

## **Encouraging Underrepresented Minority and Women Students to Become Interested in Research and to Attain Graduate Degrees**

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### Abstract

Although the numbers of underrepresented minority and women students have been slowly increasing during the last decade at the undergraduate level, a similar increase has not occurred at the graduate level for minority students. The percentage of women pursuing an advanced degree in engineering (20%) is slightly higher than women pursuing an undergraduate degree. But, although the percentage of underrepresented undergraduate minority students in engineering is approximately 15%, the graduate minority percentage still hovers around 5%.

A program to help change this situation is the Collaborative Interdisciplinary Research Community (CIRC) program, whose goal is to increase the number of both women and minorities seeking a graduate degree in engineering. The Fulton School of Engineering CIRC program began in the Fall of 2002. CIRC is part of the Computer Science, Engineering, and Mathematics (CSEMS) program funded by the National Science Foundation (NSF) to recruit underrepresented minority students to pursue a graduate degree in engineering. The first CIRC class of 22 included 15 students who were either a minority or female or both.

The CIRC program students meet five times a semester. CIRC informative sessions include guest speakers on how to get involved in an engineering research project, writing a resume to obtain an internship, how to select and apply for graduate school, and getting funding for graduate school, which will be described in detail. Assessment of the program is done at each meeting and feedback is provided to the students at the next meeting. Students in the CIRC program are obtaining research positions and are considering graduate school as part of their career goals.

The Fulton School of Engineering graduate recruitment activities include booths at national meetings, participation in GEM (National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc.) and EMERGE (Empowering Minority Engineers/scientists to Reach for Graduate Education) , and a second CSEMS program for transfer students. In addition, we are “growing our own” by encouraging ASU students to pursue a graduate degree at ASU. The Fulton School provides undergraduate support programs for women and underrepresented minority students which include student chapters of AISES, NSBE, SHIP, and SWE. The Center for Engineering Diversity and Recruitment (CEDAR) is part of the strong support network for women and underrepresented minority students in engineering. The Fulton School is dedicated to supporting women and underrepresented minority students at the graduate level with the philosophy that we can only do this one student at a time.

I. Introduction

The Ira A. Fulton School of Engineering and Arizona State University (ASU) are dedicated to diversity. Similar to the national statistics, the numbers of underrepresented minority and women students have been slowly increasing in the Fulton School during the last decade at the undergraduate level. However, a similar increase has not occurred at the graduate level for minority students. The percentage of women pursuing an advanced degree in engineering (20%) is slightly higher than women pursuing an undergraduate degree. Although the percentage of underrepresented undergraduate minority students in engineering is approximately 15%, the graduate minority percentage still hovers around 5%.

In the Fulton School of Engineering, a comparison of the number of undergraduate underrepresented minority and women students shows that the enrollment has increased significantly from 1991 to 2003. Although the current percentages are higher than the national averages, they are still very low. The percentage of graduate women has also increased from 1991 to 2003, but the percentage of minority graduate students has remained relatively unchanged. Although the percentage of Fulton graduate women is higher than the national average, the current 4.1% percentage of Fulton underrepresented graduate students is just below the national average.<sup>1,2</sup>

| Year | Undergraduate Engineering Students |          |        |          | Graduate Engineering Students |          |        |          |
|------|------------------------------------|----------|--------|----------|-------------------------------|----------|--------|----------|
|      | Minority                           |          | Women  |          | Minority                      |          | Women  |          |
|      | Fulton                             | National | Fulton | National | Fulton                        | National | Fulton | National |
| 1991 | 10%                                | 12.8%    | 17.5%  | 16.6%    | 4.6%                          | 4.0%     | 14.5%  | 14.2%    |
| 1997 | 16.1%                              | 15.8%    | 19.8%  | 19.4%    | 5.0%                          | 5.3%     | 21.5%  | 17.4%    |
| 2003 | 17.7%                              | 14.7%*   | 20.2%  | 18.5%*   | 4.1%                          | 5.4%*    | 22%    | 20.7%*   |

Table 1. Percentages of women and minority engineering and computer science students in the Fulton School of Engineering versus national engineering enrollments  
 \*= 2002 Fall Enrollments

In order to increase the numbers of underrepresented students (women and minority) in undergraduate and graduate school, the Fulton School wishes to increase the enrollment of underrepresented (both women and minorities) students and encourage them to go on to graduate school. The students need to be introduced to research and to graduate school.

II. The Need for Scholarships

In order to attract top engineering students, scholarships are vital. Before Fall 2002, several scholarships were available for freshmen. The 60 underrepresented minority entering Fulton School Engineering freshmen that attend our Minority Engineering Bridge Program each earned a scholarship at \$800 to \$2,000. These scholarships were only for one year and have now been limited to just a few. The Dean’s Industry Scholarships are given to freshmen and renewable for one year based on good academic achievement. Women and underrepresented minority students are encouraged to apply. A requirement for receiving this scholarship is financial need as documented by FAFSA (Free Application for Federal Student Aid).<sup>4</sup> Since each year there are a

few of these students and other top students that simply do not have the finances to attend ASU, there is a need for additional scholarships from the other categories to support entering freshmen. Studies show that, unfortunately, Hispanic women, especially, usually do not make it to a four-year college if they begin their education at a community college. Sophomore scholarships are very important for community college students entering after one year and for freshmen, often minority or women students, who were given one-year scholarships to begin college, but have financial need to continue. There is often great difficulty in securing financial aid for the second year. The student then begins to work in order to make payments and the schoolwork begins to suffer. After the sophomore year, students have better opportunity to be placed in internships and earn extra money to help finance the rest of their college education. However, other students have had help for two years, such as our Dean's Industry Scholarship recipients and need additional help the third year. Transfer scholarships are especially needed since over 30% of the new undergraduate students each fall are transfer students. Half of those transfer students only decided on engineering after they began college, usually at a community college. Many top students are interested in several majors, do not know a lot about engineering, and so are undecided on their major and begin their studies at a community college. Other top students are committed to studying engineering, but do not have the finances to begin college at a four-year school. Due to a strong, local community college system, ASU, as an institution, receives applications from and admits more transfers each year than any other university in the nation. Since many local industry jobs are available to graduated engineering and computer science students, the extra stipend to remain in graduate school is very much needed.

- The need is especially great to assist Arizona families to support their child in college. Arizona is ranked #2 in rural poverty (Center for Budget and Policy Priorities, 1999).<sup>5</sup> In addition, Arizona has the largest gap between the rich and the poor (Corporation for Enterprise Development, 1999).<sup>6</sup> Arizona received a C- on affordability in the recently published "Measuring Up 2000."<sup>7</sup> When our in-state tuition was less than \$2,500 per year, Arizona families still needed to use 27% of their income to pay 50% of the college expenses minus financial aid at a public 4-year college/university. This shows that Arizona family incomes are low and that there is not a high level of financial aid available. In top education states, the families needed to only pay 17% of their income for college expenses minus financial aid. The in-state tuition is now \$3,593 and rising for next fall, making it even more difficult for some students to afford tuition; however, financial aid has also been increased accordingly. In 2002-03 ASU awarded more than \$305 million in all forms of financial aid to nearly 34,000 students across 3 campuses.

### III. National Science Foundation CIRC Scholars Program

In 2002, the National Science Foundation awarded a Computer Science, Engineering, and Mathematics Scholars (CSEMS) grant for \$100,000 per year for four years to ASU. Students, who have financial need are allowed stipends of \$3,125 per year. Since the ASU tuition is still relatively low, this stipend pays for a substantial percentage of the in-state tuition. Graduate students recruited through this program are given additional financial support, if possible, by the ASU Graduate College.

The NSF Fulton School CSEMS Program provides: (1) a structure for introduction and rapid integration of the new scholars into the research community through Research Orientation Workshops (ROWS), and (2) a community-building support network of faculty, senior researchers, and peers. Women and underrepresented minority students in the Fulton School are targeted for the program. The first goal of the program is to make sure that the student graduates with their engineering or computer science degree. The ultimate goal of the program is to increase the number of both women and minorities seeking a graduate degree in engineering or computer science.

### Student Selection Criterion

The Fulton School Collaborative Interdisciplinary Research Community (CIRC) program began in the fall of 2002. The first CIRC class of 22 included 15 students who were either a minority or female or both. Two of the students were freshmen, an exception that had been anticipated. The two students had attended our Summer Minority Bridge Program and were in great need for financial support. The program recruitment was coordinated through the school's Minority Engineering Program, the Women in applied Science and Engineering, the Community College night, and the school's research office. The students were also recruited through the scholarship website for the School. In addition, the leaders of the program encouraged students to apply. The PI of the grant is on the National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM) Board. Students who have applied for GEM Fellowships are sent a recruitment letter to the Fulton School and the students are encouraged to apply for a CIRC Scholarship. The Fulton School also has a booth at each AISES, NSBE, SHPE, and SWE national conference each year. Students who show an interest in graduate school in engineering complete an information sheet. This information is followed up by a letter from the Associate Dean of Student Affairs and contact from their department of interest. In the Dean's letter, the students are encouraged to apply for the CIRC Scholarship. Every student who applied and was eligible was accepted into the program. Since the full quota of students was not recruited the first year, we were able to add new students the second year. More positions became available because a few students graduated or chose not to continue in the program.

In addition to the FAFSA eligibility, students must be a US citizen, national, or alien admitted as a refugee; be enrolled full time in the Fulton School of Engineering at ASU; have a minimum 3.0 GPA (under special circumstances students with a 2.8-3.0 GPA can be accepted); and have a faculty recommendation and a statement of purpose addressing personal and career goals.

### The Workshops

Early in the Fall Semester, the grant coordinators met with the CIRC Scholars. The meeting was held in a nice room and refreshments were available for the students. The students reported feeling very special to have been selected for this program and to be treated to refreshments. We continued to have refreshments for them at each meeting. At the first meeting we gave them an overview of the program, some information about the current research being done in the School, and some information on graduate school. The second meeting of the Fall Semester was a Workshop on Graduate School: what is expected, how to choose a school, how to apply, and tips about getting into the school of your choice. The students were also given their assignment for

the year, the guidelines to put together a portfolio. See Figure 1. Instructions were also given that the portfolios were due on April 18 and the students were instructed as to where they could be turned in.

To find one meeting time in the same week was impossible. Through a survey, we learned that late Wednesday afternoon and Friday afternoon were the most available times. Five meetings were held in the spring. Each meeting was held two times: on a Wednesday and on a Friday in the same week. Students were allowed one unexcused absence. The result was that this worked well. Among the three PIs and co-PIs, usually at least two PIs were in attendance at each meeting. The students took their attendance seriously and all on the email list attended the required number of meetings. Most students attended one particular day or the other, but the double schedule allowed them to switch to the other day if needed.

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| <p><b><u>Portfolio Guidelines</u></b></p>  |
| <p><b><i>Binder Specifics</i></b></p> <ul style="list-style-type: none"> <li>➤ The portfolio is to be in a one-inch binder and must include dividers for several sections and sheet protectors for your work</li> <li>➤ The binder cover or first sheet should include a title page with project title – “CIRC Scholars Program” 2002-2003 with your name and ID number</li> </ul>   |
| <p><b><i>Preliminary Binder Sections</i></b></p> <ul style="list-style-type: none"> <li>➤ Copy of initial application (we will provide copies)</li> <li>➤ Copy of essay</li> <li>➤ Copies of letters of recommendation “ ”</li> <li>➤ Copy of resume</li> <li>➤ 1<sup>st</sup> Report – one page for each of the 3 possible research opportunities explored</li> <li>➤ 2<sup>nd</sup> Report – one page outline on initial graduate school research opportunities explored <ul style="list-style-type: none"> <li>○ include a short summary of what you learned about graduate school from your faculty advisor or other faculty member if your advisor is staff</li> </ul> </li> <li>➤ 3<sup>rd</sup> Report – one pager on each of 3 research journal article reviews</li> <li>➤ A journal and calendar section which will indicate the meeting times, workshops/seminars attended, etc.</li> <li>➤ Letter of intent for research placement, if available</li> </ul> |
| <p><b><i>Other Reports on Experiences</i></b></p> <p>If you have any of the following, an additional one-page report will be required for your portfolio:</p> <ul style="list-style-type: none"> <li>➤ An internship</li> <li>➤ A current research project</li> <li>➤ Past experience on researching graduate school opportunities</li> <li>➤ If you are currently a graduate student, a report on your experience</li> </ul>  |

Figure 1. CIRC Scholars 2002-2003 Portfolio Guidelines

Faculty presented workshops on research projects and on graduate school requirements. Based on the student evaluations, students would like to see more research presentations and more specifics on the graduate school application process. This will be incorporated into next year’s program. In addition, students were required to present one of their portfolio findings and they were highly encouraged to present on the research they had done to secure a research opportunity. Several students who were interested in graduate school chose to present on their experience researching universities in which to pursue their graduate education. Many undergraduate students do not research the departments and faculty carefully before they choose

a graduate school. The CIRC students, who looked at potential graduate schools, did focus on the departments and faculty in these universities after the advice they received in the CIRC workshops.

#### IV. Discussion and Assessment

The students were required to put together a portfolio, including reports on possible research areas and interviews of engineers. The most important was:

-Make an appointment with your advisor (if a faculty member) or a faculty member, if your advisor is not a faculty member

- Talk to this faculty member about graduate school
- Talk to this faculty member about a possible research project, paid or unpaid

Students were encouraged to develop a relationship with their advisor (staff or faculty) so the advisor would be in a position to write a letter of recommendation for them, if required. Some students met with their advisor for the first time. Several students secured research positions by talking with their faculty advisor or other faculty, while doing this assignment. At least two students were hired into paid internship positions after first volunteering to help with a research program.

At each meeting the participants were surveyed with a short written survey at the end of the meeting to determine how effective the meeting was and to identify topics of interest for future meetings (including their preferred food choices). These short evaluations were a good tool and helped to keep the meetings relevant to the students. Pertinent comments were read at the next meeting and questions were answered. This gave the students confidence that the organizers of the workshops had their best interest at heart and were listening. We especially tried to accommodate reasonable food requests. The survey asked the following questions:

- What did you like most about this meeting?
- What was the most important item that you learned today?
- What do you need to know more about?
- Suggestions for future meetings (topics, food)
- Comments

The students seemed to appreciate the program. They were very grateful for the stipend. The stipend allowed one student (married) to not have to work for the year for the first time in his academic career. He remarked how refreshing it was to just concentrate on his studies. Several students have relayed that they had never considered graduate school before this program and now they were seriously considering graduate school.

The project was delayed some in the first semester since one of the co-PIs took a higher administrative position outside of the college. We also tried in vain to find a meeting time when all of the CIRC Scholars could meet. It soon became clear that we could no longer wait on his schedule, and we needed to have two meeting times, and so the meetings proceeded well in the spring semester. Since this was our pilot year, we gained confidence that the type of meetings

that we were holding were of value to the students and were accomplishing the goal of the project.

At the end of the first year a couple of students suggested that for the second year, the portfolio should be different for continuing students and new students. Since several of the continuing students were seniors, his suggestion was that their emphasis for seniors be gathering information and receiving help on applying for graduate school. His suggestion was used for the second year of the program.

Of the 22 students enrolled in the CIRC Program the first year, four graduated (two are now graduate students in the School, with one continuing in the program), one chose not to continue in the program, one student dropped out of school after the fall semester, and the other 16 continued in the program for the second year.

## V. Conclusions

General consensus is that the first pilot year went very well. The students were happy with the program and several were able to secure internship positions because of the program. We suggested that students volunteer for some research experience if there was not a paid position available. At least two of the students volunteered to do research and were later hired on for a paid research internship. Several students are now considering graduate school or going on to graduate school who had not considered graduate school before the program.

Going into a second year, the project leaders are now more confident that the program is on the right track. We were able to schedule five meetings each semester in year two, but need to continue to have two different days of the week for each meeting in order to accommodate the students.

We decided after the first year that the program would work better by having the portfolios checked at the end of the fall semester and again at the end of the second semester for the complete portfolio. We fall-semester-loaded the assignments some, and students are required to turn in their up-to-date portfolio by the end of the fall semester or early spring and again at the end of the school year for renewal of their scholarship.

The long range assessment of the program is dependent on the graduation and attainment of graduate degrees by the students participating in the program. This program is absolutely dependent on scholarships. The higher the success rate of CIRC students going on to graduate school, the better chance we should have in obtaining continued external funding for the project. We believe that we are accomplishing the goals of the project and that the project is very beneficial to the students, both financially and in helping them choose to go to graduate school.

## References

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MARY R. ANDERSON-ROWLAND

Mary R. Anderson-Rowland is the Associate Dean of Student Affairs in the Fulton School of Engineering at ASU. She was selected for the National Engineering Award in 2003, the highest honor given by the AAES. In 2002 she was named the Distinguished Engineering Educator by the Society of Women Engineers. She has received other diversity support awards including the YWCA Tribute to Women 2001 Award (Scientist/Researcher) and the University Achievement in Gender Equity Progress Award, Faculty Women's Association, 1995. An ASEE Fellow, she is a frequent speaker on the career opportunities in engineering, especially for women and minority students.

PAUL C. JOHNSON

Paul Johnson is the Associate Dean of Research for the Fulton School of Engineering at ASU. In the last six years he has been principal investigator on research grants that have led to the mentoring of 3 undergraduate, 14 graduate, and 2 post-doctoral researchers on a variety of projects. He has been selected twice to receive the School of Engineering's Teaching Excellence Award, and the students involved with his research program have been co-recipients of awards from the National Ground Water Association, the American Petroleum Institute, the Arizona Water Pollution Control Association, The Environmental Technology Certification Program, and the White House.