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Students to Engineering Practice

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STUDENTS TO ENGINEERING PRACTICE (STEP) is a manifestation of a research project* that sets the task of developing a sustainable and replicable industry-academia partnership model for helping talented, but financially disadvantaged, students complete their baccalaureate degrees in timely fashion and move successfully into the workforce. The intent of the project is to demonstrate that significant improvements in retention, placement, and workforce throughput can be achieved by combining scholarships, professional development activities, intervention, and academic support in a coherent program designed to help empower students to take responsibility for their own success. Organization, management, objectives, and accomplishments of the project are discussed. Recommendations and suggestions for program replication at other sites are provided. Additional information is available from the project web site at http://www.eng.fau.edu/step.htm.

Significance of the Project

The STEP project impacts upon five issues of national interest and importance, all associated with human resource development:

- The future engineering and computer science workforce
- Under-representation of women, minorities, and persons with disabilities in this workforce
- Preparation of students for productive contributions upon entry into this workforce
- The increasing length of time for students to earn degrees
- Increasing numbers of transfer students in engineering and computer science baccalaureate programs

At the time of project conception (1999), various groups and agencies were projecting explosive growth in employment for engineers and computer scientists. Current employment projections for the technical workforce are more modest. The Bureau of Labor Statistics[1] is now projecting that overall engineering employment will increase more slowly than the average for all occupations (3-9% increase) over the period 2000-2010. However, related issues, such as the

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under-representation of women, minorities, and persons with disabilities in this workforce – issues addressed by the STEP project - remain areas of concern. See, e.g., Campbell[2,3,4], Director[5], Drier[6], IEEE[7], NSF[8].

Project Plan and Organization

STEP is a partnership between the Florida Atlantic University (FAU) College of Engineering, industry partners, and the National Science Foundation. NSF provides funds for scholarships, industry partners provide professional development opportunities and other project support, and the College of Engineering provides student support and project management.

The four-year STEP project began in July 2000 and ends in June 2004. It is organized into two phases, each of two-year duration. In each project phase, thirty (30) undergraduates in engineering and computer science participate in STEP as a cohort group during their junior and senior years. Results presented in this paper are primarily for the first cohort group of participants, who completed the program in summer 2002.

Project success is defined in terms of performance objectives relating to participant diversity; retention in the project and in their degree programs in engineering or computer science; accelerated progress toward graduation; participant workforce "readiness"; and successful placement in industry or in graduate programs. Program strategies were designed to support these objectives.

Key elements of the STEP program, described in more detail later, are:

- Cohort Groups of Student Participants
- Scholarships
- Industry Partners Program
- Professional Development Workshop Series
- Personal and Professional Counseling and Intervention
- Student Internships
- Student Portfolios
- Mentors and Tutors
- Student Professional Societies
- Placement Advising and Services
- Performance Objectives/Measures

"Best practices" for student retention, professional development, recruitment of women and minorities, and similar activities are both institutional and program dependent. The STEP program elements listed above were selected after careful review of the literature, other NSF projects, current practices at Florida Atlantic University, and input from industry partners. Combined experiences of the project PI (K. Stevens) and co-PI (S. Schlossberg) weighed heavily in the selection process.

The City College of New York's program for retention of engineering students, involving several of these same elements, reportedly increased retention rates from 50% to 90%[9]. Similarly, the

Mississippi Alliance for Minority Participation[10] and the Texas Alliance for Minority Participation[11]are using many of these elements in their programs to increase minority enrollments and graduation rates. Strategies used in other minority engineering programs are reviewed in Hermond[12] and Reichert and Absher[13].

Student Participants: Recruitment of student participants focused upon junior-level undergraduates in engineering and computer science. Students in this group have reasonable opportunity to complete their degree requirements during their two years of participation in the project. The idea was that students would engage in two years of full-time academic studies and a summer internship, while participating in STEP.

NSF required that project participants be United States citizens, nationals, or aliens admitted as refugees; that they be eligible for U.S. Department of Education Pell Grants (this definition of financial need later was relaxed by NSF); and that they be enrolled as full-time students. Our requirements were that candidates for STEP have a minimum overall GPA of 3.0/4.0 and a grade of B or better in all calculus and physics courses. Students with significant financial need often have lower grades because of their need to work. Accordingly, the GPA requirement was relaxed in some instances to 2.8 or greater, but only for those judged to have outstanding potential.

STEP involves a two-year commitment for financial aid and other student support. It was particularly important that those selected have the ability, desire, and tenacity to maintain their good academic standing and to complete the full two years of participation in the project. Applicants were required to submit a completed application form and two letters of recommendation attesting to their reliability, integrity, and maturity. Each qualified candidate also had a personal interview with a three-person committee of project staff and industry representatives. This personal interview was, without question, the most important element of the selection process.

Students selected to participate in STEP were provided an agreement signed by the Project PI outlining the financial aid and other support they would receive. The students also signed this agreement, certifying that they agreed to the conditions of participation (enrollment as a full-time student, etc.) and that they would participate fully in all project activities (orientations, professional development workshops, internships, etc.).

Information about STEP was disseminated by personal letters and phone calls to qualified students. Faculty announcements, industry colleagues, campus newsletters, bulletin boards, e-mail lists, student professional societies, and colleagues at sister institutions were some of the other means used to market STEP. No opportunity to publicize the program was ignored. Recruitment for the first cohort group of participants was challenging, because of the very short time frames involved. From forty-four (44) qualified candidates, thirty (30) were selected for the STEP program. Word-of-mouth was in full bloom when it came time to recruit for the second cohort group, which helped considerably.

Cohort Group: Student participation as a cohort group is central to the plan for STEP. Besides simplifying project management, this arrangement has important implications for student retention and professional development. It also helped build identity with the STEP program and

to enhance student confidence and self-esteem. For example, the STEP participants are called "STEP Stars" and there is a STEP mascot (a small step ladder painted gold and covered with gold glitter). An opening reception with STEP Industry Partners and top members of the University administration features a "STEP Star" poster with each student's picture and a large cake bearing each student's name.

Advantages of clustering students in groups have been discussed by Landis[14] and others. Advantages of a cohort group are summarized nicely in the paper by Gloria Murray[15]. Drawing upon the works of others, she writes: "The rationale for cohort structures comes from cognitive learning theory which suggests that learning is a profoundly social process that depends on dialogue, language and group processing. Additionally, cohort formats enhance student self-esteem, provide peer support, and furnish networking opportunities. It appears that leadership practices that are transforming emphasize social interaction and group processing, the very elements that describe cohort structures". Interestingly, these are precisely the elements prominent in studies of student retention.

A cohort structure provides good opportunities for influencing student attitudes. Brainard and Carlin[16], in their comprehensive study of retention of women in engineering and science, found that "lack of self-confidence", "feeling intimidated", and "isolation" were among the items most frequently cited by students as perceived barriers to their persistence. Perhaps more importantly, they found that these factors persisted, and even became more significant, as women progressed through their degree programs. For example, 23% of freshmen women in their surveys reported lack of self-confidence as a barrier to their progress; this number increased in the sophomore and juniors years, reaching levels of 45% for seniors and 49% for fifth year students. Others have noted attitude as a factor in the careers of women; see, e.g., NSF[8] and Seat[17].

Similar results were cited by Hermond[12] in his study of retention of minority engineering students and by Adelman[18] in his investigation of the engineering career paths of men and women. Mary Besterfield-Sacre, et.al[19] write in their paper on characteristics of freshmen engineering students: "There is strong evidence that among all factors studied, attitudes are the most correlated with retention".

Scholarships: Financial aid is an important component of project strategies to retain students and to accelerate their progress toward graduation. The idea is that such aid would enable participants to reduce, or even eliminate, their need for outside employment, enabling them to devote more time to their studies. Students participating in Phase I of the project received a scholarship of $2,500 per year, split equally between the Fall and Spring semesters; those in Phase II received $3,125 per year. These were the maximum amounts permitted by NSF. For continuation of the scholarship, students had to remain in good academic standing, be enrolled on a full-time basis (12 credits or more per semester), and show satisfactory participation in all STEP activities.

Numerous studies have shown that financial need is an important factor in student retention and that this factor persists, and even increases in importance, in the junior and senior years. In their longitudinal study of undergraduate women in engineering and science, Brainard and Carlin[16] found that financial problems continue to be a concern for about 20-30% of students throughout

college. Robinson[20] and Soriano[21] reported that up to 30% of minority students leave college because of lack of funds, independently of their academic performance. Hendley[22] listed financial need as the biggest obstacle faced by most community college transfer students and noted that financial aid for this group is in short supply.

Extensive information on college access and affordability has been compiled by the National Center for Education Statistics; Choy[23]. The following excerpts from Choy's work are of particular relevance to this project; extensive data and research support these conclusions:

- The price of college attendance has increased faster than family incomes.
- Despite financial aid, many students have unmet need.
- For students from low-income families, the total unmet need remains a substantial proportion of family income.
- For a certain level of unmet need (cost minus financial aid received), low income students are more likely to be deterred from attending higher education than are higher income students.
- Working can have negative consequences on students' academic opportunities and performance.
- Working a modest amount is positively associated with persistence.

Choy[23] reports that, in 1998, the average annual unmet financial need (cost minus financial aid received) for low-income, full-time, dependent undergraduates attending public 4-year institutions was about $3,800. Upper division and transfer students, the focus of this project, likely have greater need.

The STEP scholarship, combined with income from a paid internship, has proven to be sufficient to enable most students to reduce, or eliminate, their need to work and to enable them to participate fully in STEP activities. Additional financial benefits accrue to program participants when they are able to graduate and enter the workforce earlier than might otherwise have been possible.

Industry Partners Program: A STEP Industry Partners Program, populated by twenty plus local and national firms, was created to provide community exposure for the STEP program, to help showcase STEP participants, and to provide them special opportunities for professional networking. Partners were asked to provide paid internships and other opportunities for professional development, such as mentors and plant visits. Representatives from Partner firms participated in selection of STEP participants, served as advisors to project staff, and conducted sessions in the Professional Development Workshop Series. Industry Partners also provided some project financial support not available though the NSF grant. In return, these firms developed close contacts with a group of top students.

Industry/Research Internship: There is universal agreement on the value to engineering students of work experience in their major prior to graduation. Accordingly, centerpiece of the STEP professional development activities is a paid internship in business or industry. Qualified students with a strong interest in graduate studies may choose to engage in a research internship

within the College of Engineering. Students receive one semester-hour of academic credit for this activity, with credit toward degree requirements at the discretion of their home department.

At the time the project proposal was prepared (1999), pledges for internships exceeded the number of student participants anticipated. The job market had changed dramatically when it came time for the first internships (Summer 2001), and placement of students was a major challenge. For some students, we had to deviate from the original plan of having the internship in the summer between the junior and senior years of study. Eventually, students in the first cohort were placed, at salaries up to $22/hr.

Students report on their Internship experience in the Professional Development Workshop courses. For most, it was their first exposure to work related to their academic major, and the experience was transforming. The resulting sense of empowerment undoubtedly was an important factor in motivating them to complete the remainder of their degree requirements in timely fashion. Many of the STEP students accepted employment after graduation with the same companies for which they interned.

In one case, the internship experience possibly was too successful. The student ended up with a high-paid, part-time work assignment that eliminated need for the STEP scholarship. This student withdrew from the STEP program, but did complete his degree.

Professional Development Workshops: The Professional Development Workshop (PDW) Series consists of four one-semester credit courses developed especially for STEP. Participants take a PDW course each of their four semesters in the program.

Goals of the PDW Series are to

1. Help students bridge the gap between the classroom environment and the expectations and realities of the workplace
2. Provide learning and career development activities not generally available in engineering and computer science curricula
3. Help prepare students for successful placement upon graduation

These goals are accomplished through activities that assist students with:

- Self-knowledge and awareness
- Work and communication in teams
- Career planning
- Understanding of the corporate culture
- Development of their professional image
- Development of their leadership and communication skills
- Preparation for successful job searches and placement
- Networking with business, industry and working professionals
- Collaborative learning, socialization, and networking among STEP participants.

Syllabi providing course objectives, activities, schedules, and student assignments are available at http://www.eng.fau.edu/step.htm. Class topics include *Teambuilding and Teamwork*, *Professional Portfolios, The Intern Experience, Marketing Yourself, Corporate Culture and You, Making Effective Presentations, "True Colors" Program, and Opportunities for Graduate/Professional Studies.*

PDW class sessions, conducted mostly by working professionals from outside the University (many by STEP Industry Partners), are videotaped in the FAU Instructional TV studios. Copies of class tapes/CDs are retained on file as resource materials in the Learning Resources Office of the University Library. Course grades (Satisfactory or Unsatisfactory) are based upon a required portfolio of class activities and assignments. All of our academic programs allow credit toward degree requirements for PDW courses, up to a maximum of three semester-credits.

PDW class assignments are minimal, but meaningful. They are designed to foster student exploration and outreach, to reinforce class sessions, and to showcase student support services available. Several examples follow:

Class Session: Professional Portfolios Mr. ----, former engineer at Pratt & Whitney and now a math and science teacher in the Palm Beach County School System, will discuss the use of professional portfolios to document and monitor your career progress and to help prepare for marketing your abilities and services. Guidelines for development of STEP portfolios will be presented.	**Accompanying Assignment** Plan and start development of your own STEP portfolio. Include assignments from items 2 and 3.
Purpose: Review of STEP Requirements, Acquaintance with Student Support Services Available, Monitoring of Student Progress.	**Accompanying Assignments** **Start of first STEP semester**: Make an appointment at the opening reception for a first meeting with Dr. Schlossberg (project co-PI). Prepare a brief written summary of the key points of your meeting, including the meeting date and time. Have Dr. Schlossberg review and sign off on your summary. Keep a copy for in your STEP portfolio. **End of each STEP semester:** Near the end of the semester, schedule and attend a meeting with Dr. Schlossberg to discuss your progress in the STEP program and any other issues or concerns that may have arisen. Prepare a brief written outline of your plans for next semester. Have Dr. Schlossberg review and sign off on your plan and place a copy in your portfolio.

Purpose: Student Outreach and Professional Development.	Accompanying Assignment Attend a student professional society meeting of your choice. Write and place in your portfolio a brief paragraph explaining the main theme of this meeting. List the name of the organization, the date, time, and place of the meeting, and the names and class standing (freshman, sophomore, junior, senior, graduate student) of five students you met at the meeting.

The FAU College of Engineering places considerable emphasis upon student professional societies. Research has shown that participation in such societies has a significant positive impact on engineering student retention; Hermond[12]. As illustrated in the PDW assignment above, STEP students are required to become acquainted with student professional societies of the College. Interestingly, simple assignments such as this one have proven to be very effective in getting STEP students involved with professional societies. Many of them have emerged as society officers and student leaders on campus.

Students also report on their internship experiences in PDW Workshop sessions. This provides the entire STEP group a broader overview of work opportunities and corporate cultures and work styles. It also enables the speaker to practice skills learned in the Workshop session on effective presentations. Evaluations of the presentations by STEP student peers provide important feedback to the speaker and help project staff determine whether PDW objectives on oral presentation skills are being met.

PDW Workshops have proven to be very effective in broadening students' horizons, in preparing them for the workplace, and in providing them a regular forum for networking and interaction with working professionals and with each other. The Workshops have been so successful, in fact, that PDW concepts have been incorporated into an elective one semester-credit course, CAREER CONNECTIONS, available to all students in the Colleges of Engineering and Business.

Project Management

With the exception of peer mentors and tutors, the STEP project is managed entirely by existing staff in the College of Engineering. The PI, who served as Associate Dean for Academic Affairs at the time of project conception and now serves as Dean of Engineering, has responsibility for the Professional Development Workshop Series, for overall project management, and for interactions with NSF.

Academic and personal counseling are provided by the co-PI, an experienced educational counselor and Director of the FAU Division of Engineering Student Services (DESS). This person also serves as Assistant Dean for Student Affairs. As part of the STEP intervention plan, student participants are required to meet with this individual at the beginning and end of each semester, with other meetings optional. DESS staff facilitates interactions with student professional societies and collaborates with academic advisors to insure that student course schedules meet both the requirements of their degree and the special needs of the STEP project.

Student progress in their courses is monitored closely, and faculty members are asked to alert project staff to any perceived problems or difficulties.

The Director of the College's Division of Engineering Professional Development has management responsibility for the Industry Partners Program. This Office helps arrange internships and placement upon graduation, provides sessions in the PDW courses on topics such as preparation of effective resumes, and is available for advice and counseling on career-related issues and concerns. STEP students interested in graduate studies receive advice and assistance with submission of graduate applications (selection of schools, selection of majors, letters of reference, etc.) from select faculty and other project staff.

A program coordinator in the Dean's Office serves as Project Manager. This individual has responsibility for day-to-day operation of the project and assists STEP students with problems and issues involving items such as course registration, payment of fees, checks for financial aid, and submission of portfolios.

Two senior engineering students, one male and one female, served as peer mentors for the first cohort group. Supported by the project, they were available for student consultation, assistance, and advice. They also served as additional pairs of eyes and ears for alerting STEP staff to student problems and concerns. As a result of experiences with the first cohort, the staff for the second cohort was changed to one peer mentor, plus tutors for advanced level courses in engineering and computer science. This change proved to be very successful, and two graduate teaching assistants now have been added to the staff of the Division of Engineering Students Services to provide help for all students enrolled in the College.

Project Results

Key project results, benchmarked against those for a control group comprised of all junior level students enrolled in the College of Engineering in fall 2000 who had qualified for Pell Grants (the population from which the first cohort of project participants was drawn) show good participant diversity, significant improvements in retention and time to graduation, a doubling of the graduation rate, a 100% rate of placement, and increased student interest in continuation for graduate studies. Results presented here are primarily for the first cohort group of participants, who completed the program in summer 2002. Final results are not yet available for the second cohort group, which will complete their participation in the project in summer 2004.

Participant Diversity: Participant diversity is a project objective. As indicated in Table 1, both student cohort groups are highly diverse. Our engineering student body is diverse, so no particular efforts were required to recruit women or minorities.

TABLE 1: STEP PARTICIPANT DEMOGRAPHICS

	Cohort I (2000-2002) Thirty (30) Students		Cohort II (2002-2004) Thirty (30) Students	
	Number	**Percent**	**Number**	**Percent**
Women	11	37%	8	27%

African Am.	9	30%	11	37%
Hispanic	5	17%	6	20%
Asian Am.	6	20%	3	10%
With Disability	0	0%	1	3%

Student Retention: Of the thirty students in the first cohort group, twenty-six (87%) completed their full two years of participation in the project (our objective was 90% completion rate) and, by that time, had either graduated or remained enrolled in the College of Engineering. The corresponding figure for the control group is 65%, indicating a significant improvement in student retention. Of the four students who did not complete the program, one switched majors and received a degree in Education; the other left the project, but later graduated in engineering. The remaining two left the program because of family issues. No participants were lost for academic reasons.

Student Graduation and Placement: Project participants took longer to complete their degree requirements, even though enrolled full-time, than had been anticipated. Our objective for students retained in the project was an 80% graduation rate by the end of their two years of participation and 100% graduation rate after one additional semester. Here, we fell short of our mark. Of the twenty-six students who completed project Phase I, sixteen (62%) graduated in accordance with this objective. The corresponding figure for the control group was 29%. These results reflect a substantial reduction in time to graduation for project participants.

By summer 2003, one year after completion of their participation in the project, twenty-four of the twenty-six students (92%) from project Phase I had graduated and the remaining two still were actively pursuing their degrees. At this same point in time, only 43% of the control group had graduated – a rate less than half that for the project participants!

All (100%) of Phase I participants were placed; sixteen (67%) accepted positions in business and industry and eight (33%) entered graduate school at Florida Atlantic University or elsewhere. Two have completed their master's degrees and now are engaged in doctoral studies in engineering. One student graduated cum laude, two graduated magna cum laude, and one graduated summa cum laude. One completed his degree requirements in three years.

Of the thirty students in the second cohort, project Phase II, five have already completed their degree requirements.

Project Replication.

Aside from funding for scholarships, the STEP program is very simple and straightforward. Many of the things done for STEP were already being done in our College of Engineering. We just did them in more systematic and intense ways. Arrangements of internships for participants could be a problem for schools without close ties with business and industry. Otherwise, if the

institutional commitment is there, STEP concepts are easily replicable – either selectively or in their entirety.

Without doubt, project strong points are the STEP Professional Development Workshops and the STEP Industry Partners Program.

Conclusions

Project success has exceeded original optimistic expectations. Ideas and concepts put forth in the initial project proposal are proving to be "on target". Students are being retained and students are completing their degrees, although not as quickly as originally anticipated. There has been considerable spin-off benefit from STEP for all students in the College of Engineering.

As a group, STEP participants are proving to be strong leaders; they have garnered numerous awards and citations for their efforts, either on campus or in the community. Obviously, we were fortunate in the students recruited for the project. All the ways in which the project was of benefit to them likely will never be known What is clear is that the close personal attention and support, both from STEP staff and from fellow project participants, is a great confidence builder and has inspired many of them to do bigger and better things.

One unexpected outcome of the project is better understanding of our student body. Our close interactions with students participating in STEP have further opened our eyes to the many impediments students face in completing their university studies, particularly those from lower income families or who have emigrated recently from other countries. Recent transfer students from local community colleges have comprised about half of the STEP cohort groups. The thinking always was that transfer students were reasonably savvy and focused. STEP proved this not to be case. Transfer students need every bit as much support and counseling as those who enter as freshmen. As a result of these experiences, many of our College of Engineering programs for student orientation, advising, and support have been improved.

References

1. BLS (2002). ***Occupational Outlook Handbook-2002 Edition***, U.S. Bureau of Labor Statistics. Washington, DC, http://stats.bls.gov/ocohome.htm.

2. Campbell, G., Jr. (1998). "Shortage of American Engineers". ***Nightly Business Report***, National Action Council for Minorities in Engineering, April 1. http://www.nacme.org/infApr1,1998,21,16,14,111051.html.

3. Campbell, G., Jr. (1998). "Engineering Enrollment: What's Wrong with This Picture". ***Information Article***, National Action Council for Minorities in Engineering, Aug. 17, http://www.nacme.org/infAug17,1998,21,48,26,090554.html.

4. Campbell, G., Jr. (1998). "Talent Pool". ***Prism***, American Society for Engineering Education, October, pp. 52.

5. Director, S. W. (1999). "Testimony to the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development". ***Policy Issues***, The American Society for Engineering Education, July 1999, http://www.asee.org/policy/html/director.htm.

6. Drier, D. "Workforce Skills Shortages-Hon. David Drier". ***Congressional Record***, Aug. 4, 1999, http://thomas.loc.gov/cgi-bin/query/D?r106:5./temp/~r1066J9qOD::

7. IEEE (1999). "Diversity in the Engineering Workforce". ***IEEE-USA Issue Brief***, Jan. 18, http://www/ieeeusa.org/COMMITTEES/WFC/diewbrief.html
8. NSF (1998). ***Women, Minorities, and Persons with Disabilities in Science and Engineering-1998,*** National Science Foundation, Arlington, VA. http://www.nsf.gov/sbe/srs/nsf99338/start.htm.

9. Watkins, C. B. (1997). ***Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring***. NSF Award No. 9725117.

10. Sullivan, R. H. (1999). ***AMP:*** Mississippi ***Alliance for Minority Participation***. NSF Award No.9623750.

11. Watson, K. L. (1997). ***AMP: Texas Alliance for Minority Participation***. NSF Award No. 9153745.

12. Hermond, D. (1995). "Measuring the Retention Strategies of a Minority Engineering Program: A Service Quality Perspective". ***Journal of Engineering Education***, October, pp. 395-400.

13. Reichert, M. and Absher, M (1997). "Taking Another Look at Educating African American Engineers: The Importance of Undergraduate Retention". ***Journal of Engineering Education***, July 1997, pp. 241-253.

14. Landis, R. B. (1995). ***Studying Engineering: A Road Map to a Rewarding Career.*** Discovery Press, Burbank, CA. pp. 78-84.

15. Murray, G. J. (1998). "New Leaders for Restructured Schools: Can Cohort Models Meet the Challenge?" ***The AASA Professor***, American Association of School Administrators Online Publications, Volume 21, No. 4, http://www.aasa.org/TAP/spring9804.htm

16. Brainard, S. G. and Carlin, L. (1998). "A Six-Year Longitudinal Study of Undergraduate Women in Engineering and Science". ***Journal of Engineering Education***, October 1998, pp. 369-375.

. 17. Seat, E. (1998). "Women Engineers: Preparing Them for the Workplace". ***Proceedings American Society for Engineering Education Annual Conference***, Seattle. Paper No. 3592.

18. Adelman, C. (1998*). **Women and Men of the Engineering Path: A Model for Analyses of* Undergraduate ***Careers.*** Office of Educational Research and Improvement, U.S. Department of Education, Washington, DC.

19. Besterfield-Sacre, M, Atman, C. J., and Shuman, L J.(1997). "Characteristics of Freshman Engineering Students: *Models* for Determining Student Attrition in Engineering". ***Journal of Engineering Education***, April 1997, pp. 139-149.

20. Robinson, T. (1990). "Understanding the Gap between Entry and Exit: a Cohort Analysis of African American Students' Persistence". ***Journal of Negro Education***, Vol. 59 (2), pp. 207-218.

21. Soriana, E. (1985). "Financial Aid". In R. Landis (Ed.), ***Improving the Retention and Graduation of Minorities in Engineering***, NACME, New York, pp. 93-98.

22. Hendley, V. (1997). "Recruiters Hear A "Me Too" from Community College Students". ***Prism***, American Society for Engineering Education, April 1997, pp. 20-26.

23. Choy, S. P. (1998). "College Access and Affordability". ***The Condition of Education: 1998***, National Center for Education Statistics, Washington, DC, Chapter 3.

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