

Mentoring Minority Engineering Students: A Program at Florida International University

**Irma Becerra-Fernandez, Richard Campbell,
Gustavo Roig, Gordon Hopkins
Florida International University**

Abstract

This paper describes PRISM (Program of Industry Supported Mentorships), the Florida International University mentor program. The purpose of this program was to develop and test a university-industry partnership in the College of Engineering. The participating mentors represented some of the major corporations and small firms in the South Florida area. Unlike many other mentor programs, PRISM included fifteen mentees who had grade point averages below 3.0 on a 4.0 scale. All of these mentees were minority students, including both persons of Hispanic and African descent, with a good gender representation (5 students or 33% were females). Several activities were held over a nine month period which included meetings with the mentors, a “get-to-know-you” breakfast, and a seminar where the mentors spoke about their careers and life experiences. Anecdotal responses from students, mentors, and professors have shown that the participants all found the program to be very valuable. Due to their participation in this program, the mentees have already seen a correlation between their academic work and the real-life working world.

Introduction

Recent analyses have uncovered that the future will require the participation of greater numbers of females and minorities in the increasingly technological work ^[4]. The U.S. Census Bureau estimates that individuals of African, Indian, and Hispanic descent account for over 30% of the U.S. population, yet they are woefully underrepresented in the technological fields. The Bureau estimates that by the year 2050, minorities will comprise half (50%) of the U.S. population. Minorities, therefore, will be expected to comprise half of the labor force in the technological fields, or a resulting shortage of scientists and engineers may result ^[8]. Therefore, as educators, we need to discover new and innovative techniques to motivate this segment of the population to study math, science and engineering, and to provide them with appropriate role models. Even today "precious few women, worldwide, are choosing careers in engineering. In the United States, women make up 51 percent of the professional workforce. However, only a paltry 8.5 percent of all engineers are women" ^[6] .

One of the most popular ways to increase women and minority retention, and at the same time ensure academic success, is through mentoring ^[9]. Though there are varied operational definitions of mentoring, its origins are from the ancient Greek language. The Greeks described mentorship as a relationship in which an older and wiser person would counsel and direct the experiences of a younger, developing person. A review of the research literature tends to show that mentoring programs, however vague, do have a positive impact upon the academic life of the students or

mentees. Valadez^[9] found that mentorships tend to provide an effective way of producing minority research scholars. Unfortunately, Boyer^[2] found that mentoring of minorities and women in colleges and universities is rare. Additionally, Blackwell^[1] found that only one in eight African American students had a college or university mentor. However, more and more businesses and institutions of higher education are using mentorship as a method of training and of increasing the academic success of their employees and students^[3]. Most of the literature confirms that the focus in higher education in the science and engineering fields is on the graduate population, where the professor serves as a mentor to the graduate student^[7]. However, if the goal of increasing female and minority participation in the science and engineering fields is to be achieved, the focus of the nation's mentorship programs must begin as early as possible at the undergraduate levels.

The Florida International University (FIU) Program of Industry Supported Mentorships (PRISM) uses industrial support in the form of "minds" and role models as a way of developing a viable undergraduate mentorship program. PRISM addresses the problem of a shortage of female and minority participation in the scientific fields by partnering participating undergraduate students at FIU with mentors from local industry. Just as a real prism produces a continuous spectrum of light, so too, it is hoped, that the FIU PRISM will help to produce a continuous spectrum of racial and gender diversity in the engineering and science fields.

The FIU Program of Industry Supported Mentorships

FIU, a member of the State University System of Florida, is a doctoral granting, public, multi-campus institution offering a broad array of undergraduate, graduate and professional programs. FIU has two major campuses, two additional academic sites and a Center for Engineering and Applied Sciences. It is an urban institution which serves the South Florida region (Dade, Broward, Monroe and Palm Beach Counties). Recently, FIU was reclassified as a Doctoral I University according to the Carnegie-Mellon classification system. FIU was chartered by the Florida Legislature in 1965 and began offering classes in 1972. Since then, it has grown at such a rapid rate that it is now one of the 50 largest universities in the nation. During the 1995 Fall semester, FIU student enrollment surpassed 28,000, a growth of over 6% from the previous year. There are 1,901 and 375 undergraduate and graduate engineering students, respectively. FIU has a student body that approximates the diverse local community: Hispanics - 49%; African Americans - 14%; Asians - 3%; Whites, Non-Hispanics - 28%; Non-Residents - 6%. FIU's total minority enrollment is approximately 17,500, or 63% of the total student population, while 58% or 16,153 students are female. Although the total numbers of females and minorities come close to reflecting the diversity of the local community, female and minority enrollment in the graduate science and engineering disciplines are not representative of their numbers in the local population. Specifically, Hispanics make up 34% and African Americans make up 9.5% of the graduate population in engineering at FIU, while they represent 50% and 21% of the local population, respectively.

One of FIU's greatest assets is that, unlike most universities, most of its alumni obtain employment in the region, with 72% of all alumni residing in South Florida alone. Because most of FIU's alumni stay in the local area, they can be encouraged to assist in the recruitment of local minority students.

As a way to encourage students and to increase student retention ^[5], PRISM was created as a pilot program in the College of Engineering and Design. The goals of PRISM are:

1. To identify mentors and role models in engineering and the sciences from underrepresented groups;
2. To provide female and minority engineering students with an early experience and exposure to the working environment through their assigned mentors;
3. To increase the retention rates of women and minority students in engineering and the sciences through interaction with their role models and mentors; and,
4. To increase the number of women and minorities enrolling in graduate engineering and science programs as a result of the expected increase in retention rates.

PRISM, which is a university-industry joint partnership, is supported by the local private and public sectors. The mentors represent some of the largest companies in the area, such as Florida Power and Light, BellSouth, the Florida Department of Transportation, Harris Computers, the Burger King Corporation, as well as many small firms such as Basulto & Assoc., CAS Engineering, Marathon International, and Pistorino & Alam Consultants. The pilot group of mentors, consisting of 16 individuals from industry, offered their time, in-kind, in order to assist FIU to design and pilot-test this program.

The pilot group initiated their activities by defining PRISM's scope of operations as follows:

1. Complement the college experience by providing the participating students or mentees with the means to establish relationships with individuals working in the public and private sectors.
2. Provide the mentees with a learning opportunity, different from their academic curriculum, by exposing them, through their mentors, to the real-life working environment. It was determined that this exposure, based on the mentors' professional and personal experiences, would enhance the mentees' collegiate education.
3. Serve as a sounding board in profession-related matters for those mentees who want to ask questions, voice concerns, or just share experiences.
4. Provide the mentees with the additional motivation and guidance they may often require to achieve their academic, professional and personal goals.

Mentors identified and selected for PRISM had to meet the following criteria:

1. Have time available to meet with students during the academic year;
2. Have interest to work with students;
3. Have appropriate work-related experiences to draw upon to provide guidance to the students;
4. Have completed a degree in the relevant discipline.

Students selected for PRISM had to meet the following criteria:

1. Start no later than the third (Junior) year of their undergraduate program. The reason for starting at this level is that the mentors felt that waiting until the students were seniors would be too late for the kind of impact this program was providing.
2. Remain in good academic standing (minimum 2.2 GPA out of possible 4.0). This means that PRISM is available to those students who have the highest academic standing as well as to those who show promise of succeeding academically.
3. Complete at least one term at FIU.
4. Be recommended by their academic advisor for participation.

5. Be willing to, upon becoming a senior and if had maintained a high academic standing, become a mentor for freshmen students.

Mentor Program Activities

After the initial group of mentors was contacted and enlisted, they in turn identified other mentors who they thought might be interested in participating in the program. This pilot group met for the first time in January 1995, where they plotted the strategy of the program. The pilot group then had a second meeting with a group of select undergraduate engineering students to determine their thoughts concerning the viability of this program. The students welcomed the mentorship program concept with great enthusiasm. Subsequently, the pilot group then met several times to determine the purpose and goals of PRISM. Once the program goals were established, the various engineering student advisors were encouraged to submit names of potential applicants for this program. In August of 1995, the mentors met to review the set of student applications submitted by the student advisors, and each mentor selected a mentee based on common areas of interest or engineering discipline.

The pilot group was introduced to the first group of fifteen mentees at the Mentors Breakfast Mixer on September 27, 1995 (14 Hispanics - 1 Black; 5 Females - 10 Males). Seating arrangements for the breakfast were made based on the prior mentor and mentee match. During the breakfast, the mentors and mentees were given the opportunity to learn about each other; specifically, they discussed areas where the mentor could assist the mentee. The mentors and mentees then scheduled meetings on an as-needed basis, either via phone, in person, or through electronic mail. In order to facilitate communication, electronic mail (e-mail) addresses were provided to the mentees.

One of the first and most fundamental activities planned and accomplished during the year involved each mentor organizing a "Take your mentee to work for a day." Each mentee spent several hours or a full day at the work place of his/her mentor. The students had an opportunity to participate in work-related meetings and activities with their mentors. This experience had a very positive impact because it allowed students to experience a "sneak-preview" of an engineer at work, a situation quite different from what they see in the academic setting.

PRISM's second major activity occurred in March. The Spring Forum consisted of a panel of mentors who shared their on-the-job experiences with the mentees, as well as with a number of lower division undergraduate engineering students and university faculty. The forum was planned so that each mentor was given five minutes to speak on a variety of topics. These topics included such issues as: (a) engineering diversification in the face of companies "re-engineering" and downsizing; (b) management of technology and its key areas: knowledge of subject matter, disciplined approach to process, leadership, and team work; (c) the future for engineers in telecommunications: deregulation, technology development, and globalization; (d) engineers as computer scientists; (e) environmental engineering in Florida; (f) engineers as entrepreneurs and small business owners; (g) engineers in marketing and sales; (h) electrical engineers in technical positions; and (i) diversification in the workplace. These presentations were followed by a question and answer period where students in the audience directed specific inquiries to the panel. Some of the questions asked by the students were: (a) What percentage of what you have learned do you use

now?; (b) What percentage of your time do you spend communicating, either orally, visually or in writing?; (c) How hard is it to move up in large corporations?; (d) How important is it to be ethical in your profession?; (e) Should I join student societies? Are there any benefits?; (f) How hard is it to start your own business?; (g) What is the ratio of males to females in the engineering profession and how do their salaries compare? As a consequence of the question and answer session, the students were allowed to enter into a dialogue with practicing engineers, an opportunity they usually do not acquire in academia.

PRISM's third major activity involved some of the pilot group of mentees becoming mentors themselves to a group of 14 high school students (juniors and seniors). These high school students visited FIU during the last week of classes in April 1996. The event was called "Shadow an Engineer Day." The high school students attended an orientation session at FIU where they were addressed by an engineering advisor, who explained some of the academic requirements of an engineering major. This guidance session was geared toward preparing these students for an academic career in engineering. It was deemed to be of great help to these students even if they had not planned to attend FIU but would rather begin their academic careers at a community college or other university.

The student mentors then lead the high school students on a tour of the different engineering labs, and had lunch together. The high schools that participated in this event were: Miami Springs Senior High School (SHS), South Miami SHS, Miami Norland SHS, Miami Carol City SHS, Hialeah SHS, and Mast Academy. These schools are mostly inner city minority high schools, and their participants were either African Americans or Hispanics, with good gender representation.

Results

To determine participant's perceptions and opinions about PRISM, survey and anecdotal data were gathered. Both survey and anecdotal data thus far with PRISM has shown that it provides an invaluable experience for our students. Some of the anecdotal comments from students were presented by the first author of this paper as an invited presentation to the Quality Education for Minorities (QEM) Conference, held in Miami, Florida in 1996. The goals of QEM are to serve as a focal point for the implementation of strategies that help realize a significant increase in the participation of underrepresented minorities in all sectors of the nation's mathematics, science, and engineering communities. A group of mentees from PRISM were also invited as panelists to present their experiences from the program. Some of the highlights of their presentation in recounting their experiences are captured in the following anecdotes:

"I can see how all my hard work and effort now in school has a purpose...I have been able to get a better view of what the engineering field is like" (Richard Lopez)

"What truly compliments the success of any student's road to achievement is the opportunity to access the experience of those already established in their career. No matter what the profession, the existence of a mentor program is an integral part of a student's curriculum. I wish to thank...my mentor [who] has kindly given his time and knowledge to pace me through the road that lies ahead" (Jesus Arias)

"Among the benefits...[a] better understanding of the different responsibilities of a professional engineer...[and] a future goal of establishing a small business...I thank...my mentor...without him I would not have learned what really goes on in a world that I will belong to in a couple of years" (Erika Suarez)

"...A remarkable experience...I feel that I'm learning in the Mentor Program, and all that information that I'm absorbing, I'm releasing to the younger engineering students... the engineers of tomorrow" (Jesus Lebena)

"I learned about electrical engineering and its diversity...real world engineering problems...the downsizing situation...[and it] helped me decide what branch of electrical engineering to pursue" (Marlin Brinson).

In addition to the comments made at the conference, students made similar comments about the Spring Forum. Some of the students' feedback received on this activity were: "This is the best Friday class we've had yet", "Enjoyed the interaction with real engineers", and "I'm ready to go out and work".

In addition to the anecdotal comments from student participants, general comments from faculty members included:

"I can't think of any activity that could have a higher impact on so many minds at the same time. You've found a formula that probably is the most important retention effort made available to our students."

In addition, general comments from the mentors included:

"I found the Mentor Program to be worthwhile in that it gave me an insight into a current engineering program from the point of view of the student. Discussions with prospective employees are not as candid. I also made contact with a student that is a good prospect as a future employee, and I was able to get to know him better than it would have been possible in an interview situation...I think the program is successful. I am on the advisory board to the University of Central Florida Engineering program and I recommended to them that they look into adopting a program like this." (Alfredo Romagosa, Harris Computers)

Table 1 shows the results of the student responses to the FIU Engineering Mentor Survey Form. The students were asked to rate each statement based on their feelings on a scale of 1 to 5, where 1 meant "Strongly Disagree" and 5 meant "Strongly Agree". Of the student population that participated in the program, 64% responded to the survey. From the survey, question 16 deserves some explanation, since most mentees still have not graduated, but the two that graduated were able to obtain a job through their mentor. From the survey results we can see that the majority of the students agreed that the Mentor Program provided them with an opportunity to learn about prospective employers, and gave them a better insight into the kind of skills and specialization that exist in the world of engineering. Also, from the survey results in Table 1 we can see that students strongly agreed that the Mentor Program:

1. Provided them with invaluable information about the world of engineering that would not otherwise have received.

2. Their mentor was very involved with them and gave them an opportunity to better understand the different jobs engineers do.
3. Their mentor made them feel comfortable and free to discuss problems.
4. Provided them with an opportunity to learn about skills needed in the work place.
5. Provided them with an a link between academic work and the world of engineering.
6. Helped them understand the complexities of the world of work, such as corporate downsizing and the different responsibilities of a professional engineer.
7. Provided them with an opportunity to tap the knowledge and experiences of engineers already in the field.
8. Helped them gain confidence in their abilities and encouraged them to strive harder in their academic work.
9. Was valuable and would recommend it to fellow classmates.

What makes PRISM unique was the matching of students with mentors from industry, rather than faculty mentors. Of the mentors involved, 93% were minorities or women. Specifically, 33% of the mentors were women, and 73% were Hispanic. Of the students involved, 100% were minorities, specifically, 36% were women and 93% were Hispanic. There was a higher representation of women and minorities in this program than in the population at the College, which is 15.3% women and 68.7% minority at the Undergraduate level.

As a summary, it is clear that mentorship allows the students to have a sense of professional awareness, a real understanding of an engineer's job, a visualization of themselves as a member of the engineering community, and an opportunity to interact with professionals in the field they want to enter. Mentorship also encourages students to sharpen their skills for possible entry into a graduate program.

Future Plans

FIU is seeking a multi-year seed grant to institutionalize PRISM across several disciplines beyond engineering, including architecture, computer science, and mathematics. FIU now needs external support to administer this program. Furthermore, FIU would like to disseminate this knowledge and propose it be replicated at other urban universities, particularly historically black colleges and universities (HBCU's) and minority institutions (MI's). PRISM recognizes the need for a larger evaluative statistical database to track the value of this program. Another paper will be forthcoming to publicize those results if the program gets funded. Finally, we recognize the mentor-student matching process needs to be streamlined, perhaps through the development of a database application that would allow for the identification of a number of students (say five) that might have common interests with each mentor. Currently, the matching is done by hand and this process needs to be enhanced to allow this program to grow.

Recently at the FIU Alumni Breakfast, the first author made a small presentation encouraging our alumni to join PRISM. Furthermore, we are planning to involve the faculty and ask them to nominate candidates to PRISM. Also, future plans include an extension of this program whereby senior undergraduate mentored students will themselves mentor seniors from academically and financially needy high schools in Dade County and/or freshman university students. Some of this

Table 1 - FIU Engineering Mentor Survey Form

- | | |
|--|---|
| <p>1. The Mentor Program provided me with invaluable information about the world of engineering that I would not otherwise have received. (Strongly Agree 38%, Agree 38%, Unsure 25%)</p> <p>2. My mentor was very involved with me and gave me an opportunity to better understand the different jobs that engineers do. (Strongly Agree 50%, Agree 25%, Unsure 25%)</p> <p>3. My mentor made me feel comfortable so that I felt free to discuss any problems with him/her. (Strongly Agree 75%, Unsure 25%)</p> <p>4. The Mentoring Program provided me with an opportunity to learn about skills I will need in the work place. (Strongly Agree 38%, Unsure 38%, Agree 13%)</p> <p>5. The Mentor Program provided me with an opportunity to get learn about prospective employers. (Agree 50%, Strongly Agree 25%, Disagree 13%)</p> <p>6. The Mentor Program has provided me with a link between my academic work and the world of work in engineering. (Strongly Agree 50%, Agree 25%, Unsure 25%)</p> <p>7. The Mentor Program has helped me understand the complexities of the world of work, such as corporate downsizing and the different responsibilities of a professional engineer. (Strongly Agree 75%, Disagree 13%)</p> <p>8. The Mentor Program provided me an opportunity to tap the knowledge and experiences of engineers already in the field. (Strongly Agree 63%, Agree 13%, Disagree 13%)</p> <p>9. The Mentor Program helped me gain confidence in my abilities and encouraged me to strive harder in my academic work. (Strongly Agree 50%, Agree 38%)</p> <p>10. The Mentor Program helped me gain a better understanding about requirements for graduate school. (Agree 38%, Neutral 25%, Strongly Disagree 25%)</p> | <p>11. The Mentor Program provided me with an opportunity to meet University officials that I would not have met otherwise. (Neutral 38%, Strongly Agree 25%, strongly Disagree 25%)</p> <p>12. The Mentor Program provided me with invaluable information about upward mobility in the job market. (Agree 25%, Neutral 25%, Disagree 25%, Strongly Agree 13%)</p> <p>13. I was encouraged about my future prospects because I was able to interact with mentors from the same cultural background as myself. (Strongly Agree 25%, Neutral 25%, Strongly Disagree 25%, Agree 13%)</p> <p>14. I consider my mentor to be a role model in my professional career. (Neutral 38%, Strongly Agree 25%, Agree 25%)</p> <p>15. My mentor is the reason why I stayed in engineering. (Strongly Disagree 38%, Disagree 38%, Neutral 13%)</p> <p>16. My mentor helped me get a job (internship or permanent). (Strongly Disagree 50%, Strongly Agree 25%, Disagree 25%)</p> <p>17. The Mentor Program gave me a better insight into the kind of skills and specializations that exist in the world of engineering. (Agree 63%, Strongly Agree 13%)</p> <p>18. The Mentor Program provided me with an opportunity to meet other students in the engineering program that I did not know. (Strongly Agree 25%, Agree 25%, Neutral 25%, Disagree 25%)</p> <p>19. The Mentor Program helped me improve my grades by giving me knowledge that I could apply in my classes. (Agree 25%, Neutral 25%, Disagree 25%, Strongly Disagree 25%)</p> <p>20. I would recommend my fellow classmates to participate in the Mentor Program. (Strongly Agree 75%, Neutral 25%)</p> |
|--|---|

work has already started with the "Shadow an Engineer Day" activity, in which we plan to increase participation through solicitations sent to college advisors at each of the local high schools.

None of this is possible without a firm and permanent financial underpinning. This country must not lose sight of the importance of continued investment in the future of our technological strength. The wisest place to invest in education is in the future of our engineers and scientists. If we are to remain competitive in the global marketplace, we need to provide educational opportunities for those people who will fill our future job needs. Programs like PRISM can provide the necessary motivation toward enriching their educational experiences.

References

- [1] Blackwell, J. (1989). Mentoring: An action strategy for increasing minority faculty. Academe, 75, 8-14.
- [2] Boyer, E. (1987). College: The undergraduate experience in America, New York.
- [3] Brainard, S. & Ailes-Sengers (1994). Mentoring engineering students: A model program at the university of Washington. Journal of Women in Science and Engineering, 1 (2), 123-135. New York, NY.
- [4] Fentiman, A. & Britton, R. (1995). A workshop to improve retention of women engineering students. Investing in the Future. (American Society For Engineering Education, 1995 Annual Conference Proceedings, 2, 1660-1663) Anaheim, CA.
- [5] Fortenberry, N. (1994). Engineering, education and minorities: where now? Journal of Women in Science and Engineering, 1 (2), 87-89. New York, NY.
- [6] Geppert, L. (1995). The uphill struggle: No rose garden for women in engineering. IEEE Spectrum. (Women in Engineering, 32(5), 40-50). New York, NY.
- [7] Jacobi, M. (1991). Mentoring and undergraduate academic success: A literature review. Review of Educational Research, 61(4), 505-32.
- [8] Peng, P., & Hill, S. (1994). Characteristics and educational experiences of high-achieving minority secondary students in science and mathematics. Journal of Women and Minorities in Science and Engineering 1(2),137-152.
- [9] Valadez, J & Duran, P (1991). Mentoring in higher education. (American Educational Research Association, 1991 Annual Conference Proceedings, Microfiche Ed331451, 13(1), 1-12) Chicago.

Bibliography

IRMA BECERRA-FERNANDEZ is Director of External Programs for the College of Engineering and Design at Florida International University. Dr. Becerra-Fernandez holds a Ph.D. in Electrical Engineering from Florida International University, and a Masters in Electrical Engineering from University of Miami. Dr. Becerra-Fernandez has over ten years of experience in Energy, Space Administration and Academia, in the areas of engineering management, information technology, technology transfer, competitive intelligence, and secure communications.

RICHARD CAMPBELL is Dean of Graduate Studies and Professor of Science Education at Florida International University. Dr. Campbell holds a Ph.D. in Science Education and Masters in Student Personnel Administration, both

from Indiana University. Dr. Campbell has authored over fifty scholarly papers and presentations in the area of Science Education, and has served as a consultant to many school districts and for the National Science Foundation.

GUSTAVO A. ROIG is Acting Chairperson of the Department of Electrical and Computer Engineering, and Associate Dean for the College of Engineering and Design, at Florida International University. Dr. Roig holds a Ph.D. in Electrical Engineering as well as a Masters in Electrical Engineering, both from the University of Florida. Dr. Roig is the founder of the pre-college Florida Action for Minorities in Engineering (FLAME) Program.

GORDON R. HOPKINS is Dean of the College of Engineering and Design at Florida International University. Dr. Hopkins holds a Ph.D. in Engineering Mechanics from the University of Alabama, and a Masters in Mechanical Engineering from the University of Kentucky. Dr. Hopkins is a member of the Board of Directors of the Florida Medical Devices Association as well as the International Health Council.