Re-framing and Reimagining the Doctoral Student Narrative: Black Women's Experiences in Engineering and Computer Science

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Reframing & Reimagining the Doctoral Student Narrative: Black Women's Experiences in Engineering and Computer Science

Abstract

Recent data reveal that a higher percentage of Black women (9.7%) are enrolled in college than any other group, topping Asian women (8.7%), White women (7.1%) and White men (6.1%). Despite these gains in college attendance, Black women are often underrepresented in the fields of engineering and computer science. This paper presents the findings from a qualitative study that investigated the identity and experiences of Black women who are pursuing doctoral degrees in engineering and computer science. This research is grounded on the tenet that one cannot effectively serve or impact a community until he/she genuinely understands the issues and challenges facing the people who are its members. This work explores how Black female doctoral students persist in environments where they are grossly underrepresented. Content analysis is used to examine interview data obtained from 13 Black women who are pursing doctoral degrees in engineering and computer science. This paper concludes with some of the key challenges these women face in their programs on a daily basis. The goal of this research is to bring awareness to not only the challenges, but also potential strategies to increase the retention and persistence of Black women in engineering and computer science across all academic levels.

Introduction

In 1840, Catherine Brewer became the first woman in the United States to earn a bachelor's degree. One hundred and seventy-six years later, women made significant gains in degree attainment and are now outpacing men. Females matriculate in greater numbers than males in both undergraduate and graduate institutions [1]. They also have higher graduation rates at all academic levels [1]. According to a report published by the National Center for Education Statistics, the difference in degree attainment between women and men is most pronounced within the Black community [2]. Between 2009 and 2010, Black women earned 68% of all associate degrees, 66% of bachelor's degrees, 71% of master's degrees, and 65% of all doctorates awarded to Black people. The report also revealed that a higher percentage of Black women (9.7%) are enrolled in college than any other group, topping Asian women (8.7%), White women (7.1%) and White men (6.1%) [2].

Although the above-mentioned statistics are encouraging, Black women on college campus are often the most socially isolated group, regardless of their academic achievement [3]. This isolation fosters feelings of incompetence and cultivates fear of failure [4-5]. Black women in academia face a variety of challenges, including co-occurring discrimination related to race and gender [6], lack of support systems and networks [7], and unwelcoming, insensitive, and isolative environments [8]. These feelings can be even more conspicuous in academic fields where women are grossly underrepresented. According to the U.S. Census Bureau Survey in 2012, women were 50.79% of the population, and the population of Black women was 6.85% [9]. In that same year, women earned only 22.2% of the PhD degrees in engineering. The representation of Black women was a mere 0.74%. According to the latest reported numbers, there is a decline in the number of Black women earning doctoral degrees in these disciplines. In

2015, 0.5% of the PhD degrees in engineering and computer science were awarded to Black women [11].

Since Black women are not represented in engineering or computer science degree programs at the PhD levels, it is unrealistic to expect to find them as faculty members in these colleges. In an effort to create a pool of Black women who qualified to pursue academic careers in engineering or computer science, there must be intentional initiatives focused on understanding the authentic experiences of these women. Strategies, grounded in research, must be developed to enhance the recruitment and retention of Black women across all academic levels. The academic community must also gain a better understanding of how to increase the awareness and interests of Black women to pursue careers in the professoriate. Once these most promising practices are unveiled, meaningful avenues must be created to share how they can be effectively implemented.

Project Overview

The Niela Project is a 4-year study to explore how Black female doctoral students and postdoctoral scholars succeed in their engineering and computer science programs. Niela (also spelled Nyela) is an African name that means "one who succeeds or perseveres." The Niela Project is an appropriate and meaningful name because the overarching goal of this research is to increase understanding of how the experiences of Black female doctoral students impact their academic persistence and overall well-being. This understanding is crucial for both higher education personnel (*including faculty, researchers, administrators*) and Black women.

The Niela Project aims to offer a disaggregated view of Black women's experience in engineering and computing. Most studies in the literature group all women and use multiple minority groups when investigating factors influencing students' persistence patterns in in science, technology, engineering, and applied mathematics (STEM) fields [12]. This aggregated approach prompts generic conclusions and implies that all women and/or all minority groups' educational experiences are equivalent in all STEM disciplines. Although there may be similarities as to why some groups are underrepresented in STEM, it is likely that there are unique differences. Also, engineering is distinct from science, technology, and mathematics. On the one hand, engineering involves the practical application of science and mathematics, as in the design of structures and systems [13]. On the other hand, science entails the systematic knowledge of the physical or material world gained through observation and experimentation [13]. The distinctiveness of the disciplines must be examined separately, as each may possess idiosyncrasies, which impact the persistence among various student groups in disparate ways.

While Black women comprise the largest number of students of color in college at both the graduate and undergraduate levels, only four published studies have been identified which included Black female engineering students as respondents [14-17]. Black women are rarely studied. Therefore, this paper aims to focus attention on Black women pursuing doctorates in engineering and computer science. The literature is replete with research that studies women pursuing undergraduate engineering and computer science degrees [18-23]. There are also several studies in which women faculty in engineering are participants [24-33]. However, studies in which the participants are Black women pursuing engineering or computer science doctoral degrees are lacking.

This paper reports preliminary results of a study investigating the experiences of Black female doctoral students in engineering and computer science. Researchers interviewed Black women doctoral students attending universities across the United States. The primary goal of the interviews was to gain an in-depth understanding of the experiences that may be unique to Black women. An additional goal was to learn some of the strategies these women used that improved their experiences and overall well-being. This research adds to the literature meaningful qualitative data that frame meaningful ways to address the lack of Black women represented in academia.

Research Design

Quantitative research methods are not always the most effective measures to understand the root of a problem. Often, qualitative research methodologies, which focus on everyday life experiences and value participants' perspectives [34], are more appropriate because they tackle the "Why?" and the "How?," not just the "How many?" This study adopted a qualitative approach to better understand why there is a shortage of Black women in engineering and computer science and how to increase their presence in the academy. The design and conceptualization theory chosen for this study is Black Feminist Thought; whereas Grounded Theory was selected as the analytical and interpretative theory. Black Feminist Thought integrates, validates, and centers on the unique experiences of Black women [35-36]. Grounded Theory was used in this study due to the vast underrepresentation and unique experiences of Black women in engineering and computer science. Grounded theory a systematic methodology and framework that uses inductive and deductive reasoning to develop theories based on the plausible relationships between themes that emerge from the data [37].

Methodology

Recruitment: For this study, Institutional Review Board approval was obtained prior to recruitment and data collection. Recruitment of the targeted participants was solicited through various email listservs and conferences for underrepresented students in engineering and computer science. The project team recruited through the National GEM Consortium (GEM), National Society of Black Engineering (NSBE), and National Society of Blacks in Computing (NSBC). The following NSF-funded programs were also targeted: Alliances for Graduate Education and the Professoriate (AGEP), Louis Stokes Alliance for Minority Participation's Bridges to the Doctorate (LSAMP-BD), Engineering Research Centers (ERC), and Science and Technology Centers (STC). The team also contacted directors of Ronald McNair Scholars and Research Experiences for Undergraduate programs to recruit alumni from their programs. Recruitment also took place at the annual NSBE National Convention, NSBC Conference, and the Richard Tapia Celebration of Diversity in Computing Conference. All of these organizations, programs, and conferences have access to a large percentage of Black female doctoral students and postdocs in engineering and computer science. All participants received a $25 gift card as compensation for their time.

Participants: This study used the criterion-based purposive sampling method to target 13 female doctoral students that self-identify as Black [38]. Purposive sampling was appropriate because it

allowed for underrepresented women in doctoral programs in Engineering and Computer Science at Predominately White Institutions (PWIs), Minority Serving Institutions (MSIs), and Historically Black College and Universities (HBCUs) to provide their unique experiences. The research team interviewed 38 participants to get a deep understanding of their complex and multi-layered experiences. Creswell suggests a range from five to twenty-five as the appropriate number of participants in qualitative research [39]. The sample size is larger because this is a national study that aims to make significant comparison among schools, fields, and other individual characteristics. This paper highlights the experiences of only 13 participants. While this is not the complete data set for the national study, the analysis of 13 interviews allows for redundancy across participants. Also, a lack of emergence of new themes and patterns is in accordance with Grounded theory [38]. Redundancy is a tenet of grounded theory, stating that data collection and analysis continue until theoretical saturation, or once no new data or concepts of a theory appear [40].

Prior to the interview, each participant received a document with pertinent information regarding the study. The interviewer orally reviewed the document with the participant and obtained verbal consent before the start of each interview. Researchers also recorded notes during transcription. A digital recorder was used to capture all interview data. Interviews were transcribed for analysis. Table 1 displays the demographics of the 22 participants whose interviews were analyzed for this manuscript. Figure 1 displays the four different stages of participants in their doctoral programs.

Table 1: Demographics of Participants.

Gender	Females – 22 (100%)
Race/Ethnicity	African-American/Black – 21 (95.4%) Multiracial – 1 (4.54%)
Mean Undergraduate GPA	3.43
Mean Doctoral GPA	3.62
Pell-Grant Eligible/Low Income	8 (36.4%)

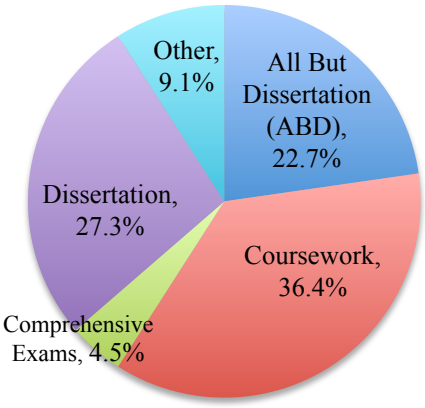

Figure 1: Participants' different stages of doctoral study.

Interviews: This primary research question is, *what are the perceptions of the experiences of Black women pursuing doctoral degrees in engineering or computer science?* To further explore this primary research question, there are two sub-questions:

1) How do Black women pursuing doctoral degrees in engineering and computer science perceive and characterize their experiences while enrolled in their programs?
2) How do Black women shape their academic persistence and overall well-being?

To answer these questions, the study consisted of interviews with Black women pursuing doctoral degrees in engineering and computer science. Researchers conducted semi-structured interviews in order to allow the important issues to be addressed while allowing for flexibility determined by the participants [41]. These interviews were completed by phone. The interview protocol was developed by the researchers and framed with the use of Black Feminist Theory and the literature. To capture data on the research question, *how do Black women pursuing doctoral degrees engineering and computer science perceive and characterize their experiences while enrolled in their programs,* the following questions were asked:

- Tell me about yourself. What characteristics, strengths and weaknesses, do you have that make you who you are?
- Describe what it is like to be a Black woman in your Engineering or Computer Science program. How does your race and gender impact your experience in your program and in the field?
- How do you think others described you, in general at your undergraduate institution? At your Master's institution? What about individuals in your doctoral program? Advisor? Doctoral peers? Other faculty?
- Describe a typical day for you as a doctoral student.
- What strategies have you used to overcome any challenges/barriers that you have faced in your doctoral program?

To capture data on the research question, *How do Black women pursuing doctoral degrees in engineering and computer science experiences shape their academic persistence and overall well-being?)*, the following questions were asked:

- How would you describe the "public you" that you present in academic settings? How is that different from the way you present yourself in your personal life? Is this a conscious decision?
- What are the advantages and disadvantages of presenting yourself differently in one context from another context?
- Do you have an individual or a group of individuals with whom to share your frustrations? Describe those relationships and the benefits of those relationships, from your perspective.
- How have the experiences in your program impacted your desire and ability to continue pursuing your degree?
- How have the experiences in your program impacted your overall wellbeing?

The interview protocol contains multiple probing questions to help participants reflect deeply on their experiences as they relate to the research question. The protocol includes probing questions designed to discover why people behave in a certain way by uncovering the assumed, mutual knowledge, symbolic meanings, motives and rules that provide the context for their actions [42].

Analysis: Grounded theory was used as an analytic methodology to identify themes, which includes a two-stage, open, and axial coding process to analyze the data, followed by memo writing, theoretical sampling, and theoretical saturation [37]. The content analysis consisted of researchers coding themes independently followed by the five-member research team meeting as a group to reach consensus about themes and relationships. Member checking was used to clarify responses and ensure accurate presentation of the participants' comments and thoughts [43]. Finally, the research team unanimously agreed on the themes that emerged from the interviews.

Results and Discussion

Three emerging themes surfaced from the interviews:

1. Token/The Lone Ranger
2. Code-Switching
3. Support/ Bigger Than Me

The *"Token/The Lone Ranger"* theme captures how the participants are hyperaware of being "one of a few" Black women. Participants shared that as a token or lone ranger, their presence was highly visible in their departments and programs. At the same time, this token status ignited a sense of invisibility due to their race and gender. They also shared how this increased awareness of their race and gender, heightened the pressure for them to challenge stereotypes and act as trailblazers for other Black women. Select participant quotes that highlight the *"token/lone ranger*" them are presented below:

> *"I'm just here by myself without really knowing anybody at all without anybody who looks like me, without having any type of community."*
>
> *"I feel kind of badass for being like one of the only people that look like me in this position... in other ways, it comes with a huge burden or a cross to carry."*
>
> *"I would like people to stop bringing up the fact that I'm a black woman. That kind of annoys me because I feel like it's a pity party."*
>
> *"...the unicorn. It's like when someone sees you and they're like oh wow, you exist. I think that's [it is] being a black woman in engineering."*
>
> *"I know I'm one of the few, well one of the four of the 130 people we have now."*

"Code-Switching" emerged as participants discussed how their typical and authentic ways of interacting or presenting themselves were rarely accepted in academic settings. They described feeling an increased pressure to conform to the academic culture in order to feel accepted. Participants noted the advantages and disadvantages code-switching. Example quotes from participants that support the code-switching theme are as follows:

> *"it's hard to feel like I'm juggling two different versions of me."*
>
> *"While I'm at school or I'm in the lab I have to have no emotions. I have to pretend that*

things don't faze me. So I might go outside of the PhD ... It's hard for me to turn that on, "Like, oh I'm human again." So a lot of switching back and forth, co-switching between who I am for real and the person I have to be to survive in this atmosphere."

"I feel a little bit like a shape-shifter, a code-switcher. I feel angry. I feel alone, I feel passionate and excited that I have this opportunity. Yeah, I think I feel all of those things at once"

"...By behaving that way, it's currently working for me. It's working for me in the academic setting. I'm progressing, and people do respect me, and they think highly of me, or so they say. You never know. I think that's a double-edge sword. I mean, on one hand, it's working for me. On the other hand, I shouldn't have to do that."

"I feel like no one from either side, my personal life or from academic life really gets to see the true me because I'm always hiding parts of myself, either where I think you may not understand or I might just get tired of talking about something. A lot of times I don't have anyone to talk to about the issues that go on in my life. So at times I'm just pushing them down and just try to move on through them and not really dealing with my own personal issues."

The final theme that emerged is *"Support/ Bigger Than Me"*. This theme relates to how the women stressed the necessity to find support from a variety of sources, including their families, Black student groups, advisors, and professional organizations. Participants framed the dissertation process as being "bigger than [themselves]." They also had a desire to motivate others, serve as a trailblazer, and succeed for their larger community as persistence strategies. Select participant quotes that demonstrate the *"Support/Bigger Than Me"* theme are below:

"The fact that I go to [one of the best] institutions and they haven't graduated a Black woman, which lets me know there is a need, strong need in that field. That's one great thing that keeps me going. Then, my family. I didn't come all the way up here not to finish."

"So that's when I started looking out and reaching out to other groups and looking into the Empowering Women of Color Conference Committee and kind of connecting with more people of color through that conference."

"The most important thing, you need to have what I call a board of directors. Those are your go to people... so when the going gets tough... they're the people you go to because they got your back."

"I can't let the people at home down."

"I think I don't want to say being the first, but the fact that I go to the number one institution and they haven't graduated a black woman lets me know that there's need, strong need in that field. That's one great thing that keeps me going. Then, my family. I didn't come all the way up here not to finish."

Conclusion

The preliminary findings of this study have identified some key challenges that Black women in engineering and computer science doctoral programs face. This is the first step to understanding important strategies for academic persistence. Potential strategies include programmatic changes that may be useful in improving the overall experience, retention, and recruitment of Black women doctoral students in engineering and computer science. This new knowledge serves to increase higher education personnel's (including faculty, researchers, and administrators) understanding of experiences of Black female doctoral students in engineering and computer science. This research also serves to assist educators, researchers, administrators, funding agencies and policy makers. A better understanding of the specific dynamics and factors impacting Black women in engineering and computer science has the potential to impact their success, academic persistence and well-being. Engaging the broader community in this discussion is invaluable. For future research, the research team will complete the data analysis for the other Black female doctoral candidates, interview research mentors, translate research into most-promising practices, and develop workshops and printed materials on how to most effectively implement most-promising strategies.

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