

"BROOKLYN BRIDGES:" REACHING ACROSS THE TWO YEAR - FOUR YEAR GAP

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BACKGROUND

Polytechnic University, an urban school specializing in engineering and the physical sciences, has a diverse undergraduate population, but the diversity does not mirror the ethnic and gender mix of its neighborhood. More than 90% of undergraduates major in engineering, but the percentage of women undergraduates has not exceeded 15%. Polytechnic enrolls substantial numbers of asian american students and international students, and, in recent years, a growing population of refugees from former Soviet block countries. African American and Hispanic populations have averaged just 10-13% over the past few years.

Conversely, two neighboring colleges with predominantly two year programs in the sciences and pre engineering have high populations of women and minorities, primarily African American, with fewer Hispanic students. One school, New York City Technical College [NYCTC], is located directly across the street from Poly's Brooklyn campus, while the second, Megar Evers College of CUNY [ME], is within easy distance by subway. Transfer of students from NYCTC and ME over the past decade has been on an ad hoc basis, with but sporadic attempts to facilitate transfer of NYCTC or ME students into Polytechnic programs in the physical sciences and engineering in any systematic way.

Historically, Polytechnic has enrolled significant number of transfer students but has made very little effort to establish formal "bridge programs" or to set up articulation agreements with other colleges. 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 at Polytechnic, but no particular effort has been made to recruit women/minority students into physical sciences or engineering departments by this route.

RATIONALE

With shifts in demographics resulting in relatively fewer white males and relatively greater numbers of minorities and women reaching college age and entering the job market, undergraduate programs in engineering and the physical sciences need to refocus recruitment and retention efforts to attract and retain students. Faculty attitudes which may be "Laissez-faire" or indifferent at best towards issues of culture and gender, may be significant contributors to differential retention rates for women and minorities. True

"systemic change" may require refocusing of faculty attitudes as well as a variety of "infrastructure supports" for students.

Why do minorities and women continue to be underrepresented in the physical sciences and engineering disciplines? In New York City, as elsewhere, it is not uncommon that public schools in economically disadvantaged areas have relatively weak math and science programs, leading to poor preparation of students in these disciplines. Further, in our experience, many talented minority women in high school and in two year college programs are "prefocused" on biology and the medical/health sciences. Without downplaying the need for talented women in these fields, we need to provide women with the opportunity to change their attitudes so they understand it is culturally and socially acceptable to like math and do math and to think about careers in the physical sciences and engineering. Many of our undergraduates, and not just women, have had almost no experience in taking things apart and putting them together, or other "hands on" activities that provide so much of the joy of engineering and science. We need to provide these opportunities, as well.

In brief, our vision is to change the paradigms for two year college students - their own aspirations for the future - and the "mindset" of university faculty who may have the preconceived idea that all students enrolled in two year programs ipso facto are unable to successfully pursue BS and advanced degrees in engineering and the physical sciences.

RESEARCH AND PRE-RESEARCH PROGRAMS in "POLYMERS and MATERIALS" AS INTERCOLLEGE LINKS

Polytechnic has taken advantage of two funding initiatives - a Research Careers for Minority Scholars [RCMS] grant from NSF and a Undergraduate Engineering support grant from DOD] - to develop an ad hoc model for increasing the flow of women and minority students into undergraduate engineering and physical sciences curricula. In addition, we interact informally with NYCTC and ME through the NSF-AMPs program, a program for minority students that encompasses several of the City University of New York [CUNY] campuses.

Strategies include:

- * Phase I: a modular, group learning "preresearch" program for students in two year programs at NYCTC or ME designed to stimulate interest in polymer and materials science and engineering.
- * Phase II - Option One: Students who complete Phase I are eligible to take Polytechnic's new freshman engineering course: EG 101 Introduction to Engineering during summer session at no cost.
- * Phase II - Option Two: Students from NYCTC or ME who complete Phase I are eligible to be considered for summer undergraduate research positions in polymers/materials science and engineering at Polytechnic, just as if they were Poly undergraduates. This is the traditional RCMS mode.



* Phase III - Transfer into four year programs.

Our intent is develop a general strategy for Polytechnic to systematically increase the flow of students from ME and NYCTC into engineering and physical sciences programs at Polytechnic. We also enable NYCTC and ME students to phase into the CUNY AMPs program and enter four year CUNY programs, as well. That is, there is an attempt to place the needs of the students first.

Regardless of where a NYCTC or ME participant decides to matriculate into a four year degree program, we provide career and course counseling to help them achieve their goals.

RATIONALE FOR THE PRE RESEARCH COMPONENT

Our approach has been to introduce a "preresearch" component to phase in students from two year programs into the engineering and research environments with the rationale that student expectations and preparation may not be congruent with the university research environment without a transition phase. Further, the population of women/minority students at NYCTC and ME enrolled in the physical sciences generally have a high motivation for careers in biomedical and pharmaceutical fields, so extra affords are needed to broaden the horizons of their thinking.

The three authors of this paper bring together three areas of expertise. Sr. Mary Maier of St. Josephs College designed and has run very successful Saturday modular programs in science for high school students. Polytechnic University has a Polymer Research Institute, hence many research faculty interested in materials and polymers. Prof. Pamela Kramer of Polytechnic has experience in running programs for minority women transfer students in certain technical fields and is experience in evaluation procedures. Prof Nancy Tooney of Polytechnic has conducted research in the biopolymers field and helps to link Polytechnic undergraduates with summer research mentors. She chaired the faculty committee that developed Polytechnic's new freshman Introduction to Engineering course. Hence, we have coupled the our areas of expertise to develop a multi phase pilot program to encourage students in two year college programs to move into the university environment.

DESCRIPTION OF THE PHASE I - PRERESEARCH COMPONENT

Students participate in four day-long modular sessions, generally one session per week, that emphasizes a hands-on, group learning approach and includes the development of writing and speaking skills as an integral component. Mary Maier supervises the participation of a second faculty member and three undergraduate students aides. The technical content focuses on Polymers and Materials:



MODULAR PROGRAM

Day one: Introduction

Synthesis and Physical properties of Polymers
computer/word processing - write-up of synthesis & properties
Fun with Polymers - Polymers and toys

Day two: Forensic Investigations related to polymers

Thermal analysis Demo - glass transition temperature
Introduction to CD-ROM database searching for journal references
hands-on AST database search for library research topics

Day three: Determination of Polymer molar mass

lunch - WEPAN and NSF video presentations
Medical applications of polymers
submission of outline for library research paper and oral presentations with feedback

Day four: Optical properties of Polymers

Intro to Polymer thermodynamics using neoprene and polynorbornene
Intro to engineering design - why design "failure" leads to success
The egg drop experiment - comparison of adhesives and packing on design success.
Preparation of overheads for final oral presentations

Wrap-up: Reception, final oral presentations and award of certificates and stipends

DESCRIPTION OF PHASE II COMPONENTS

Students from two year college programs who have participated in Phase I are eligible to apply to one of two programs - a traditional RCMS experience, that is, participation in research in a regular university lab conducting experiments related to polymers and materials science and engineering. Students receive a stipend of up to \$2000 per summer, depending on the length of participation. As an incentive to faculty to accept students, each participating faculty member received up to \$1000 per year in materials and supplies related to conduct of the research. Polytechnic has used this approach in the past for its precollege Youth in Engineering and Science [YES] summer research program. This support provides an incentive for faculty to mentor students and is a key component of the program. In addition, some travel money is made available for students to attend to meetings to present papers. We anticipate supporting up to four NYCTC or ME students this summer.



OMEN IN ENGINEERING CONFERENCE: EFFECTING THE CLIMATE

1994 WEPAN National Conference

A second option is for students to take without cost Polytechnic's new freshman level Introduction to Engineering course over the summer. Again, some financial support is provided to students to compensate for the fact that they cannot hold jobs that require them to work while the class is in session [six weeks two full days per week. This option became available summer of 1994 and we currently have seven students from ME or NYCTC enrolled.

SELECTION PROCESS

Campus visits were made in May 1993, December 1993 and April/May 1994 to visit specific classes or school science clubs at Medgar Evers and at New York City Technical college. Recruiting materials were disseminated and students were selected, emphasizing participation of women/minorities, grade point average and math and chemistry background. We focused particularly on women/minorities in physical sciences/engineering majors, while making allowances for students who were undecided or willing to think about different options.

FINANCIAL INCENTIVES

Experiences with Polytechnic undergraduates and discussion with our typical program participants shows that financial support for a college education and good job opportunities are primary factors in selecting a college. The two year college students who have participated to date generally work part time and summers just to matriculate at a public two year college with relatively low tuitions. Thus, we have provided successful participants in the pre research program with a modest stipend of \$200. Students who then are selected to participate in Phase II components which require a greater commitment of time and effort receive commensurately higher stipends. Without financial supports, they simply could not afford to participate.

Our intent is that the summer research experience or the Introduction to Engineering course motivates women/minority students to seriously consider BS and graduate programs and that it enlightens professors about the aptitude and potential of such students currently enrolled in two year college programs.

EVALUATION

Selection procedures were described above. At the end of each Phase I program, students are asked to fill out a questionnaire that enables us to evaluate student attitudes, perceptions and satisfaction. Student responses have been very enthusiastic. The forms also have enabled us to fine tune the program content, based on student responses.

RESULTS AND DISCUSSION

The modular Phase I Preresearch program was piloted in June of 1993 with 10 participants from NYCTC or ME with seven women and three men. eight of ten participants were African American, one was hispanic and one white. All had completed at least two semesters of college chemistry and math. Seven were majoring in chemistry or preengineering.



In January 1994, a second group of 18 from NYCTC and ME colleges participated in the program during academic intersession, fairly evenly divided between minority women and men. This size group proved a bit unwieldy, so this June [1994] we have divided 18 participants into two groups that work on separate days. Students appear to gain confidence and enjoy the experience of working in teams of two to three with a woman undergraduate peer lab assistant. The use of undergraduate peer teaching assistants is significant, and not just from a cost analysis. The participants "relate" easily to them and the peer TA's gain invaluable experience.

During May, participants from June 1993 and January 1994 Phase I sessions were invited to apply either to take a summer course Introduction to Engineering [developed by Polytechnic as part of its initiative as a member of the Gateway Coalition of engineering Schools] or to participate as summer research students in university laboratories. We will support up to four in summer research and seven in the Introduction to Engineering course during summer of 1994. Selection is based on GPA, choice of major field, and intent to transfer into a 4 year engineering or physical science program at Polytechnic or CCNY .

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[For further information about the content of the modular lab program experiments, contact Dr. Mary Maier, St. Josephs College, 245 Clinton Ave, Brooklyn, NY 11205]