2006-1774: BEST PRACTICES FOR PROMOTING DIVERSITY IN GRADUATE ENGINEERING EDUCATION

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Isadore T. Davis, who passed away in November 2005, was a powerful advocate for increasing diversity in engineering. Most recently head of university relations for Rolls-Royce, he was also serving ASEE as Chair of the Corporate Member Council and as a member of the Board of Directors. He will be greatly missed.

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Eugene Deloatch is Dean of Morgan State College of Engineering. He served as the President of ASEE in 2002-2003.

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Best Practices for Promoting Diversity in Graduate Engineering Education

Abstract

This presentation builds on panel discussions that began at the ASEE 2004 National Conference and continued at the 2005 Conference. Our focus is on promoting diversity in engineering education, with an emphasis on graduate education. This paper serves as a summary and introduction to this session, which is co-sponsored by three ASEE divisions—the Graduate Division, Women in Engineering Division, and Minorities in Engineering Division. In previous years, we presented evidence of the need for diversity in engineering education to promote the national good. We discussed specific issues of concern for promoting diversity in graduate engineering education. We outlined an overall strategy for achieving diversity in engineering education in general and in graduate engineering education in particular, based on a holistic model applicable to both education and industry. Now our goal is to identify best practices which can help to implement this strategy and to disseminate these practices to a broad audience.

Graduate Degrees in Engineering—What is the Picture?

One way to promote diversity is to encourage and support students from diverse backgrounds in obtaining advanced engineering degrees, either at the M.S. or Ph.D. level. Students with advanced training in engineering will be excellent candidates for leadership positions, both in industry and academia, and can help to support and mentor those who come after them. One way to measure our success is to compare the rates at which students from various groups complete undergraduate engineering programs with the rates at which they enroll in and complete graduate programs in engineering. This comparison can help us see where we might profitably target our efforts at increasing diversity. In Figure 1 we have compared these rates for 6 groups—women in U.S. engineering programs, African Americans, Hispanic Americans, Asian Americans, Native Americans, and Foreign Nationals, based on data from the Engineering Workforce Commission for 1990-2004[1]. In each chart we have plotted percentages with respect to all U.S. students:

        --percent enrolled in undergraduate engineering programs
        --percent earning an undergraduate degree
        --percent enrolled in graduate engineering programs
        --percent earning an M.S. in engineering
        --percent earning a Ph.D. in engineering

We did not adjust for the time lag between earning an undergraduate degree and earning a graduate degree. We did not use uniform scales in the different graphs, as we are interested in comparing rates within each graph, to study retention and success once a student is in the engineering "pipeline." Nevertheless, we can create a picture of our overall progress in increasing diversity at each level and see where we might target our efforts for improving diversity. From these graphs we see that:

- relatively more women are enrolling in graduate programs and completing M.S. programs;
- Asian Americans have a relatively high graduation rate from undergraduate programs, but do not enroll in graduate programs at rates comparable to those for women;
- foreign nationals have the highest comparative rate of success in Ph.D. programs;
- for African Americans, Hispanic Americans, and Native Americans, there is a steady drop-off in relative graduation rates, entry into graduate programs, and success in obtaining graduate degrees; the relative number of Ph.D. degrees earned by these groups continues to be small compared to the other groups.

Thus we see that much remains to be done in promoting diversity at the graduate level and in mentoring students from underrepresented groups both to enter graduate programs and to succeed in them.
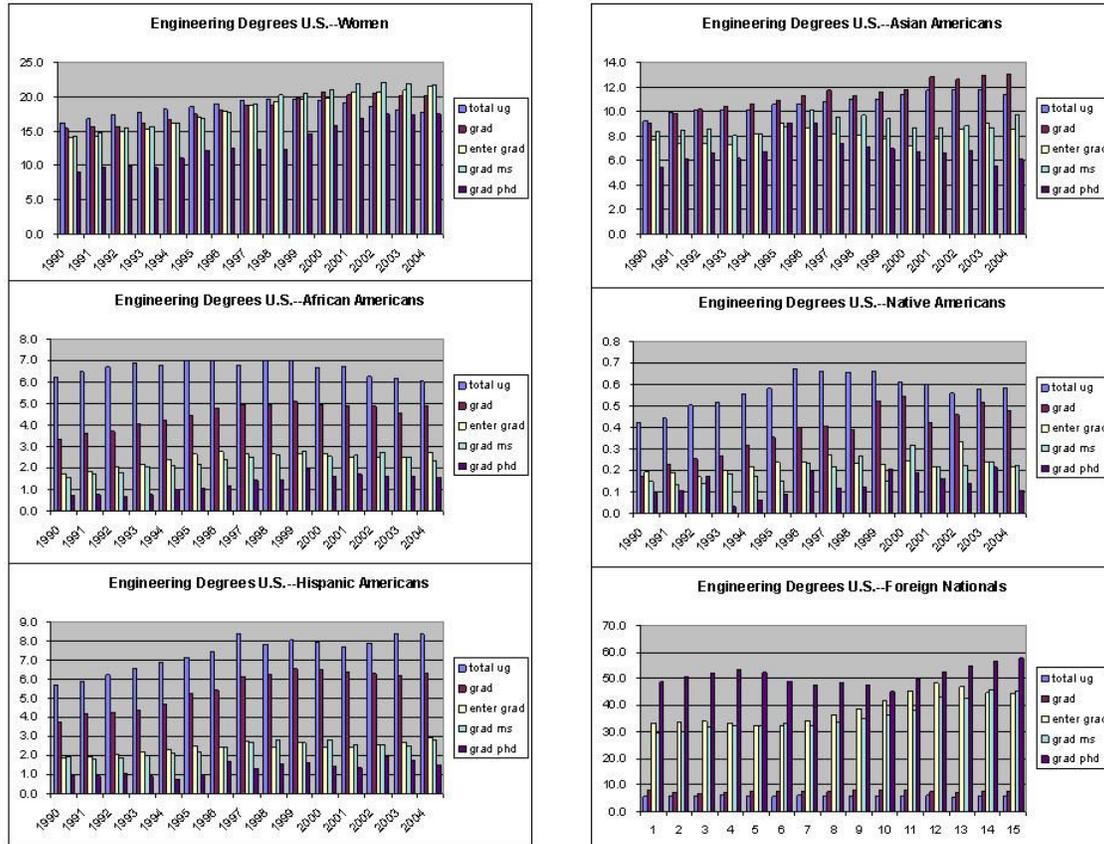
Figure 1. Success in Engineering for Diverse Groups (Engineering Workforce Commission[1]).

Strategies for Success

Last year, in the precursor to this year's session, some strategies for promoting diversity were suggested:

A. Human Environmental Awareness Training (HEAT)[2]. This is a unified strategy which includes Human Environmental Rights:
- All people have a right to be treated fairly, justly and impartially.
- All people have a right to be treated with dignity and respect.
- All people have a right to visit, study, work or live in an environment that is free of hostility.

Along with roles and responsibilities of Human Environmental Awareness visionary leaders:
- Embrace a philosophy that values and respects diversity.
- Communicate to faculty, students, staff, and employees their philosophy that values and respects diversity.
- Set the example.
- Establish appropriate policies, procedures and practices.
- Are fair, just, and impartial in their interactions with students, staff, faculty members and internal and external customers.
- Treat people, internally and externally, as individuals and not as a member of this or that group.
- Assure that all personnel - students, faculty, staff and employees and customers - have an awareness, understanding and recognition of the impact of inappropriate actions based on differences.
- Are alert to danger signs.
- Support the recruiting, hiring, promotion, education, assignment of challenging tasks, and training of individuals from all groups and both genders.
- Create multi-cultural teams and honor cultural perspectives different than their own.
- Develop strategic plans with clear goals and metrics to build a diverse faculty whose numbers reflect the need for women and under represented minorities in those engineering education programs.

B. Specific target areas for increasing diversity[3]:
- Graduate School Recruitment
- Admission Procedures
- A Community of Support
- Institutional Priorities
- Shared Information

Our overall goal in this session is to share ideas on how these strategies can be put into practice. Some ideas worthy of discussion and future development include:

- Obtain support from professional societies such as ASEE.
- Establish and maintain scholarship programs such as those run by GEM and AAUW.
- Develop programs run as part of Women and Minorities in Engineering Programs or initiatives such as ADVANCE.
- Establish opportunities for improved mentoring.
- Educate faculty and administrators on issues such as admission procedures and actively including diversity in institutional priorities.
- Establish and support student-run groups, focused on individual colleges, departments, or programs, to provide graduate students with a supportive community and with help on specific issues such as time management and writing the thesis or dissertation. These can be grassroots initiatives, such as Berkeley's now well-established Noetherian Ring[4], or groups with narrower objectives such as providing support during the actual writing of the dissertation[5].
- Conduct continuing studies of efforts to support graduate students and how well they succeed.
- Include diversity issues in programs such Preparing Future Faculty and in university teaching and learning center programs.
- Continue to develop web-based initiatives such as preparing-faculty.org and MentorNet.
- Develop partnerships linking the top ranked graduate universities with under represented undergraduate institutions such as HBCUs, to be not just a pipeline for minority recruitment, but also a holistic model having both partners involved with students from their freshman year. This will show students early on that they can succeed and will also help them learn what it takes to make it at the top schools in the nation.
- Establish programs, including but not limited to research experiences for undergraduates, that target women and under represented minorities in an undergraduate setting and that focus on the benefits of continuing engineering education beyond the bachelor's degree.
- Understand the needs of women in balancing graduate work and family life and develop programs which will meet these needs.
- Enlighten the communities of underrepresented minorities about the benefits of continuing an engineering education beyond a bachelor's degree. Understand that the current paradigm of these communities supports educational attainment; however, there is the notion that additional educational accomplishments are either not

financially rewarded and/or are reserved for those that are aspiring to higher levels of management responsibility.

- Overcome the digital/technology gap between underrepresented minorities and the average American family.

Bibliography

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4. math.berkeley.edu/~nring/

5. M. Wasburn, Creating community: A pilot program for doctoral students. *Proc. ASEE 2002 Conference*.