

BROOKLYN BRIDGES REVISITED: SPANNING THE TWO YEAR -FOUR YEAR GAP

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Rationale

Undergraduate programs in engineering and the physical sciences need to emphasize recruitment and retention efforts to increase the numbers of women and minority students. Demographic trends, especially for large urban areas, project that fewer white males, but greater numbers of women and minorities, will enter the labor market as we move into the 21st century. Two factors affecting the numbers of women and minority students seeking baccalaureate degrees in these disciplinary areas are students' career preferences, partially shaped by a lack of awareness of possible career paths and a real or perceived lack of preparation for the so-called "hard sciences" and engineering. Research faculty in the university setting may feel that students matriculating in two year college programs lack the "right stuff" to attempt, let alone complete, academically rigorous programs. We believe that these two factors contribute to the small numbers of women and minority students from two year programs transferring into BS programs in engineering and the physical sciences.

In our experience, many talented minority women in two year colleges consider only careers in biology, medicine and the health sciences. We need to make these students aware of career opportunities in engineering and the physical sciences and to help them understand that it is socially and culturally acceptable to like math and technological subjects. Our vision is to contribute to systemic change by changing the paradigms for two year college students and the conscious or unconscious mindsets of university faculty researchers by demonstrating that many minority students, especially minority women have the capacity and interest to pursue BS and advanced degrees in science and engineering. "Bridge Programs," for example as managed by the University of Washington, have served to increase the numbers of women entering four year engineering programs.^{1,2}



Background

Polytechnic University, an urban school specializing in engineering and the physical sciences, has a very diverse undergraduate student population; the diversity however, does not reflect the ethnic and gender mix of the inner city. More than 90% of undergraduates major in engineering disciplines, but the percentage of women undergraduates has not exceeded 15%. Although the university enrolls substantial number of Asian American students and a steadily increasing number of students from the former Soviet Block countries, Hispanic and African American enrollments have average just 10 - 13% each over the past few years.

In marked contrast, two neighboring colleges with predominantly two year programs in the physical sciences and pre-engineering have very high African American, and to a lesser extent, Hispanic populations. A large number of these minority students are women in the two institutions [Medgar Evers College of CUNY, located a short subway ride away, and New York City Technical College of CUNY, located across the street from Polytechnic]. Polytechnic University, a private institution, has made little effort to establish formal "bridge programs" or to set up formal articulation programs with these institutions. A small-scale 3-2 articulation program with Brooklyn College of CUNY typically brings in a half dozen or so students per year as engineering majors, but no effort has been made to recruit women/minority students by that route.

Polymer and Materials Science as Intercollege Links

With support from the National Science Foundation [Research Careers for Minority Scholars Grant] and similar funding from DOD-ARO, Polytechnic University and St Josephs College have collaborated for the past three years to develop an ad hoc model for increasing the flow of minority students, particularly women, from two year programs into BS degree programs in physical sciences and engineering. The authors of this paper bring together several areas of expertise. Prof Tooney is a member of the Polymer Research Institute at Polytechnic and has conducted research on biopolymers. She helps link undergraduate students with faculty research mentors. Sr Maier of nearby St. Josephs College has designed and run very successful Saturday programs for high school students for several years. She and Prof Tooney have collaborated for three years in presenting a modular "pre-research" Saturday program for two year college students, described below. Sharon DuPree is a graduate student at NYU who acts as project coordinator. Prof Kramer, a Social Scientist, has responsibility for evaluation. We have collaborated to



develop and deliver a multiphase program designed to encourage minority students, especially women, in the two year college environment to consider research careers and enter BS level programs.

Components of the Plan

This program was designed to support students in three phases:

Phase I is a modular, hands-on, group learning "preresearch" program for students matriculated primarily in two year degree programs at New York City Technical College or Medgar Evers College of CUNY. Offered for four consecutive Saturdays, Phase I has been offered June '93, Jan '94, June '94, and Jan '95 to a total of 58 students, predominantly minority female. In July 1995, the program will be offered to 12 additional students.

Components of Phase I are offered at St. Josephs College and Polytechnic University, depending on content. Prof Maier, together with a second colleague and undergraduate aides from St. Josephs provide a supportive learning environment, based on a hands-on, group/team learning approach that includes development of communications skills, as well as an introduction to technical content. Polytechnic University is the site of a thermal analysis demonstration, an introduction to CD-ROM database searching and a version of the "Egg Drop" experiment. An outline of the course content was published in last year's proceedings.³ Phase I concludes with a Wrap-up Ceremony including a reception, final oral presentations, and presentation of a certificate and a \$200 stipend to participants. Students who have participated in earlier sessions are encouraged to attend.

Phase II is a regular 6-8 week summer research experience in laboratories of Polytechnic University that conduct research related to polymers and other aspects of materials science. This phase is open to minority students [especially women] who are enrolled at Polytechnic or to students from two year programs who have completed Phase I. As an alternate, six students from two year programs in 1994, were placed in a summer section of Introduction to Engineering. This freshman level course was developed by Polytechnic as part of its initiatives as a member of the Gateway Engineering Coalition [EEC] and currently is taken by all Polytechnic freshman engineering majors. Phase II was piloted in July of



1994 with six students enrolled into Introduction to Engineering; all had previously completed Phase I. In addition, four students were placed into research laboratories. All Phase II participants received stipends of \$2000, depending on the duration of their participation. Faculty mentors receive up to \$1000 per student to be allocated for materials and supplies to support the research. Students from two year college programs who are placed into the Introduction to Engineering Course receive a similar stipend for participation.

Phase III - coordinates transfer of students into four year engineering or physical sciences degree programs, primarily at Polytechnic. Regardless of where a student chooses to transfer, we attempt to provide appropriate career and course counseling to help them achieve their goals.

Selection and Evaluation Process

To recruit students from Medgar Evers College and New York City Technical College for Phase I, we discussed the program and distributed literature in students' classrooms or at science club meetings two to three months prior to offering the Phase I module. Favorable student responses to the program have led to a applicant pool two to three times larger than the number of slots available. Selection is based on grade point average, a major in an appropriate field, background and performance in math and chemistry coursework and a personal interview. We do not exclude male minority students, but do ensure that each group has in excess of 50 % minority women. We have focused on students who are majoring in pre-engineering or the physical sciences, while making some allowance for women who are undecided about their majors or willing to consider different options.

Phase II summer research is open to students who [1] have completed Phase I or [2] are majoring in science and engineering courses relevant to the materials sciences at Polytechnic University. Phase III is open to students from two year programs at Medgar Evers or New York City Technical college who have completed Phase I and, preferably Phase II. Students whom we accept for transfer in this program are given substantial tuition supports for a year; support is continued if students maintain a good grade point average.

At the end of each Phase I program, students are asked to fill out questionnaires that help us evaluate their level of satisfaction and perceptions about the experience, enabling us to "fine-tune" the program. In general, student responses to Phase I have been very positive. Students

willing to take on these students in research laboratories. During the pilot phase in the summer of 1994, we experience some reservations on the part of faculty about supervising students from two year programs. However, the students performed very well and we have arranged for faculty to take about 12 students during the summer of 1995. Thus, the program appears to be meeting our dual objectives of motivating two year college students to consider entering four year degree programs and overcoming faculty researchers' reservations about mentoring such students in summer research activities.

1. A.R. Karpov and S.G. Brainard, *Strengthening the Bridge: A Coalition Between the University of Washington and Five Community Colleges*, 1994 ASEE Annual Conference Proceedings.
2. A.R. Karpov and S.G. Brainard, *Facilitating the Transfer of Female S & E Students: A University and Community Colleges Coalition*, Women in Engineering Conference: Effecting the climate, Washington, D.C., June 1994.
3. Nancy M. Tooney, Pamela Kramer-Koehler and Mary Maier, *Brooklyn Bridges: Reaching Across the Two Year - Four Year Gap*, Women in Engineering conference: Effecting the Climate, Washington, D.C., June 1994



enjoy the opportunity to work with undergraduate peer assistants, who serve as valuable role models and peer mentors in both Phase I and II

Financial Incentives

Students who successfully complete Phase I receive stipends of \$200. Students who participate in summer research Phase II receive up to \$2000 to \$2500, depending on the duration of research activities. Students who are accepted for transfer to Polytechnic receive significant tuition support, but must maintain a good grade point average.

Results and Discussion

component	Pilot	To Date	Projections
Phase I	June '93 10 students	Through Jan '95 58 students	July '95 12 additional to give a total of 70 participants
Phase II	June '94 6 students in Intro to Eng, 4 in Research		July '95 12 additional students in summer res. total of 16
Phase III	Fall 1994 3 students transfer to Poly		Project additional 3 fall 1995

Tracking of Phase I participants is ongoing. We have identified three women who have transferred to four year programs at Rutgers, CUNY and Hunter College. Although we encourage qualified students to transfer to Polytechnic, we regard their transfer into a four year degree program at a major college or university to be a "student success." Most students who come through the program have very limited financial resources and both real and perceived tuition outlay remains a barrier that requires extra incentives to overcome.

In addition to attracting and motivating two year college students, we have found that Polytechnic professors have become much more

