

AC 2008-2671: A PRELIMINARY ANALYSIS OF FACTORS AFFECTING THE PERSISTENCE OF AFRICAN-AMERICAN FEMALES IN ENGINEERING DEGREE PROGRAMS

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A Preliminary Analysis of Factors Affecting the Persistence of African-American Females in Engineering Degree Programs

Abstract

This paper describes a mixed-method study designed to identify and characterize factors that contribute to the persistence and attrition of African-American females in undergraduate engineering and technology degree programs. A preliminary analysis of survey data from the first phase of the study is provided examining engineering persistence. Using the Student Persistence Instrument, data was collected from 130 African-American students (49% females) currently in their third year or beyond in an undergraduate engineering degree program. The factors examined include initial commitment and high school preparation for studying engineering, confidence in completing current degree program, impact of course workload and institutional climate, and academic and financial variables.

Introduction

There is continued concern for the recruitment and retention of females and minorities in the fields of science, technology, engineering, and mathematics (STEM). This issue is particularly acute for engineering and technology disciplines and may have more intense consequences for females of color. Institutions ranging from community colleges to research intensive universities have undertaken activities to enhance the recruitment and retention of females and students of color in engineering and technical degree programs. Despite increases in baccalaureate degree production in engineering and computer science for women and students of color, their overall representation is still quite low¹. A recent National Science Foundation (NSF) report indicated the percentage of women receiving baccalaureate degrees in engineering and computer science in 2002 was 21% and 27% respectively². That same year, Blacks earned less than 5% of the baccalaureate degrees awarded in engineering and roughly 10% in Computer Science². Consequentially, the number of women and minorities entering the engineering and technology workforce is limited. As the US workforce becomes more diverse, increasing the participation of US citizens that are typically underrepresented in STEM disciplines is essential to the vitality of the country's future workforce. The National Science Foundation and the National Science Board have issued strong warnings regarding the loss of U.S. dominance in critical areas of science and innovation³. Additionally, the Department of Labor projects Information Technology (IT) job growth will exceed IT degree production for the current decade³.

Current recruitment and retention efforts in STEM fields, particularly engineering and technology, must be examined with regard to their effectiveness on specific student populations so that successful strategies can be expanded and replicated. A number of strategies have been employed to recruit and retain females and minorities in engineering and technology degree programs including innovative classroom pedagogies aimed at making course content and curricula more attractive to students, summer bridge programs, mentoring programs, tutoring programs, and scholarships. An examination of the current body of engineering education literature reveals limited data on the experiences of African-American females in engineering and technology degree programs and the effect of retention activities designed to increase their

persistence and promote their career success. Issues pertaining to the educational experience of African-American females may be overlooked because they are typically placed into research categories based solely on race or gender⁴⁻¹⁰. While they share many of the same experiences and challenges identified for each group, they may have unique experiences and challenges.

This study aims to identify specific factors that affect the persistence of African-American females in engineering and technology degree programs, to describe their experiences in these programs in an effort to understand any unique obstacles they may face, and to examine factors that influence many to leave these programs for other academic majors. This research is being conducted in two phases. In the first phase which focuses on engineering persistence, African-American students in their third year or beyond in an engineering or technology degree program were solicited to complete a survey designed to measure a number of factors regarding their persistence in their degree program. African-American students will also be solicited to participate in focus groups and one-on-one interviews to further identify factors that impact persistence. In the second phase, institutional databases at Prairie View A&M University (PVAMU) were mined to gather statistical data and identify African-American students who entered as freshman during the 2003, 2004, or 2005 academic year majoring in technology, computer science, or engineering, but subsequently switched to other degree programs at PVAMU. These students were recruited to complete a survey designed to measure their reasons for leaving. In this paper, a preliminary analysis of the survey data from phase one of the study, which focuses on engineering persistence, is provided. In examining the following questions, we provide descriptive and frequency results.

Research Questions

1. What factors influence African-American students to major in an engineering or technology degree program? Are the reasons different for males and females?
2. Do students feel their high school education adequately prepared them to be successful in their degree program? Are there differences by gender?
3. How confident were students when they begin their program? How confident are they now in their ability to complete the program?
4. What are the predominant factors that influence African-American students' decisions to persist in their engineering or technology degree program? Are there differences by gender?

Methodology

Participants and Procedure

During the 2007 spring and fall semesters, data was collected from 130 African-American students enrolled in their third year or beyond in an engineering or technology degree program. Participants were solicited from PVAMU, a Historically Black University with seven ABET accredited programs in the College of Engineering, which include computer science, computer engineering technology, chemical engineering, civil & environmental engineering, electrical engineering, electrical engineering technology, mechanical engineering, and computer engineering which goes through accreditation this year. Participants were also recruited from the pool of African-American undergraduate students attending the National Society of Black Engineers (NSBE) Conference in March 2007. Sixty percent (n=78) of the survey participants are undergraduate students enrolled at PVAMU and 40% (n=52) are pursuing engineering or

technology degrees at other U.S. institutions. Fifty-one percent of the participants were males (n=66) and 49% (n=64) were females. Table 1 shows the gender distribution and enrollment among participants. Survey participants were from all the core engineering and technology disciplines with the largest percentages from Chemical Engineering (16.9%) and Electrical Engineering (16.2%). The average self reported grade point average was 3.1/4.0 (SD= 0.41) and 2.9/4.0 (SD=0.39) for females and males respectively.

Table 1: Survey Participants

	Gender		Totals
	<i>Males</i>	<i>Females</i>	
PVAMU	48	30	78
Other	18	34	52
Totals	66	64	130

Survey Instrument

Data was collected using the Student Persisting in Engineering (SPE) instrument developed by the Assessing Women (AWE) in Engineering Project¹¹. This instrument was chosen because it measured the variables we had hypothesized that may be critical in engineering persistence for African-American females. These factors include confidence, high-school preparation, academic advising and mentoring, university and departmental environment, participation in extracurricular activities and student organizations, household demographics, family support, financial assistance (e.g., grants, scholarships) and financial motivation. These factors are not unique in that they have been the focus of prior studies on engineering persistence^{4-6,12-14}. However, the findings of this study will contribute to our understanding of these issues for African-American females. The SPE instrument was designed to measure a number of the aforementioned variables including participant demographics (e.g., ethnicity, gender, classification, etc.), initial commitment and preparation for studying engineering, the impact of several factors on student persistence (e.g., course workload, institutional climate, academic advising, finances, peer relationships, etc.), participation in academic and extra-curricular activities, confidence in complete engineering degree program, and post graduation plans of subjects¹¹.

Results

Factors influencing majoring in Engineering or Technology

Participants were asked to indicate why they initially chose to major in an engineering or technology discipline. As shown in Table 2, both males and females reported they initially chose to major in their degree program because they felt they were good at math and science (72% of females versus 65% of males) and wanted a good paying job after graduation (47% of females versus 55% of males). Other reasons provided by participants included they loved working with others and they wanted careers and not just jobs. In a subsequent question, most participants reported their parents were very supportive of their decision to study engineering (78% of males versus 92% of females).

Table 2: Surveys Results – Reasons for majoring in Degree Program

Question: Why did you initially decide to major in engineering? (Check all that apply)	Females (n = 64)	Males (n = 66)
	Percentages %	
Attracted by the challenge of a difficult curriculum	28	29
Good at math or science	72	65
High school adviser or teacher recommended it	13	19
Like the design work that engineers do	39	37
Like to solve problems	36	37
Parents, other relatives or friend is an engineer	14	28
Parents, siblings or other relatives recommended it	14	23
Participated in engineering camp or workshop that influenced me	20	15
Received or anticipated possibility of good college scholarship	17	12
Wanted to be able to get a well-paying job after I graduate	47	55
Wanted to use engineering solutions to address social problems	12.5	7.7
Not Sure	3.1	4.6
Other	7.8	3.1

High School Preparation for studying Engineering or Technology

Participants were asked if they felt their high school coursework adequately prepared them to be successful in an engineering curriculum. Of the 127 participants that answered this question, 66% (n= 42) of the females answered “yes” and 51% (n=32) of males answered “yes”. We asked participants in an open-ended question to explain their response. Example responses for the participants who answered “no” included:

- *“High school only prepared me for state aptitude tests”*
- *“My state has one of the nations worst public school systems”*
- *“I still had to take remedial course and my SAT scores weren’t high”*

Confidence in completing degree program

Despite about half of the male participants and a third of the female participants indicating they felt high school left them unprepared, a large percentage of both males and females reported that when they began their programs they felt confident they would complete them (see table 3). Additionally, most participants reported they were presently confident they would complete their degree program at their current institution (85% males versus 78% females).

Predominant factors affecting persistence

Participants responded to a 26 item question regarding factors affecting their persistence. The items addressed a variety of factors related to confidence, academic advising and mentoring, academic performance, university and departmental environment, family support, financial assistance, and financial motivation. Participants rated the items on a scale from 0 to 4 where 0 corresponds to “Not a Factor” and 4 equates to a “Significant Factor”. We report here only the

top factors rated by males and females. As shown in Table 4, both males and females reported “having a fulfilling career” and “high earning potential in an engineering career” as the factors most significant to their persistence.

Table 3: Surveys Results – Confidence in completing degree

Question: When you began your engineering degree, how confident were you that you would complete it? (Check one)	Males (n = 66)	Females (n = 63)
	Percentages %	
Not at all confident; I was already unsure of my plan to study engineering	6	5
I felt there was about a 50% chance that I would complete a degree in engineering	8	11
I was fairly confident that I would complete a degree in engineering	24	19
I was very confident that I would complete a degree in engineering	62	60
Other	0	5

Table 4: Survey Results – Predominant Reported Persistence Factors

Question: The following are factors that may be associated with you persisting in your engineering education. For each factor choose a column ranging from Not a Factor (left most) to a Significant Factor (right most) to indicate the degree to which that factor influences your persistence in engineering.						
	Not a factor	Somewhat a Factor	A Factor But Not Significant	A Somewhat Significant Factor	A Significant Factor	Mean
Having a fulfilling career						
Females	1.6%	3.3%	6.6%	11.5%	77%	3.59
Males	1.6%	0.0%	1.6%	18.8%	78.1	3.72
High earning potential in an engineering career						
Females	1.6%	0.0%	9.8%	23.0%	65.6%	3.51
Males	1.5%	4.6%	10.8%	23.1%	60%	3.35

Summary and Future Work

The results presented here are a preliminary analysis of data from phase 1 of the study and provide only descriptive and frequency results of survey data. A comprehensive data analysis is

in process which will provide detailed results on any statistically significant differences regarding persistence for African-American females versus males as well as how these results compare to prior research on engineering persistence for women in general. In future work, this data will be analyzed with study results on students who switched from engineering or technology to other degree programs, which is phase 2 of the study. These results will help to provide a complete picture regarding engineering persistence and attrition for African-American female students.

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