

The Ira A. Fulton School of Engineering at Arizona State University, Center for Engineering Diversity and Retention: A Study of Persistence and Graduation Rates for Participating and Exiting Undergraduate Engineering Students.

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Abstract-In 2002, the Ira A. Fulton School of Engineering reorganized the recruitment and retention efforts for women and under-represented students. The reorganization resulted in the creation of the Center for Engineering Diversity and Retention (CEDAR) and the Center for Outreach and Recruitment (COR). Both programs are under the same department, Student Outreach and Retention Program (SORP). This paper will discuss the major program and implementation components of CEDAR. In addition, we will provide program evaluation results including student enrollment numbers, persistence and graduation rates, and program satisfaction. Data will reveal the difference in student participation as a result of the organization and will highlight increased involvement in engineering student diversity organizations. More specifically, this paper will provide critical data results concerning persistence and graduation rates on all ASU CEDAR participants since its creation in 2002. Survey results will reveal influences and enablers for those staying in engineering and will highlight barriers and impediments for those choosing not to persist. Finally, this paper will provide an evaluation of funding sources and a discussion on the increases in funding since the reorganization. It will also provide reasons why industry has provided additional funding and the relationship between those reasons and the reorganization of diversity retention efforts in the Fulton School of Engineering at Arizona State University.

Introduction- There is much interest in understanding enrollment and persistence rates for minority and female students in schools at all levels. In his article, “Research Currents: Cultural-Ecological Influences on Minority School Learning”, John Ogbu (2000) suggests that one possible solution would be for “teachers and schools to develop programs to enable the children to adopt the more pragmatic model of accommodation without assimilation”.

Additionally, the interest in engineering as a choice for a major in colleges and universities is at a 30-year low. For all students regardless of gender and ethnicity, major issues that impact first-year retention include difficulty in the transition from high school to college, financial problems, and general misinformation about the engineering curriculum (Fletcher, S. and Anderson-Rowland, M., (2000). In addition, first-year engineering students generally have little exposure to engineering. Academically, the first-year curriculum consists primarily of fundamental courses (physics, mathematics,

chemistry, English, etc.) that are essential prerequisites to upper divisions engineering courses. Often, these courses fail to motivate students and many potential engineers transfer out of their majors before they experience any engineering (Mullen-Wong, 1997).

The situation becomes more serious when we factor in student gender and ethnicity. Although the number of women enrolled in engineering has increased each year since 1989 (when women engineering enrollment was at 15.9%), except for a slight dip in 1999, still only 19.7% of the 353,118 students enrolled in engineering in Fall 2001 were women (Engineering & Technology, 2000). Minority women are the least represented in engineering, making up only 4.2% of the fall 2000 engineering enrollment (Engineering & Technology, 2000) and receiving only 2.8% of the Bachelor's degrees in engineering in 1999-2000 (Engineering Degrees, 2000).

Most of the findings of a National Science Foundation report completed in 1982 are still true today. In 1982, there were a relatively small percentage of women and minorities earning science and engineering degrees. Further, in science and engineering employment, the concentration of women and minorities were in specific fields, higher rates of part-time employment were with women, women and minorities had lower salaries, and there were a low percentage of women and minorities in full professorships (Women, 2000).

Changes in the last few years show declining numbers and percentages of minorities in engineering, and the higher attrition rate of minorities in undergraduate education (Women, 2000). Further, all under-represented students do not feel comfortable in their degree programs initially and feel a lack of contact with their college. Finally, research suggests that for students to have the best chance for achievement, schools must “produce culturally compatible environments and interactions that will serve as internal reasons for compliance and will enable school achievement” (Jordan, C., 1992). There is much work to be done. This paper will outline a comprehensive approach to addressing the creation and maintenance of a diverse engineering workforce beginning with their experience as undergraduate students.

Program Components- The Center for Engineering Diversity and Retention (CEDAR) was created in July 2002 in an effort to better serve the underrepresented students in the Fulton School of Engineering at Arizona State University (ASU). Previously, the Minority Engineering Program (MEP) and the Women in Applied Sciences and Engineering (WISE) Program both offered retention and recruitment programs. As the programs evolved, it became more apparent that the two programs were overlapping in the services that they provided. In an effort to become more effective, the programs were consolidated in summer 2002. Now, the division designates recruitment and retention efforts between two offices within the same department of Student Outreach and Retention Programs. CEDAR also houses the Coalition of Minority Engineering Societies and the Society of Women Engineers (CEMSWE). CEDAR was created to work on the persistence of underrepresented students once they are accepted to the university, beginning with programs to aid in the transition from high school to college

while maintaining identity and support services for minority and female students respectively.

Minority Engineering Program Components (MEP)-The MEP Program in the Ira A. Fulton School of Engineering shares in the responsibility for under-represented persistence programming and placement. MEP currently provides academic excellence programming such as tutoring for 10-14 subjects each semester, peer mentoring, professional development, technical paper writing, and a two week summer bridge program for incoming diverse freshman students.

Women in Applied Science and Engineering Program Components (WISE)-The WISE Program in the Ira A. Fulton School of Engineering also has responsibility for persistence programming for the female students in the School. The WISE Program currently provides a professional mentoring program with industry partners, an industry networking series, community service projects and a collaboration with the School of Fine Arts entitled, Art Ventures in Engineering. WISE also hosts a bridge program for incoming female students.

Coalition of Minority Engineering Societies and the Society of Women Engineers (CEMSWE) Program Components- CEMSWE was created in 1998 and operates out of CEDAR. This coalition is composed of the following engineering student societies: American Indian Science and Engineering Society (AISES), the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), and the Society of Women Engineers (SWE).

With combined efforts, each society forms an alliance that motivates, prepares and educates all students that fall under this coalition. Workshops and recruiting events have been initiated and executed under student direction. CEMSWE also coordinates a large career fair with industry called *Diversity Evening with Industry* each fall semester and an annual awards banquet for CEMSWE each spring semester. The CEMSWE student leadership works with the Dean's Advisory Council comprised of industry to coordinate and sponsor these events and to have representatives present at these events. CEDAR provides coordination, management and fundraising for the organizations as well as housing their activities within the CEDAR Center.

A strong collaborative effort between WISE, MEP and CEMSWE is at the heart of the success of CEDAR. Each program has its own professional and student staff to meet objectives of CEDAR. In addition to the program specific project listed above, CEDAR also offers the following choices in programming for students:

CEDAR Member

CEDAR Members enjoy a number of benefits including use of the CEDAR Center, access to computers, and information on scholarships, job opportunities, and news on upcoming workshops and events. The Center also has a small kitchen and lounge area for commuter students who comprise 80% of the population at ASU. Membership is free

and students are asked to fill out a membership application and sign in to use the facility. This aids the staff in tracking and communicating with diverse students.

CEDAR Student Success

The Student Success programs are designed to meet the individual needs of students having academic difficulties or students who wish to get a head-start on succeeding in their engineering curriculum.

CEDAR Study Groups

Students can take advantage of forming study groups in the CEDAR Center to help them succeed in their engineering courses. CEDAR organizes a select number of study groups to aid students in calculus, physics, and chemistry. Each group contains 3-4 diverse engineering students currently enrolled in core curriculum classes.

Seminars/Technical Workshops

Each semester, CEDAR offers a seminar series on topics of special interest to female and minority students. Seminars include workshops on developing effective study skills, time management, resume writing, a student wellness series and panel discussions by engineers from local industry. CEDAR also provides a variety of technical workshops including Excel, Maple, and Matlab.

All services provided by WISE, MEP, CEMSWE and CEDAR are open to all students. WISE, MEP and CEMSWE staff alternate responsibilities for CEDAR programming as needed by students. The diversity program team works under the general direction of a Director who also oversees diversity recruitment efforts in the K-12 system as well.

Program Evaluation-In fall of 2003, CEDAR staff surveyed the membership to evaluate the success of the first year of programming. Staff asked questions like:

- Primary reason for using the CEDAR Center
- Are the resources provided helpful
- How often do you use the Center
- How did you find out about the CEDAR Center
- General suggestions and student input

The evaluation was completed by 54 students. At that time, CEDAR membership was 151 students. With such a high response rate, staff have been able to utilize the results and modify or establish programming in-line with student needs.

Results include:

Primary reason for using the CEDAR Center?	14.8% studying 3.7% computer use 9.2% social support system 20.3% place to organize and prepare between classes 46% combination of four options
Are the resources provided helpful?	83.3% yes 3.7% no

	11.1% unaware of resources
How often do you use the Center?	78.4% daily 15.7% once a week 3.9% first time users
How did you find out about the CEDAR Center?	85.2% found out through student organization and/or a summer bridge program 5.5% found out through a friend 9.3% found out some other way

General suggestion and student input-Students also had the opportunity to provide ideas on how to improve services in CEDAR. A sample of these includes:

- More computers
- Mentoring Program
- Bigger center
- More printing facilities
- More quiet hours
- Keep up the good work

Because of these survey results, staff implemented several changes in spring and fall 2004. Staff began mentoring programs in both WISE and CEMSWE. Unnecessary software was removed from center computers to free up space and individual passwords were given to members for security. Quiet hours were extended from 8 a.m.-4 p.m. instead of just in the mornings. Resources and information on events are published by the organizations through list serves since that is how the majority of students found out about CEDAR. Membership cards and a sign in procedure were implemented to eliminate misuse of CEDAR resources. Tutoring and study groups are now held in CEDAR and CEDAR extended its hours of use from 5 p.m. to 7 p.m. or when the last staff member leaves.

To further evaluate CEDAR, in fall 2004 staff conducted a persistence study. Staff determined how many CEDAR students currently remain enrolled in engineering, graduation rate, average GPA, enrollment rate at ASU non-engineering and which fields of study students enrolled in when they leave the School. The findings are provided below:

Period	CEDAR Yr	Enrollment	Persistence ASU Non-Fulton (%)	Persistence ASU Fulton (%)	Graduation ASU Non-Fulton (%)	Graduation ASU Fulton (%)
2yrs ago	2002-2004	293 students	29 students (9.9)	230 students (78.5)	0	23 students (7.8)
1yr ago	2003-2004	181 students	14 students (7.7)	141 students (77.9)	0	10 students (5.5)

Current	2004	258 students	0	0	N/A	N/A
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The average GPA of a CEDAR member as of fall 2004 is a 2.9 with 40% holding a 3.0 or higher.

Change of Major

Year	Arch.	Nursing	Business	Education	Soc. Sci.	Sci/Math	Liberal Arts	Undec.	Sample size
2002	0	2 (7.7%)	3 (10%)	1 (4%)	5 (17%)	9 (31%)	6 (21%)	3 (10%)	29
2003	0	1 (7%)	2 (14%)	1 (7%)	0	7 (50%)	1 (7%)	2 (14%)	14

Finally, an on-line survey has been created to assess why student leave engineering at ASU. Survey results are not final at this time, but will be included at a later date. The survey tool is presented below.

SORP Assessment Survey

SORP in the Fulton School of Engineering is conducting an assessment of former and current students. The information provided will be kept confidential and anonymous and will be aggregated to portray an overall picture. Our hope is that the data gathered will produce better programs for our students.

Survey tool

1. What is your current major?
2. What is your future career goal?
3. When did you change your major from engineering?
4. Of the following list, which programs did you utilize for assistance during your time in engineering? Please attach a percent time for "how often"
 - a. Academic advising
 - b. Student organizations (please list)
 - c. Tutoring
 - d. Minority Engineering Program
 - e. Women in Applied Science and Engineering Program
 - f. Internal Sources (within ASU). Please identify _____
 - g. External Sources (outside ASU). Please identify _____
5. From the following list, which is the single most important factor in your decision to change your major from engineering? 1-4 [Strongly Disagree=1, Disagree= 2, Agree= 3, and Strongly Agree= 4)
 - a. Lack of support from faculty
 - b. Lack of support from staff
 - c. I was not succeeding academically
 - d. I did not enjoy my courses
 - e. Other students did not make me feel welcome

- f. Lack of effective career counseling in the engineering school
 - g. Lack of career counseling at ASU
 - h. I was not academically prepared for engineering upon entering ASU
 - i. I did not manage my time well
 - j. I could not adjust to the pace of the curriculum
 - k. I did not have a clear understanding of what engineering is was prior to enrollment
 - l. I decided that engineering did not interest me
 - m. I am personally interested in helping society (i.e., I'm a people person)
 - n. GPA (didn't want to lose scholarship/funding)
 - o. Other _____
6. Were faculty helpful? YES, NO, If "YES" please list
 7. Was the Fulton Engineering staff helpful? YES, NO. If "YES" please list.
 8. Which courses did you enjoy? (please list)
 9. Which courses were relevant to your career path and interests?
 10. Which courses do you feel need to be improved? (please list and reasons why)
 11. Did the course work and curriculum accurately reflect your expectations?
 - a. Yes. Please discuss why
 - b. No. Please discuss why
 - c. In some ways-please be specific
 12. Is there any information you would like to share with us about your experience that has not been addressed in the above survey? (please be honest)

Funding and resource allocation—Prior to the creation of CEDAR, the WISE and MEP programs competed for funding. Industry representatives found this difficult and non-collaborative. Through their involvement with the Dean's Advisory Council, they provided feedback that helped the administration implement the current structure. Staff in both offices was invited to provide feedback as well. In addition, CEMSWE while in existence since 1998, was not functioning in a collaborative manner either. Again, industry partners did not like having to choose which organization would receive support from year to year.

The proof of success truly lies in the increase in funding after the creation of CEDAR. Prior to 2002, WISE received \$15,000 to run a bridge program. That was the only money for persistence. The School provided \$7,500 for persistence programming. Currently, WISE receives \$30,500 in persistence funding.

Prior to 2002, MEP received \$30,000 to operate the summer bridge program. Currently, MEP receives \$85,000 for persistence funding. The difference in funding for the MEP and WISE programs is largely due to the high cost of running a tutoring program for all CEDAR students and a two week bridge program as compared to the WISE four day bridge program.

The largest funding increase has occurred for the student organizations. Prior to 2002, each organization received between \$1000-3000 per year. Since 2002, CEMSWE has

received a total of \$251,500. Because of the large increase, both WISE and MEP leverage resources with CEMSWE whenever possible. Industry has strongly supported joint organizational efforts which have lead to ASU having the Outstanding Student Section/Chapter of the Year for both NSBE and SWE in 2003.

Currently, SORP is seeking major endowment funding, large project funding and alumni donations. These funding sources will be used to sustain and expand the current level of programming for diverse students in engineering at ASU.

Conclusions-Traditionally, WISE and MEP programs have either co-existed or competed for students and funding. The creation of CEDAR at ASU has proven to both benefit the programs as well as the students. CEDAR enjoys record funding, student participation, program collaboration, faculty support, and industry partnerships. What was once two hidden programs in the School are now held up by the Dean and other administrators as an example of success. Enrollment rates, persistence rates and graduation rates continue to grow for under-represented students. Student satisfaction also continues to increase. CEDAR is a model for collaborative efforts that truly provide a better situation for diversity in engineering.

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