Increasing the Retention of Females of Color in Engineering and Technology Degree Programs through Professional Development Activities

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ABSTRACT

This paper provides an overview of professional development activities designed to provide minority female engineering students with the knowledge and essential skills to enhance their preparedness to transition into the engineering workforce and their ability to sustain a successful career. Three professional development workshops are discussed that focused on such topics as breaking the glass ceiling, leadership, soft skills development, balancing technical and non-technical skill development, professional etiquette, mentoring, and creating a growth plan. Industry partnerships have been a critical component to the success of these activities.

Keywords: professional development, retention, gender, minority, industry collaboration

1. INTRODUCTION

There is continued concern regarding the retention of women and minorities in science, engineering and technology (SET) career fields. While there has been an increase in overall baccalaureate degree production in engineering and technology for both women and minorities, their overall representation in these fields has remained low [1]. Women, African-Americans, and Hispanics earned respectively 20%, 5.1% and 5.4% of the engineering degrees awarded in 2003; percentages lower than their representation in the population [2]. This disparity has been characterized as a narrowed but persistent gap [3]. The National Science Board has issued strong warnings that if the United States is to be globally competitive and maintain its dominance in critical areas of science and innovation, it is imperative that the pipeline of all students entering and persisting in science, technology, engineering and mathematics (STEM) disciplines is strengthened [4]. A variety of activities have been utilized at the university level in an effort to increase the recruitment and retention of minorities and women in STEM degree programs including summer bridge programs, scholarship programs, peer mentoring programs, and innovative teaching strategies. Despite these efforts, a current research report by the Center for Work-Life Policy indicates that over time more than half of women who begin science, engineering, and technology (SET) careers leave these careers and never return to such positions [5]. Reasons identified for this large exodus of women include perceptions of a hostile and macho work environment, feelings of isolation, work cultures that encourage risk taking, and time-intensive job pressures that compromise work-life balance. The study, which examined the career trajectories of corporate women with SET degrees further reports that 45% of the women studied lacked mentors, 63% experienced sexual harassment, and 40% felt stalled or stuck in their careers [5]. Furthermore, women are less likely to have the technical self-confidence and assertiveness associated with success in engineering [6]. These issues may be particularly acute for women of color as they represent a double minority and the dual disparities they may experience are often overlooked or not considered.

As women enter SET fields, they may have questions and/or concerns about the professional path on which they are about to embark that are not easily answered by faculty or family. For women of color, access to individuals who have professional experience in the STEM fields, particularly engineering and technology is limited at best. Trenor et al. found that minority students were less likely to know someone employed as an engineer and have access to engineering role models [7]. Their research investigated the relations of ethnicity to

female engineering students' educational experiences and career plans. The challenges faced by minority female engineering and technology students during their academic career and as they transition into the workforce are far beyond mere academic ability. Education does not explain the disparities and career dissatisfaction experienced once females enter the engineering workforce [6].

Many university programs aimed at increasing the retention of minorities and women in SET focus on improving the academic capabilities and technical proficiency of students; however, issues pertaining to personal and professional growth are typically not addressed. To fill this void, universities have typically relied on student organizations to provide resources to students on personal growth and professional development. This paper describes professional development activities coordinated by the authors who serve as the faculty advisors to the student chapter of the Society of Women Engineers (SWE) at Prairie View A&M University (PVAMU). The activities were designed to provide female students in the College of Engineering (COE) with knowledge and essential skills to enhance their preparedness to transition into the engineering workforce and their ability to sustain a successful career. We describe how carefully designed professional development activities can be used to increase the retention of women of color in engineering and technology degree programs and careers. In addition, these activities served to increase the visibility of the SWE student organization in the COE and resulted in significant membership growth and an improved perception of the organization. Also, discussed is the role of industry collaboration in ensuring the success of women of color in engineering and technology disciplines.

2. MOTIVATION

Historically black colleges and universities (HBCUs) have filled the vast educational needs of cultural minorities for decades. They have supported the economic development and social mobility of people of color in disciplines that minorities have traditionally been underrepresented in such as engineering and technology. This success has come from their ability to create educational environments in which students from a variety of micro cultural groups such as gender, social class, and disabilities experience educational equity [8].

Prairie View A&M University, a Historically Black University, is the second oldest public institution of higher education in the state of Texas. It is a primarily undergraduate institution with growing graduate programs. The University's enrollment exceeds 7,500 students with approximately 96% (90% African-American, 3.5% Hispanic, 2.5% other ethnic minorities) of the universities students classified as ethnic minorities, of which 59% are women. The College of Engineering at PVAMU consists of six departments offering Bachelor of Science, Master of Science, and Doctorate of Philosophy degrees. The undergraduate programs are accredited by the Accreditation Board for Engineering and Technology (ABET).

During its' 130 year history, PVAMU has been at the forefront graduating African-American engineers who have gone on to make significant contributions to the nation's scientific workforce, enabling PVAMU to consistently rank among the top ten producers of African-American engineers. However, female enrollment in undergraduate engineering and technology programs at HBCUs including PVAMU mirror national trends. The COE at PVAMU has experienced a steady decline and subsequent flattening of female enrollment during the period of 2003-2008. During this time, the percent of female undergraduate enrollment dropped from 34% to 24% in a 5 year period. The exodus of female students varies by department with Mechanical Engineering and Computer Science witnessing the largest drops in female student enrollment. In an effort to address the declining enrollment of female students, the authors worked with the administration through the SWE student organization to identify strategies and develop initiatives to reduce the attrition of female students in the COE. Currently, the authors are conducting a study to further identify the factors that impact the persistence and attrition of female students in engineering and technology [9, 10].

3. PROFESSIONAL DEVELOPMENT ACTIVITIES

A number of professional development activities have been sponsored by the authors and the SWE chapter. Specific objectives of these activities include:

- Students will learn leadership strategies and effective networking strategies.
- Students will learn how to seek and establish mentoring relationships and the importance of community involvement.
- Students will learn how to increase their marketability and how to sustain a healthy and progressive career.

An underlying goal of these activities has been to create and maintain a well established network through the SWE chapter to support the academic and professional growth of current and future female students in the COE. To date, specific activities have included: (1) establishment of a professional development workshop series, (2) establishing a peer-mentoring program for

undergraduate and area high school students, (3) sponsorship of key events in the COE (e.g. new Dean's reception, engineering week reception), (4) sponsoring student attendance at national and regional SWE conference, and (5) hosting SWE leadership coaches to conduct workshops. The authors have been successful in obtaining financial sponsorship to host these activities from the Lockheed Martin Corporation, ExxonMobil, and the ExxonMobil and Ford Foundations (through the SWE Program Development Grant #DR 251). The Program Development Grant was awarded by the national SWE organization to support the expansion of the professional development workshop series. Additionally, industry, government, and academic representatives have contributed to the success of these activities by volunteering their time and expertise. Whereas, several activities have been conducted, this paper describes the professional development workshop series and a preliminary analysis of its impact.

4. PROFESSIONAL DEVELOPMENT WORKSHOP SERIES

Three professional development workshops (PDW) have been organized and sponsored. The workshops were open to all students in the College of Engineering as well as students from the College of Arts and Sciences were invited to attend. The workshops have covered an array of topics that cover both technical and non-technical skills. The PDW combined professional development and socialization activities in order to effectively engage the students throughout the workshops. The format changed for each workshop depending on the number of speakers (and topics) as well as to offer variety for participants. For example, Workshop II consisted of individual presentations and a panel of speakers who represented members of academia, various industries, hiring consultants, alumni, and government agencies and discussed career options and answered student initiated career questions. Comparatively, Workshop III which focused on mentoring consisted of two presenters and included minority female high school junior and senior students from an area high school.

Each workshop has focused on providing students with the essential tools needed to increase their marketability, their understanding of industry expectations, and the successful transition from college into the workplace. The topics were selected based on (1) direct feedback from industry recruiting/hiring managers, (2) direct observation of female student's "soft skills", and (3) student input. Industrial and academic representatives served as presenters for the workshops and have been an integral component to the PDW success and longevity. Workshop I entitled "*Essential Skills for Entry-Level Engineers"* aimed to provide the participants with knowledge of the unwritten rules for career success. A sample of the topics presented include: *breaking the glass ceiling, leadership skills for engineers, the importance of soft skills, and balancing technical and non-technical skill development.* Workshop II entitled "*Empowered to Lead"* focused on topics that would enhance the students' leadership skills. A sample of topics presented include: *professional etiquette and creating a growth plan.* Workshop III was entitled "*Building Effective Mentoring Relationships: Career Mentoring for Minority Women in Engineering, Technology, and Computer Science"*. The goal of Workshop III was to inform students including the high participants of the value of developing mentoring relationships to their educational and career development and advancement.

At the end of each workshop, participants were provided an opportunity to network with the presenters and other workforce representatives during a refreshment and socialization activity. A fourth PDW is scheduled for spring 2009. The topics covered in Workshop IV will focus on providing students with the skills needed to best navigate their career. The topics chosen for future workshops will be determined based in part on student input and industry guidance.

5. INDUSTRY COLLABORATIONS

Partnering with industry, government, and academia has been critical to the success of the professional development workshop series. Representatives from industry, government, and academia have volunteered their time and served as workshop presenters. A partial list of partnering collaborators is provided in Table 1. Increased participation by the female students in the COE has helped increased both the financial and human resources contributed by our collaborating partners to the SWE student chapter and the professional development activities.

Table 1. Partial List of Collaborating Partners

Industry	Type
Bechtel	Industry
Hewlett-Packard	Industry
4W Solutions	Industry
Chevron Texaco	Industry
Oracle	Industry
ExxonMobil	Industry
Raytheon	Industry
Texas A&M University	Academia
PVAMU ROTC	Academia/Government
US Navy	Government/Military

6. IMPACT OF PROFESSIONAL DEVELOPMENT ACTIVITES

The authors have witnessed a tremendously positive impact on the female students' leadership skills, engagement in college and national activities, and professional growth. The increased organizational focus on issues most pertinent to the professional and personal growth of females of color has resulted in an increase in chapter membership and participation in organization sponsored events. Additionally, the organization has been able to increase its visibility within the College of Engineering and within SWE at the regional and national level. Preliminary analysis of student feedback indicates that the workshops have provided invaluable information not previously presented to them. Notably, the PVAMU SWE chapter has witnessed a 76% increase in participant attendance from Workshop I to Workshop III. Based on initial student feedback, this increase was due in part to increased advertisement (e.g., using such avenues as FaceBook), workshop topic selection, and increased visibility of the organization in the COE.

7. FUTURE WORK

The authors through the SWE student chapter will continue to host Professional Development workshops that focus on topics most pertinent to women of color entering the engineering and technology workforce. Pre and post surveys were completed by the workshop participants for each workshop. Analysis of the survey data and dissemination of the results are in progress.

8. REFERENCES

[1] Chubin, D., May,G., and Babco, E. (2005). Diversifying the Engineering Workforce. *Journal of Engineering Education*, 94 (1).

[2] Engineering Task Force. (2005). *The Engineering Workforce: Current State, Issues, and Recommendations.* NSF Report, May 2005.

[3] Huang, G., Taddese, N., and Walter, E. (2000). *Entry and Persistence of Women and Minorities in College Science and Engineering Education.* U.S. Department of Education, Report Number NCES 2000-601.

[4] National Science Board. (2006). *Science and Engineering Indicators 2006*. Two volumes. Arlington, VA: National Science Foundation (volume 1, NSB 06-01; volume 2, NSB 06-01A).

[5] Hewlett, S., Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., and Sumberg, K. (2008). *The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology.* Center for Work Life Policy. Harvard Business Review, Research Report Number 10094.

[6] Mcilwee, J. and Robinson, J. (1992). *Women in Engineering: Gender, Power, and Workplace Culture.* State University of New York Press, Albany, NY.

[7] Trenor, J., Yu, S., Waight, C., Zerda, K., and Ting-Ling, S. (2008). The Relations of Ethnicity to Female Engineering Students' Educational Experiences and Career Plans in an Ethnically Diverse Learning Environment. *Journal of Engineering Education*, 97 (4).

[8] Baldwin, A. (1991). *Ethnic and cultural issues*. In N. Colangelo and G. Davis (Eds.), Handbook of Gifted Education. Boston: Allyn & Bacon.

[9] Frizell, S., and Nave, F. (2008). Work in Progress – Reexamining the Problem of Engineering Persistence of African-American Students. In *Proceedings of 38th ASEE/IEEE Frontiers in Education Conference.* Saratoga Springs, NY.

[10] Frizell, S. and Nave, F. (2008). A Preliminary Analysis of Factors Affecting the Persistence of African American Females in Engineering Degree Programs. In *Proceedings of 2008 ASEE Annual Conference & Exposition*. Pittsburgh, PA. American Society for Engineering Education.

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