

In Her Words: Factors Influencing African American Women to Pursue and Complete Doctoral Degrees in Engineering

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Abstract

The purpose of this paper was to examine and document the factors that influenced five African American women to pursue and complete doctoral degrees in engineering disciplines. Critical race theory (CRT) and literature on graduate student persistence influenced the conceptual framework for this paper. CRT is imperative to this research endeavor, as this theory advocates for the voices of marginalized populations to be included in mainstream discourse and places underrepresented groups as experts. Through in-depth interviews, study participants identified involvement in summer research or internship programs and encouragement from others as factors influencing the decision to pursue advanced degrees in engineering. Support from peers, faculty, administrators, and family were instrumental to doctoral degree completion. The documented experiences of this group of African American women doctoral recipients can be used to influence the development and implementation of programs and policies designed to recruit, retain, and graduate a cadre of women engineers with doctoral degrees.

Introduction

African American women continue to be severely underrepresented in doctoral engineering programs. Despite the alarmingly low enrollment and doctoral degree completion rates of African American women in engineering fields of study, little attention has been focused on what inspires African American women to pursue and complete doctoral degrees. Much of the existing literature on the underrepresentation of African Americans in graduate engineering degree programs relies heavily on quantitative research methods with aggregate samples of men and women. As a consequence, the experiences of African American women are overshadowed. This research methodology also inadvertently results in African American women being silenced and reduced to percentages, making it difficult to learn about the experiences of African American women doctoral degree recipients. Therefore, the use of qualitative research methodology in this paper allowed the experiences of five African American doctoral recipients in engineering to be documented and presented in their own voices.

Literature Review

Although the literature presented is not based exclusively on the experiences of African American women doctoral recipients in engineering, the findings provide insight into the factors that influence African Americans to persist in graduate education. The review of literature suggests that significant factors impacting the persistence of African American graduate students include: adviser-student relationships, mentoring, family support, and peer support. Despite the identification of these factors, there still is a need to examine the graduate school experiences of African American women in engineering to gain insight about the factors specifically influencing their enrollment and doctoral degree completion.

Researchers have documented the positive impact faculty advisers can have on the persistence of African American graduate students. Specifically, Hamilton (1998) explored the impact of persistence factors on African American and Latino doctoral students and found academic advisement one of several “dominant success factors.” In her study of the retention of Black and Hispanic doctoral students, Clewell (1987) identified having a supportive adviser as a

characteristic of minority graduate students that attain the doctoral degree. According to Harrison (1996) positive interactions with faculty can reinforce the graduate student's "sense of belonging, academic achievement and in some cases, professional development" (p 231).

Hamilton (1998) and Willie, Grady, and Hope (1991) consider mentoring a significant factor that contributes to the persistence of African American doctoral students. According to Patterson-Stewart (1997) and her colleagues, some African American doctoral students believe it necessary to have an African American mentor and often seek such mentoring relationships outside of their academic department. King and Chepyator-Thomson (1996) also reported that mentors are critical to the persistence of African American doctoral students enrolled at predominantly white institutions. Similarly, Oden (2003) concluded that positive mentoring and advising relationships were critical to the persistence of four African American students enrolled in a doctoral engineering program at a predominantly white institution.

Family support is another important persistence factor identified in the literature. Miller (1993) investigated the experiences of twelve black graduate students enrolled in a southern university and found family to be a critical source of support. In fact, Miller asserted, "family support, in some cases, filled voids which existed in other deficient relationships between students and faculty" (p 111). Bickhman-Chavers (2003) also identified family support as the "primary source of support" outside of the academic environment (p 159). Bingman (2003) and Harrison (1996) also found that family members motivate African American graduate students to complete the doctoral degree by instilling within these students the importance of education. Similarly, Clewell (1987) observed that a characteristic of Black and Latino graduate student persisters was that their parents encouraged them to pursue advanced study in higher education. Phillips-Evans (1999) observed that family members might serve as "relief from the everyday pressures wrought by the demands of school" (p 178).

In addition to receiving support from family members, African American doctoral students seek support from peers within and outside of their academic departments. However, Ellis (1997), Miller (1993), and Oden (2003) observed a tendency for African American doctoral students enrolled at predominantly white institutions to seek support outside of their academic department or institution. Ellis (1997) considers these outside support systems critical in assisting African American graduate students with succeeding academically, but these same relationships prevent them from becoming more socially integrated into their academic departments. According to Harrison (1994) peer relationships provide "informal opportunities for learning in a safe place" in which students can share ideas and experiences as well as develop strategies for navigating the academic terrain and departmental politics (p 231). Similarly, Bingman (2003) reported that interacting with other black graduate students allowed the opportunity to discuss various issues and concerns regarding successful matriculation and to fulfill social needs. Overall, African American peer relationships are critical to the psychological well being of African American graduate students enrolled at predominantly white institutions (Patterson-Stewart, Ritchie, and Sanders 1997).

In summary, previous research on African American graduate students identified the following factors as having a positive impact on the persistence of this student population: adviser-student relationships, mentoring, family support, and peer support. Although this information is helpful in understanding the experiences of African Americans in graduate degree programs, the experiences of African American women doctoral recipients in engineering are not well documented. Therefore, this paper will focus on the factors that influenced five African

American women to pursue and complete doctoral degrees in engineering from their lived experience.

Conceptual Framework

Components of Girves and Wemmerus' (1988) model of doctoral degree progress and Tinto's (1993) longitudinal model of graduate student persistence were combined with critical race theory to form the conceptual framework for this study. Girves and Wemmerus found that involvement in the academic department, student-faculty relationships, and department characteristics directly contributed to doctoral student progress. Therefore, it is expected that such factors as student-faculty relationships, involvement in the academic department, department characteristics, and funding will influence the persistence of African American women doctoral recipients.

Such factors are also included in Tinto's (1993) longitudinal model of doctoral persistence, which illustrates the interaction of various variables that impact the persistence of doctoral students from entry into and completion of the doctoral degree program. Based on this persistence model, the graduate student will encounter institutional experiences that will influence persistence. For example, the graduate student will be exposed to academic systems (i.e., classroom relations, faculty relations, and graduate positions) and social systems (i.e., peer relations and faculty relations) within the larger university environment and within the academic department/program. The student's membership in or integration into the academic and social communities will impact the student's transition and persistence into candidacy. Once the graduate student reaches the candidacy stage, relationships with faculty are critical.

These graduate student persistence models illustrate the importance of academic and social integration. Students who are integrated into the academic and social communities of the graduate school program are more likely to persist. These models serve as a framework for understanding the academic and social experiences of doctoral students. However, graduate student persistence models fail to look at the issue of persistence from the lens of graduate students of color, as the racialized, gendered, and class-based experiences of underrepresented minority groups tend to be excluded. Focusing on a marginalized population permits others to learn about persistence from their perspective. Therefore, critical race theory was included in the conceptual framework.

Critical race theory (CRT) acknowledges the wealth of cultural knowledge that marginalized populations possess, which is often overlooked within the scholarly literature (Yosso 2005). Through the voice and storytelling components of CRT, the experiences of marginalized populations are not only documented, but are given legitimacy and alternative perspectives are provided. According to Ladson-Billings (1999),

[t]he 'voice' component of CRT provides a way to communicate the experience and realities of the oppressed, a first step in understanding the complexities of racism and beginning a process of judicial redress. The voice of people of color is required for a deep understanding of the educational system (p 16).

From a CRT perspective, African American women will not be treated as silenced bystanders, but are instead themselves placed at the center of the topic being examined (Yosso 2005). Therefore, the five African American women respondents are experts who possess knowledge about what it takes to navigate and complete the engineering education pipeline.

Sample Selection and Characteristics

This paper focuses on the experiences of five African American women that participated in a larger study that I conducted on the persistence of African American doctoral degree recipients in engineering and applied science disciplines. Study participants were recruited from the National Society of Black Engineers (NSBE) in summer 2007. A total of 53 women expressed interest in participating in the study. However, many participants were enrolled in doctoral programs and did not qualify to participate. Availability to participate in face-to-face in-depth interviews and the inability of the researcher to travel to various geographic regions of the United States significantly decreased the pool of potential respondents. Ultimately, five African American women that completed doctoral degrees at predominantly white institutions were selected to participate in the study.

Informants were awarded doctoral degrees between 1995 and 2005 from predominantly white institutions (PWIs). The average self-reported doctoral grade point average was 3.46. The average self-reported time to doctoral degree completion was 3.2 years. Doctoral degree recipients represented the following engineering disciplines: chemical engineering (2), electrical engineering (1), industrial engineering (1), materials science and engineering (1). Two participants reported receiving funding through a graduate research assistantship, while the other three participants reported receiving a combination of funding in the form of a teaching assistantship, portable fellowship, school scholarship, and/or part-time employment. Three women completed master's degrees, two in engineering fields and one in education. The self-reported master's degree grade point average was 3.53. Four participants completed undergraduate degrees in engineering disciplines from PWIs. The average self-reported undergraduate grade point average was 3.12.

Research Design and Methods

Qualitative research methodology, more specifically face-to-face in-depth interviews, was used to examine the graduate school experiences of female African American doctoral recipients in engineering. Since very little is known about the experiences of African American women in doctoral engineering programs, the use of in-depth interviews allowed the experiences of five African American doctoral recipients in engineering to be captured in their own words. "Self-correcting interviews" were incorporated in the early stages of data collection to determine what was going well or wrong during the interview sessions (Rubin & Rubin 1995, 164-165). As a result, additional questions were added to structured interview protocol to allow study participants to discuss their initial interests in engineering.

Traditional data analysis steps were used for this exploratory investigation (Miles & Huberman 1994, 9). Cross-case analysis was also conducted to compare and contrast themes across the informants' individual experiences. A matrix was used to organize the data and facilitate the process of identifying similar or diverging patterns. Themes that appeared in common multiple times across cases were labeled as influential factors contributing to the pursuit and completion of the doctoral degree. A limitation of this paper is that the experiences of five African American women with doctoral degrees in engineering are only included. Therefore, the results are suggestive and may not capture the experiences of all African American women doctoral degree completers in engineering disciplines from PWIs.

Findings and Discussion

Influences on Initial Interests and the Decision to Pursue Engineering

African American women doctoral degree recipients recalled how they initially became interested in engineering. One participant attributed her initial interest in engineering to “great science and math teachers” who “were just very supportive of me as a minority woman” and “they really supported my development and said you can do whatever you want.” Another participant identified a chemistry teacher and a guidance counselor who recognized her talent in math and science. However, it was the chemistry teacher who influenced her decision to pursue an undergraduate degree in chemical engineering. She admits, “I didn’t really know what an engineer did, I did enjoy math and science.” According to another participant, her involvement in a summer pre-college program “opened up my world a lot in terms of what I can achieve and expanded my vocabulary in terms of experience.” Overall, participants acknowledged their natural talents in math and science related subjects, but high school teachers and participation in pre-college programs ultimately sparked their initial interest in engineering.

The decision to pursue the doctorate in engineering was primarily made while informants were enrolled in college, with the exception of one participant who decided to pursue the doctorate after completing the master’s degree. Parents were considered a major influence in their decision to pursue the doctoral degree, as they inspired their children to achieve more than they had accomplished educationally. A participant described her parents as “the biggest influence.” Another participant’s parents constantly inspired her to “go farther than us.” Clewell (1987) found that parents were extremely instrumental in encouraging black graduate students to pursue post-secondary education.

Involvement and exposure to research, as an undergraduate student, also contributed to the decision to pursue the doctorate in engineering. Previous research documents the importance of participation in research in encouraging undergraduate students to pursue graduate degrees in engineering and science (May and Chubin 2003). While working at a summer internship, a study participant was inspired by a research team member. She recalled, “[he] pulled me aside at the end of the summer and said I hope that you’re going to graduate school and I did.” Another study participant discussed the option of graduate school with other summer research program participants. She explained:

...the summer of my junior year I did an internship at [private university] in the research experience for undergraduate program...And I spent a lot of time with probably five other minority students...we really had a good time talking about the pros and cons of going to work versus going to graduate school...that was the summer when I came back and said to my adviser starting my senior year I’m going to graduate school. I’m not going to get a job.

Participation in research opportunities not only help African American women and other students to develop research skills, but involvement in such programs serve as potential recruitment opportunities for doctoral programs. Participants can also be inspired by professionals affiliated with the research program or other student participants to pursue graduate education. Therefore, faculty and graduate admissions professionals must continue to make efforts to recruit African American women and other students from underrepresented groups from summer research and internship programs.

Factors Influencing Doctoral Degree Completion

Although the factors influencing doctoral degree completion are presented separately, it is important to acknowledge that in most experiences, a combination of factors contributed to the successful completion of the doctorate. In addition to the required academic proficiencies required to complete the doctoral degree in engineering, combined factors of peer support, faculty adviser support, administrative support, and/or family support influenced the persistence of five African American women doctoral recipients in engineering. These sources of support also formed the study participant's support network, which was unique for each informant. The various combinations of key persistence factors contributing to degree completion ranged from study participants' having support from all four sources to having support from only peers or a faculty adviser.

Being enrolled in doctoral programs at predominantly white institutions, informants were the only African American female or one of a few African Americans in their academic department. As a result, they sought solace and support from black graduate students enrolled in other academic disciplines at their university. Similarly, Oden (2003) observed that African American doctoral students enrolled in electrical engineering at a PWI established peer relationships with other black students outside of the academic department. Bingman (2003) also reported African Americans who completed doctoral degrees in math, science, and engineering at a PWI received support primarily from other black students on campus.

In seeking support from other black graduate students, study participants became active in black graduate student associations and/or the National Society of Black Engineers (NSBE) campus chapter. According to Feagin and Sikes (1995) and Taylor and Olswang (1997), involvement in African American student organizations can ease the negative impact of racially hostile campus environments. After experiencing what a study participant described as a "discriminatory event," she connected with black non-engineering graduate students. She explained:

...I am very thankful for all of these experiences because that opened me up to look outside of the laboratory and outside of the engineering department because there [were] no blacks in the engineering departments besides me at that time. And so I went to other departments in pre-med and so forth and [graduate school] has a really great program for black grad students, a union where they meet once a month over dinner. So, I really got involved in that and that really was motivation. So, you got the chance to speak and support each other....It really made the world of difference and just to see them and to share our time together helped me a lot in refocusing my energy and completing things.

Informants were looking for individuals who understood the experience of being a black graduate student at a predominantly white institution. However, forming such relationships contrasts with prevailing graduate student persistence models, which advocate the importance of forming relationships within the academic department, as integral to the social integration necessary for doctoral degree completion. Even though informants received peer support from other black graduate students outside of the academic department, they were still successful in completing the doctoral degree without being socially integrated into the academic department.

Study participants also discussed the important role of support from research laboratory members. Although study participants indicated that they were the only black female doctoral student working in their faculty adviser's research laboratory, some of them received support from their laboratory colleagues. One informant relied on the research laboratory group to read

drafts of her dissertation chapters before she submitted them to her adviser. She commented, “It improved my dissertation quite a bit. I just went out and got students in my lab and I said you have to read a chapter and I need you to be hard on me before I hand this to my adviser.” The role of the research laboratory group as a source of peer support may only be unique to doctoral students in engineering and science disciplines, as it was not a key finding in other studies conducted on the persistence of African American doctoral students or recipients in non-quantitative fields of study (Harrison 1996; King and Chepyator-Thomson 1996; Oden 2003). Involvement in or socialization into the research laboratory should not be considered the same as socialization into the academic department in which the doctoral student establishes significant relationships with other doctoral students and faculty in the academic program.

Faculty advisers were also identified as a factor influencing doctoral degree completion. In describing her relationship with her male faculty adviser, one participant stated, “You know he really believed in me because he had seen me perform throughout...he knew what I was capable of and so he wanted me to finish.” Another study participant simply stated, “my adviser was a very significant factor.” This finding is consistent with other research in which positive faculty advisor-student relationships significantly impacted the persistence of African American doctoral students (Clewell 1987; Harrison 1996). Indeed, the positive relationships that existed between the informants and their faculty advisers proved to be critical to their overall persistence and ultimate degree completion. Faculty advisers provided the necessary encouragement and guidance that many of the study participants needed to get through their doctoral program.

Study participants also sought support primarily from black female administrators who served in such roles as deans or directors of minority or multicultural affairs on campus. Some participants also relied on support from black administrators from their undergraduate institutions in which they had developed and maintained relationships. Support from university administrators proved especially important when study participants experienced difficulty with faculty or when they faced challenges in the academic and social environments at predominantly white institutions. A study participant commented on support she received from a university administrator:

I think that if Dean [Smith] had not been the type of person she was making herself readily available day and night, always having that open door, I would not have finished...So without Dean [Smith] without a doubt there was no way.

Bingman (2003) asserts that African American college administrators enhance the support that faculty provides to students. However, based on the experiences of some participants, support from African American college administrators actually filled a void for informants who did not have supportive and nurturing relationships with faculty. Informants turned to black administrators for encouragement and support. They could share the harsh realities that many of them faced as being the only black female student or one of a few black students in the graduate engineering program. They were able to express their frustrations and concerns with someone who looked like them and understood the experience of racism and discrimination.

Such relationships demonstrate the need for the development and recruitment of African American faculty in engineering disciplines, especially at PWIs. Due to the absence of black faculty on predominantly white campuses, black doctoral students seek support from black administrators on campus. Although black administrators are able to provide solace, they are not in the position to provide the necessary socialization into the academic discipline that a faculty member can provide. Therefore, if African American female doctoral students are unable to

cultivate positive relationships with faculty, they may miss out on critical opportunities to develop as research scholars by engaging in such activities as publishing papers and presenting at conferences. More importantly, increasing the number of black faculty in engineering disciplines will provide more opportunities for black doctoral students to develop mentoring relationships with faculty who look like them and can identify with their experience.

Support from family members was also identified as an important factor contributing to completing the doctoral degree in engineering. A study participant recalled how she could “call my mother to get advice and hear I love you and I know you can do this. That kind of motivational stuff.” Another participant concluded “definitely support of family” and shared, “My sister, she and her family, came and lived with me for a short while when I was finishing up. And she was helping me type in references, you know all that other good stuff.” According to another informant growing up in a competitive family fueled her desire to complete the doctorate. She explained, “I was raised in a very competitive environment growing up...somehow not completing something was not even an option for me. I never thought of not completing the Ph.D. program.” Other researchers have found the importance of family support to the degree completion of African American graduate students. Bickman-Chavers (2003) suggests family support is the “primary source of support” for African American doctoral recipients. Bingman (2003) also found family support and encouragement contributed to the success of African American doctoral students.

In summary, four factors were identified as having a major influence on the doctoral degree completion of study participants. These factors included peer support, faculty adviser support, support from university administrators, and family support. Previous research establishes the importance of these persistence factors on African American doctoral students. Therefore, it appears regardless of academic disciplines, similar factors influenced the persistence of these five African American women doctoral recipients in engineering.

Recommendations for Future Research

From the experiences of five African American women doctoral recipients in engineering, it was revealed that peers, faculty advisers, university administrators, and/or family members are influential to the decisions to pursue and complete doctoral degrees in engineering. Such experiences are useful in guiding future research on African American women and other underrepresented groups in engineering disciplines. Rather than looking to prevailing models of doctoral student persistence, which are not reflective of the experiences of African American women in doctoral engineering education, more research relying on the experiential knowledge and expertise of this group is critical to understanding the factors necessary to succeed in engineering doctoral programs.

Based on the findings presented in this paper, it is unknown if the experiences of African American women doctoral degree recipients from historically black colleges and universities (HBCUs) are similar or different. Therefore, a comparative study examining the graduate school experiences of African American women doctoral recipients in engineering from HBCUs and from PWIs should be conducted to determine the impact of these institutional environments on doctoral student persistence in engineering. A study of this nature might provide evidence of best practices that can be used to recruit, retain, and graduate African American female doctoral recipients.

Given the small sample of African American doctoral degree recipients in this study, additional studies with larger samples must be conducted on the graduate school experiences of

African American women and other women from underrepresented ethnic groups in engineering. Documenting more voices and experiences of African American women in engineering will increase the body of literature on this underrepresented student population. Results from additional research will possibly yield similar findings or reveal additional factors that influence the decision of this underrepresented student population to pursue and complete doctoral degrees in engineering.

Conclusion

Encouragement from others and participation in research or internship programs were determined to influence five African American women to pursue doctoral degrees in engineering. Having support from peers, faculty advisers, university administrators, and family members proved to be essential to the persistence and ultimate doctoral degree completion of this group of African American women. This group of women primarily sought support from people who could relate to the experience of being black at a predominantly white institution. This finding demonstrates the importance and the necessity of a critical mass of black doctoral students in engineering programs.

The findings presented in this paper are important, as they provide insight into the factors that contributed to the doctoral degree completion of a small group of African American women in engineering disciplines. Graduate school faculty and administrators can use the findings to inform recruitment and retention strategies. For example, given the importance of peer support to the success of African American female doctoral recipients in engineering, efforts must be made to recruit, admit, enroll, retain, and graduate a cohort of black doctoral students in engineering disciplines.

Since faculty members play a critical role in admitting and graduating doctoral students, then they must be educated about the importance of diversifying engineering programs, especially at the doctoral level. It is also evident that faculty played a significant role in encouraging study participants to pursue the doctoral degree. Therefore, all faculty members should be aware of potential graduate students drawn from the pool of undergraduate students that they teach. The faculty described in this study identified the potential that the informants had and encouraged them and shared critical information surrounding the possibility of pursuing the doctoral degree. Faculty must be supported by their institutions to identify promising African American women and other underrepresented minorities and encourage these students to consider pursuing the doctorate in engineering disciplines.

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