in Engineering, Science, and Technology" (WEST). As the only state-supported technological institute in New Jersey, NJIT must play a leading role in meeting the state's and the larger national need for qualified professionals in these areas.

NJIT is the largest engineering college in the state; it is coupled with undergraduate and graduate degree programs in architecture, industrial management, and the sciences. NJIT offers degree programs in many fields in which women are traditionally underrepresented.

The decision to form the WEST program was prompted by an earlier study by NJIT Office of Institutional Research and lengthy conversations with six administrators of special programs for women in engineering and science at other universities around the country. The first study indicates that only 10.8 percent of all community college students transferring to NJIT are women, although women represent 15 percent of all full-time undergraduates at NJIT. This same study also outlines the disparity between the number of male undergraduate transfer students, which totaled 411 entering in fall 1989, and the number of female undergraduate transfer students, which totaled only 54 in the entering class. One inference that can be drawn from these data is that a program concentrating on women from community colleges will increase the total number of women transferring to NJIT and other schools with strengths in science and technology.

Information gathered through phone conversations with administrators of women in science and engineering programs around the country indicates that a multifaceted approach is necessary to encourage women to consider careers in science and engineering and to remain in these curricula once elected. These approaches frequently include precollege summer programs, career days, alumna mentorship of accepted students, special seminars for women students, and the establishment of support groups. The effectiveness of such programs is clear. Although the national percentage of full-time undergraduate women enrolled in engineering programs is about 15.8 percent, universities with established programs, such as Purdue University, have a student body made up of 21.7 percent women.

NJIT's interest in encouraging the recruitment of more women to nontraditional professional areas is a natural extension of the leadership role it has assumed in this area in the past. Current NJIT programs for women include the Program for Women in Engineering and Construction, under the auspices of the Center for Transportation Studies and Research; the Females in Engineering: Methods, Motivation, Experience program (FEMME), geared to middle school students and sponsored by the Center for Precollege Programs; the Career Advancement Plan (CAP), sponsored by the Cooperative Education Division, offering women and minority students special seminars that complement their cooperative placements; an active student chapter of the Society for Women Engineers; the Women in Science and Engineering (WISE) program, a weekly seminar for 15 selected first-year women students; a Big Sister-Little Sister Program; and monthly meetings for returning women students over 25 years of age. The last four programs are offered through the Office of the Dean of Student Services.

Through its commitment to public service, NJIT has already begun meeting some of the challenges delineated in the NSF and Department of Labor reports. NJIT has a Center for Precollege Programs and Distance Learning and a Joint Mathematics and Science Articulation Program for community college students sponsored by the Educational Opportunity Pro-

gram (EOP). The EOP's mission is to recruit minorities and increase not only their access to higher education but also their retention rates. NJIT's EOP office is one of the largest in New Jersey with over 500 students.

Although the range of activities originating from the WEST program will be extensive, the initial stages will focus on recruiting top minority community college students. The program will address this area in particular for four reasons. First, NJIT has preexisting articulation agreements with all the community colleges in New Jersey that will ensure a positive working relationship with their staffs. There are 68,000 women enrolled in New Jersey's community colleges. Second, community college populations frequently include minority, economically disadvantaged, and returning or mature students. Third, both the Center for Precollege Programs and Distance Learning and the EOP have established programs in conjunction with community colleges, thus facilitating the development of special activities and outreach for women. Fourth, national attention has been drawn to the need for more students with 2-year degrees to continue their educations at 4-year colleges. By developing a successful program for increasing the transfer population, NJIT will provide a model for colleges and universities around the country.

PROJECT DESIGN

The primary goal of the newly established WEST program will be increased recruitment of women to engineering, science, and mathematics-based career paths from New Jersey's community colleges through a preengineering course using distance learning and multimedia technology, a summer EOP program, and intensive recruitment and support strategies.

The objectives are to increase by 10 percent each year the number of community college women from selected colleges transferring to 4-year colleges and universities to pursue majors in engineering, science, and mathematics; to encourage women with undeclared majors at community colleges to select preengineering and science curricula; to help the community colleges recruit more entering women students to the preengineering and science curricula; to evaluate the model after its first year for the purpose of improvement and dissemination to other 4-year colleges during its second year; and to expand the scope of activities of the WEST program to other community colleges after its first year of operation. If successful, the WEST activities will provide other colleges and universities around the nation the opportunity to implement similar plans.

ANTICIPATED RESULTS

These objectives will be accomplished through four areas of activity: the development of recruitment and support networks; the establishment of a specific preengineering course aimed toward women at community colleges; the development of special courses for women in the summer EOP program for community college students; and the dissemination of information about these activities to other 4-year colleges.

Support and outreach networks will include two seminars per semester for women students on at least four community college campuses. These seminars will introduce them to the administrator of the WEST program; engineering, science, and mathematics majors; and representatives of other programs established for women at NJIT. The seminars will also discuss the WEST program's preengineering multimedia telecourse and the EOP summer program for students who have completed their first year of study.

Another important part of the outreach aspect of WEST will include the invitation of community college students to career days on the NJIT campus, one to be held in the fall, the other to be held in February. During these visits, students will be introduced to the admission and financial aid staff.

NJIT alumnae will be used as role models and mentors in various phases of the support and outreach activities. They will be asked to speak at career days and to mentor women who have elected a math, science, or engineering curriculum.

The WEST program will also produce posters and brochures to encourage women to consider mathematics, science, and engineering careers. These materials will be distributed to community college recruitment offices. Special flyers will be developed for recruitment to the long-distance learning and EOP programs.

The preengineering course will be developed by an NJIT faculty member and delivered to community colleges as a live, interactive telecourse through available systems. Distance learning has developed rapidly at NJIT because it serves large numbers of geographically dispersed students effectively and efficiently. Access is improved by allowing students to work on course materials at flexible time periods instead of at one fixed time, while emphasizing the importance of engaging students in ways that involve them actively in learning.

A telecourse is an integrated learning system that uses television and various print materials. This system is specifically designed to involve a variety of learning strategies to forge a complete education unit available to the student at a site remote from the university. It is not a correspondence course with pictures; nor is it a televised lecture with supplementary readings. It is an examination and presentation of a body of knowledge and information through the use of sight, sound, color, movement, and print, in a manner designed to stimulate, clarify, and quantify. A telecourse is designed to take maximum advantage of the strengths of each component to lead the student through a success-oriented experience.

The telecourse can be delivered by satellite transmission alone or in combination with Instructional Television Fixed Service. The actual delivery system will depend on location and equipment at receiving sites. Each receiving site is required to provide a facilitator who handles record keeping, proctors exams, etc. The NJIT faculty member serves as mentor, working with the facilitator and communicating with the students by live TV when possible, and by other means, such as telephone, fax, electronic conferencing, etc.

This one semester, two-credit elective course will be provided to students at four selected community colleges to which NJIT has already provided similar services. The course will focus on guided engineering design and will develop students' decision-making skills and introduce them to basic principles. Effectiveness will be enhanced by WEST facilitation of

collaborative or group learning in a peer support and exchange environment. Before the course, students will be surveyed to determine their attitudes towards careers in engineering. After each semester, student evaluations will be taken to determine whether student interest in the engineering profession has increased through the course. Students will be provided support services to encourage them to take other required preengineering courses and to facilitate their transfer to colleges that offer the bachelor's degree in engineering. Their academic progress will be followed throughout the 2 years of this project to determine the effectiveness of the activity. The goal is to enroll at least 10 women on four different campuses in the course each year. After evaluation, the course may be modified.

Another activity of the WEST office will be the recruitment of women to the EOP-sponsored Joint Mathematics and Science Articulation program that was established by the NJIT EOP office 2 years ago. This program was established with the purpose of better preparing students from community college Educational Opportunity Fund (EOF) programs for senior engineering colleges, including NJIT. The courses in the program have been designed to supplement the students' academic background rather than replace any of the home school requirements. The program recruits African-American, Puerto Rican, and female students. It draws primarily from those institutions that have articulation agreements with NJIT and preengineering programs. The largest number of students are from Essex Community College. In the past, approximately 25 percent of the students involved in this program have been female.

The WEST program would initiate two changes in this program. First, it would actively recruit women to the EOP summer program to increase the percentage of women from 25 to 40 percent. This process would include working with the NJIT EOP staff as well as the community college EOP staffs. Secondly, it would work with the mathematics summer program instructor to raise awareness about women and mathematics anxiety. After their participation in the summer program, the students would be followed until the end of the demonstration project. Their attitudes toward mathematics would be measured before and after the program, and their progress in their academic careers would be followed. Progress for women in mathematics classes between the years covered under this demonstration and previous years would be measured to determine if the special support structures have contributed to better grades and commitment on the part of the students.

EVALUATION AND DISSEMINATION

The fourth area of activity for the WEST program would be evaluation of the activities and dissemination to other colleges. Each area of activity will be evaluated separately and changes made accordingly both in recruitment strategies and in curricular design. Because the one-semester long-distance learning class will run only twice, changes can be made in recruitment and presentation for the second session after evaluation of the first. The summer EOP program will be run

twice. Follow-up on individual women students and their evaluation of the mathematics course and support networks will determine changes to be made for the second course.

In the fall of 1992, evaluation will begin of the first year's efforts. Students recruitment, retention, and progress will be areas of study in the evaluation process. By the late fall, a report will be prepared and disseminated to 4-year colleges in the New Jersey and New York area interested in recruiting

more women from community colleges to their science, mathematics, and engineering departments. The WEST office will sponsor a meeting for the purpose of discussing pilot results and sharing the report with interested colleges and universities in the geographical area.

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