
AC 2011-670: IF YOU BUILD IT, THEY WILL COME (AND STAY): RECRUITING AND RETAINING WOMEN AND UNDERREPRESENTED MINORITY STUDENTS

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Susan M. Lord received a B.S. from Cornell University and the M.S. and Ph.D. from Stanford University. She is currently Professor and Coordinator of Electrical Engineering at the University of San Diego. Her teaching and research interests include electronics, optoelectronics, materials science, first year engineering courses, feminist and liberative pedagogies, and student autonomy. Dr. Lord served as General Co-Chair of the 2006 Frontiers in Education Conference. She has been awarded NSF CAREER and ILI grants. She is currently working on a collaborative NSF-funded Gender in Science and Engineering project investigating persistence of women in engineering undergraduate programs. Dr. Lord's industrial experience includes AT&T Bell Laboratories, General Motors Laboratories, NASA Goddard Space Flight Center, and SPAWAR Systems Center. She served as the President of the IEEE Education Society in 2009 and 2010.

If You Build It, They Will Come (and Stay): Recruiting and Retaining Women and Underrepresented Minority Students

The 2006 Spellings' Commission called for attempts to diversify the science, technology, engineering, and math (STEM) student populations, which have long suffered from gender and racial/ethnicity gaps¹. Women continue to be underrepresented in engineering, accounting for just 19% of all engineering bachelor's degrees in 2007². With the exception of Asian Americans, students of color are also underrepresented in engineering. Black and Hispanic students each earned eight percent of all engineering bachelor's degrees in 2007, and American Indian and Alaskan Native students represent less than one percent of engineering degree recipients². To address these concerns, this Panel Session presents findings from two companion studies that examined recruitment strategies to attract and retain women and underrepresented minority students and to provide support services that aid in their retention in engineering programs.

Findings are based on analyses of data gathered in the Prototype to Production (P2P) and Prototyping the Engineer of 2020 (P360) studies, both funded by NSF (EEC-0550608 and DUE-0618712). P2P investigated curricular, instructional, and organizational practices and policies, as well as the educational experiences of undergraduates, in a nationally representative sample of engineering students, faculty members, and administrators in 121 engineering programs on 31 four-year campuses. P360 complemented P2P through case studies of six institutions identified to be outperforming their peers on at least one of seven measures; four of the six institutions selected for the P360 study outperformed peer institutions in recruiting and graduating women and historically underrepresented minority students.

P2P findings indicated that approximately one-third of engineering faculty members report assisting in recruiting women and underrepresented students. Faculty may choose not to participate because these activities, according to program chairs and faculty, have very little value in merit salary, promotion, and tenure decisions. But attitudes toward the admission of women and underrepresented students may also be at work. Almost 20% of faculty members and program chairs agreed with the statement that "It's very difficult to increase student diversity without sacrificing some academic quality." On the other hand, 43% of the faculty members and 19% of the chairs indicated that increasing diversity and maintaining quality were not in conflict. Interviews with faculty and administrators from on the P360 campuses revealed how these faculty attitudes are expressed -- or rejected -- as barriers to diversification of the engineering student population. Such attitudes are also associated with perceptions of the climate for women and underrepresented students. The more negative the attitudes of faculty members on a campus (in the aggregate), the more likely were that campus's engineering students to believe that men students treated other men better than women and that White students treated other Whites better than non-White students.

Few would disagree with the proposition that institutions wishing to diversify their student populations need to do more than just recruit women and underrepresented students; they need to support them as well. To better understand students' needs, the P2P study explored the importance of certain support services to women and underrepresented minority students. Women students were more likely than men to report that the services of a learning/tutoring center are important to their academic success (even after controlling academic preparedness and

race/ethnicity). Similarly, African, and Hispanic American students were also more likely to value the services of a learning/tutoring center than were White students (again, after controlling academic preparedness and gender). There was no significance difference between Asian and White students regarding the importance of tutoring and learning assistance services.

Consistent with previous studies of engineering students³⁻⁵, the P2P data showed that women and historically underrepresented students' perceptions of climate were, on average, more negative than those of men and White students, respectively. However, after controlling for gender and race/ethnicity, students who were more actively engaged in engineering-related clubs or programs for women and/or minority students (e.g., NSBE, SHPE, SWE, and WISE), tended to hold more positive perceptions of the climate of their engineering classrooms and programs, suggesting the importance of the social supports that these co-curricular activities provide to promote professional development.

Data from the P360 case studies show that most of our six institutions made a clear commitment to diversifying their student populations. At the University of Michigan (UM), students, faculty, and staff alike noted that the administration of the college and university both have made visible efforts to prioritize the recruitment and retention of a diverse student population. An administrator explained that one reason why women were successful at UM was because "...the leadership in various departments understands the importance of climate issues, and the women faculty members go out of their way to ensure the female students are well-served." At Virginia Tech the Principles of Community document describes the institution-wide commitment to diversity, specifically addressing the need to "increase access and inclusion" and create a community beneficial to the growth of all its members³. In the past decade Harvey Mudd College (HMC) made a strong effort to recruit women and increased the number of women students to roughly 30 percent of its student body; women also comprised about one-third of the engineering faculty. Admissions officers at the College noted that this "critical mass" of women students makes the task of recruiting women students easier. As a large urban institution with many commuting students, Arizona State University (ASU) tried to create a sense of community to attract and retain minority and women students. The College of Engineering's approach has evolved over time and has included the creation of dedicated, centrally located physical spaces for studying and gathering for students.

All six institutions use a variety of outreach programs and relationships with diverse middle schools and high schools locally, and in some cases nationally, to attract underrepresented students. Programs for pre-college students were an important aspect of HMC's efforts to recruit a more diverse student population. One example, the *Changing Faces of Math, Science, and Technology* program, brought high school juniors to campus for an overnight program intended to encourage talented women and students of color to consider STEM careers. To address a recent drop in numbers of women and students of color, UM's College of Engineering recruited transfer students through partnerships like the Clark Atlanta Program, through which students can earn a dual degree from Clark Atlanta and the University of Michigan.

Like many engineering schools, the six case study institutions focused their retention efforts on students in their first and second years. To help students make a successful transition to college, ASU offered extensive summer "bridge" programs designed for newly admitted

women and minority students. At UM, the Engineering Advising Center established its position as the “front door” for admitted students during their orientation programs. With the goal of establishing a trusting relationship, each student sees the same advisor twice, and meets with trained peer advisor. Peer advisors also give tours of the engineering campus, participate in Q&A student panels, and assist students in navigating the on-line course registration. Student organizations such as SWE and NSBE were often key players in retention efforts. At MIT, several student organizations and at least one of the academic departments have established programs with a peer-mentoring component.

Student support systems often included proactive advising and tracking of student progress. The Howard University Science, Engineering, and Mathematics Program (HUSEM), a multidisciplinary initiative involving nine departments in the College of Engineering, Architecture, and Computer Sciences and the College of Arts and Sciences, was among the most extensive we observed. HUSEM’s goal is to promote academic achievement increase the numbers of underrepresented minorities who receive baccalaureate and graduate degrees in STEM disciplines. At the time of our site visits, the Program provided students with financial support (e.g., stipends, book grants, travel grants, and scholarships); encouraged opportunities funded by the University’s Office of Undergraduate Research, and offered weekly and group tutoring sessions as well as personal, professional and academic mentoring. Four of our six case study institutions also offered “living and learning” communities that used an all-inclusive approach to support student retention.

For this panel session, we also examined if engineering seniors’ plans to work in or outside of an engineering profession differed by gender and race/ethnicity. The P2P survey contains three measures for this analysis, tapping students’ expectations that after graduation they will: 1) be a practicing engineer in industry, government, or non-profit organization; 2) work in engineering management or sales; and 3) work outside engineering. We found that women students were less likely than men to plan to be a practicing engineer in industry, government, or non-profit organization. We also explored if being active in engineering clubs or programs for women and/or minority students played a role in their career planning. When women and underrepresented minority students actively participated in these types of engineering clubs or programs, they were, indeed, more likely to plan to work in engineering, but they were also more likely to expect to focus on management or sales rather than on becoming practicing engineers.

After two engineering faculty members prominent in promoting a more diverse student body commented on these findings, the floor was opened for a discussion of the findings and their implications for engineering and engineering education.

References

1. U.S. Department of Education, *A test of leadership: Charting the future of American higher education*. 2006, Report of the commission appointed by Secretary of Education Margaret Spellings: Washington, DC.

2. National Science Board, *Ch. 2: Higher Education in Science and Engineering*, in *Science and Engineering Indicators: 2010*. 2010, National Science Foundation, 2.1–2.48.
3. Braskamp, L.A., L.C. Trautvetter, and K. Ward, *Putting students first: How colleges develop students purposely*. 2006.
4. Camacho, M.M., Lord, S.M., Brawner, C.E., and Ohland, M.W. *Climate in undergraduate engineering education from 1995 to 2009*. in *40th ASEE/IEEE Frontiers in Education Conference*. 2010. Washington, DC.
5. Lattuca, L.R., P.T. Terenzini, and J.F. Volkwein, *Engineering change: A study of the impact of EC2000*. 2006, ABET: Baltimore.

Session Format

The Panel Session was jointly sponsored by the Divisions on Women in Engineering and Minorities in Engineering to provide empirically based guidance for engineering programs seeking to recruit and retain women and underrepresented minority students. In the first of the session's segments, Dr. Terenzini introduced the overview of the P2P and P360 studies. In subsequent presentations, Ms. Ro presented findings from the quantitative P2P national survey, summarizing recruitment and retention practices, students' perceptions of engineering program climate, and the role of support services in students' plans to work in or outside of engineering professions. Drs. Marra and Trautvetter presented examples of recruitment and retention practices drawn from the P360 case studies of engineering schools to provide examples of specific effective practices and policies. Following the presentation of findings, Drs. Lord and Walser, as commentators with extensive expertise, opened a dialogue with the audience by remarking on the implications of the findings for engineering schools, as well as directions for future research on this topic.

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Dr. Rose M. Marra is Associate Professor in the University of Missouri's School of Information Science and Learning Technologies. She is Director of Research of the NSF-funded Assessing Women and Men in Engineering (AWE) and Assessing Women in Student Environments (AWISE) projects, and a co-principal investigator for the National Girls Collaborative project. As a co-principal investigator of the P360 project, she coordinates the Arizona State University and Virginia Tech case studies.

Dr. Patrick T. Terenzini is Distinguished Professor of Higher Education in the Higher Education program and Senior Scientist Emeritus in the Center for the Study of Higher Education at Penn State. He is the co-author of the influential books, *How College Affects Students* (Jossey-Bass, 1991, 2005). He is the project co-director and co-principal investigator in both P2P and P360 projects (with Dr. Lattuca).

Dr. Lois C. Trautvetter is Assistant Professor of Education and Director, Higher Education Administration and Policy Program, at Northwestern University. As a co-principal investigator of the P360 project, she coordinates the case studies for Howard University and MIT.

Dr. Ardie D. Walser is Associate Dean of the Grove School of Engineering and Associate Professor of Electrical Engineering at the City College and Graduate Center of the City University of New York. As a co-principal investigator of P2P project, he facilitated access to City College of New

York (CCNY) and Eugenio Maria De Hostos Community College students for interviews and focus groups and assisted developing the community college and transfer student surveys.

Dr. Susan M. Lord is Professor and Coordinator of Electrical Engineering at the University of San Diego. Her teaching and research interests include service-learning, feminist pedagogy, lifelong learning, and engineering student persistence. Dr. Lord is PI of a collaborative NSF Gender in Science and Engineering grant investigating persistence of women in engineering disaggregated by race.