Retention of Women of Color in STEM Doctoral Programs

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Abstract: Most research studies examine only gender or racial and ethnic identity, with little attention given to women who identify as underrepresented minorities (URM) within science, technology, engineering, and mathematics (STEM); furthermore, current STEM research on women and URM focuses on reasons for departure rather than on student persistence. Therefore, the current qualitative study is important because it analyzes the factors that lead to doctoral STEM persistence, considering both gender and ethnicity. Our central research question is: what are the experiences and outcomes affecting Women of Color’s persistence in STEM doctoral programs? The following themes emerged from our study as most salient to the participant’s persistence: financial, socialization (peer and faculty), motivation (preference for long-term goals and degree completion), group affiliation and external support systems. This study makes a case for the need to integrate group affiliation and external support systems in effort to retain this population. Proposals of how this study could enhance the persistence of Women of Color in STEM doctoral programs at institutional departments and programs is based on bringing awareness to academic staff of the factors that successful Women of Color in STEM doctoral programs assert contribute to their persistence.

Introduction

Doctoral student persistence for all demographics in the United States is at a rate of approximately 50% (Lovitts & Nelson, 2000). With such low persistence rates, the future of American knowledge creation and research productivity is at risk since doctoral programs serve as a primary source for generating future scholars and field experts through research training and productivity. This phenomenon is of further concern when compared to the doctoral completion rates of underrepresented minorities (URM) and women in the fields of science, technology, engineering, and mathematics (STEM). Increasing the representation of women and URM in STEM fields has become a national priority as evidenced by policy and research funding initiatives sponsored by governmental organizations such as the National Science Foundation and the U.S. Department of Education (Millett & Nettles, 2006).

Women of Color, whether they are faculty or students, must constantly navigate and negotiate these White male-dominated fields, “which has traditionally devalued their lived experiences, discourses, and ways of producing knowledge” (Souto-Manning & Ray, 2007, p. 281). Thus, much talent is typically lost at transition points of the educational pipeline, specifically from undergraduate degrees to advanced degrees.

Current STEM research on women and URM focuses on reasons for departure rather than on student persistence. Additionally, most studies examine only gender or racial and ethnic identity, with little attention given to women who identify as underrepresented minorities within science, technology, engineering, and mathematics. Therefore, the current study is important because it analyzes the factors that lead to doctoral STEM persistence, considering the intersection of both gender and ethnicity. Furthermore, the current study has implications that
may lead to success for this particular demographic to cultivate talent through programmatic and departmental changes by learning from those who have been successful. Our central research question is: what are the experiences and outcomes affecting Women of Color’s persistence in STEM doctoral programs?

In the current study, URM includes U.S. citizens and permanent residents who identify as Black/African-American, Hispanic, Asian/Pacific Islander, and American Indian/Native Alaskan. URM and Students of Color will be used interchangeably in this study.

**Literature Review**

Women’s participation in STEM doctoral programs has increased in the past 40 years. For example, the number of women who earned doctorates in STEM increased from 9% in 1973 to 47% in 2007 (NSF, 2009). While this may appear to reflect progress for women in education, women are still leaking through the educational pipeline. “Leaky pipeline” is a metaphor frequently used to “describe the fact that women are underrepresented in science, technology, engineering, and mathematics (STEM) careers” (Blickenstaff, 2005, p. 369). The pipeline refers to students from secondary school through higher education and into the workforce or academe. This is especially true for Women of Color in STEM. Of those conferred STEM Ph.D.s, URM women made up only a small percentage. In 2007, the demographic profile of Ph.D. s granted were 4.6% Asian/Pacific Islander women, 3% Black women, 3% Hispanic women, and 0.3% American Indian/Alaska Native compared to 32.7% White females (NSF, 2009). The persistence of Women of Color in STEM doctoral programs who achieve degree completion has remained consistently low and remains a pressing issue.

Currently, there is a surge in the number of underrepresented students amongst the college-age population; however, few undergraduate minorities are continuing beyond the bachelors degree level to obtain doctoral degrees in the STEM fields (United States Government Accountability Office [USGAO], 2006). Additionally, international students make up a high percentage of doctoral student enrollments in U.S. STEM programs. In engineering alone, international students were awarded 57% of all conferred doctoral degrees in 2004 (Chubin, May, & Babco, 2005). In 2006, the U.S. awarded the largest number of STEM doctoral degrees compared to other countries; however, of those awarded degrees, domestic students earned only 11% compared to international students from China who earned 21% and students from Europe who earned 19% (National Science Board, 2010). Thus, the U.S. is educating and training more international students than cultivating its own talent, which is problematic due to anticipated retirement projections.

The United States is expecting a growing retirement rate in the science and engineering workforce, which is currently comprised of mostly White males in the STEM workforce (Chubin et al., 2005; Millet & Nettles, 2006). However, White males in the STEM fields are expected to decrease from 70% in 1997 to an anticipated 26% in 2050; thus, it is imperative to encourage the talent of all Americans, especially those historically underrepresented in doctoral programs, to ensure a strong and diverse workforce (George, Neale, Van Horne, & Malcom, 2001).

**Theoretical Framework**

We are utilizing Nettles and Millet’s (2006) conceptual model of doctoral student experiences and Sedlacek’s (2004) noncognitive variables (NCV) as the frameworks in our study
of factors that lead to persistence of Women of Color in STEM doctoral programs. It is important to note that the five core areas of Nettles and Millet’s (2006) empirical model (financial support, socialization, research productivity, student satisfaction, and degree completion) are not exhaustively representative of all aspects critical to doctoral experiences. Thus, we are incorporating Sedlacek’s NCVs as a complementary framework in effort to further understand attributes that may contribute toward or play a role in doctoral student persistence. Although Sedlacek (2004) proposes eight NCVs, our study will focus only on two NCVs relevant to the current study: positive self-concept and preference for long-term goals.

Our rationale for using these two frameworks is based on three reasons: first, Nettles and Millet’s (2006) conceptual framework is empirically grounded in a study specifically focused on doctoral students. Our second rationale is due to the two frameworks’ holistic approaches that incorporate internal and external factors in doctoral students’ experiences. Finally, Nettles and Millet (2006) created a model based on doctoral students’ experiences and outcomes. In addition, the use of two NCVs allows us to flesh out additional experiences and factors that impact doctoral student retention that is not covered in Nettles and Millet’s model.

Methods

We sent emails to professional contacts, peers, student group listservs, and student organizations in an effort to recruit participants for this study. We interviewed four participants, but were only able to use the data from three interviews due to one participant revealing her “All But Dissertation” status and was not intending to complete her doctoral program. All individual, in-person interviews occurred in late March 2010 and were scheduled for one hour.

The participants are all current doctoral students at a large, public doctoral extensive university in the Midwest. All three participants fulfilled the criteria of our study: domestic or U.S. permanent resident, enrolled in a doctoral STEM program, completed at least one full academic year of coursework, and a Woman of Color. “Mary” identifies as an African–American woman in the Department of Pathobiology and Diagnostic Investigation. “Lola” is a Puerto Rican woman in the Department of Electrical and Computer Engineering, and “Carolina,” who identifies as biracial (Native American and African American), is a student in the Department of Psychology-Behavioral Neuroscience. The participants ranged in age from 28–37 years old.

We asked a total of 12 questions, including three general background questions and seven questions grounded in our theoretical framework.

Research Results

Of the theoretical themes investigated, the following emerged as most salient to the participant’s persistence: financial, socialization (peer and faculty), and motivation (preference for long-term goals and degree completion). As we analyzed the data, two additional themes emerged that are not addressed by our theoretical frameworks: group affiliation and external support systems.

Financial. Financial support was the most important factor reported by our participants that attributes to their persistence. All three participants receive some form of financial support to cover the costs associated with being enrolled in a doctoral program. The sources of funding are through their program, department, institution, or through an external organization in the forms of graduate assistantships, external fellowships, financial aid, grants, and loans. Our
participants attribute the central role that funding has on their retention for reasons such as peace of mind and increased research productivity.

**Socialization.** Participants described two distinct socialization needs that have been fulfilled in their doctoral experience—interactions with fellow doctoral students and interactions with faculty (both formally assigned faculty advisors and informal faculty mentors). When asked about their interactions with peers, the three participants further compartmentalized their peer interactions into two distinct groups: peers in their research labs and minority scholar support programs. Participants reported it necessary to feel cohesion in their lab with lab mates and highlighted the importance of having at least one faculty mentor who supported them in non-academic ways such as the personal aspects of their mental well-being, awareness of parenthood responsibilities, or emotional support.

**Motivation and Determination.** Motivation and determination for degree completion was the third common theme that emerged from the interviews. Specifically, the participants addressed the influence of their preferences for long-term goals and positive self-concept towards their degree completion. All three participants stated that they had an early interest in science, technology, engineering, and/or math, much of it fostered by a parent or a former teacher, and they decided to continue their interest through pursuing an advanced degree. Additionally, all three participants discussed a future career goal that required the need to obtain a terminal degree in their field.

**Group Affiliation.** An overarching theme from all three interviews was the importance and desire to connect with others from their racial and ethnic background. The issue of feeling “different” arose as a consistent theme when discussing their socialization and interactions with individuals in their programs. Participants attribute the ability to connect with others who are from their racial and ethnic background a factor to their persistence.

**External Support Systems.** We define external support systems as the availability of more than one person from whom participants seek and find support. The external support systems mentioned by the participants included spouse/partner, family, friends, and peers from minority scholar support programs. Additionally, one participant mentioned spiritual faith. All participants asserted that having an external support system was a key factor to their success.

**Implications**

The results of the current study align with issues raised in the literature review as well as factors leading to persistence found in our theoretical framework. Motivation and determination were individual characteristics that were driving the participants’ intrinsic desire to complete their Ph.D. Each participant stated that they would complete their degree despite existing challenges, such as the intensity of their research. Their drive is the factor that is motivating them to persist in their program. These intrinsic factors, such as motivation and determination, are beyond the control of institutional or programmatic influence. However, departments and programs should be aware that these are characteristics that may be found in successful Women of Color in STEM. Ideally they should start with their undergraduate population on their campuses in order to cultivate and retain the talent that already exists on their campus, particularly women and underrepresented minorities.

Financial support emerged as the most important practical factor outlined by Nettles and Millet’s (2006) conceptual framework. This is demonstrated by Carolina, who has guaranteed funding throughout the duration of her program. She emphasized that financial troubles would
negatively impact her productivity if she were distracted by money problems. Although Carolina and the other participants possess strong internal drive for completing their degree, the need for financial support demonstrates the importance of both intrinsic and practical factors that lead to persistence. Fundraising efforts to create scholarships and fellowships that support high achieving URM and women should be a priority to support these student populations. It is important for the departments to ensure financial stability for their students, especially Women of Color, in order to minimize anxiety and maximize productivity.

Socialization is the interpersonal component of doctoral student persistence. Interestingly, we learned that our participants identified most strongly with their peers in their research labs. All three participants made a distinction between peer interactions in lab and peer interactions in other areas of their program. Most of their peer socialization is housed in the lab; however, minority scholar support programs were equally as important to their socialization for Lola and Carolina.

Interactions with faculty also emerged as a factor in their persistence; however, their experience contrasts with the definition by Nettles and Millet (2006). The participants’ socialization with faculty focused on the personal aspects of their interactions that went beyond academic and professional training; rather, the faculty members who are instrumental to their success treated them as people, rather than a “work horse,” as described by Mary.

To retain Women of Color, all faculty need to foster supportive lab environments, even if the department or program may be perceived as being non-inclusive to women and underrepresented minorities. In addition, faculty need to be aware that their interactions with Women of Color goes beyond training them for their profession. In fact, the personal aspects of faculty interaction were reported by the participants as being more important to their retention and satisfaction in their program.

Race and gender emerged as additional layers to the socialization piece of the doctoral experience as described by our theoretical framework. This is an important component to the participants’ socialization, both with their peers and with faculty. The participants reported very low representations of domestic women and underrepresented minorities in their programs and departments, whereas there is a high representation of international students. This is consistent with the current literature and trends that reflect the current status of Women of Color in STEM (Chubin, May, & Babco, 2005; Cronin et al., 1999; NSF, 2009).

In order for departments to better serve this population within STEM academic disciplines, it is important for departments to recognize the need for this racial/ethnic connection. Furthermore, they should provide information about existing minority scholar support programs or organizations on their campus. Ideally, colleges and/ or departments should make effort to create programs or communities that support the needs of URM who share the same academic discipline. This should be a minimum effort because it plays a role in their retention, and it would likely result in recruitment efforts in terms of appeal to potential students.

External support systems was a theme that consistently emerged when we asked the question: what has helped you be successful? Although this theme did not fit within our theoretical framework, external support systems was the common answer from all participants. Specifically, each participant credited two or more people in their personal lives on whom they relied for support in helping them get through their doctoral program of study. This support network affected the participants holistically because it helped them with practical matters such as childcare, in addition to emotional and moral support when they experienced challenges in their academic programs such as failing a qualifying exam or major test. The external support
group is important because it can serve as a factor in their retention, affect their persistence, and possibly play a role in their attrition. Thus, departments need to recognize that external support systems influence academic performance, and they also need to be sensitive to those who may not have an external support system on which to rely.

Conclusion

The current study is important because it analyzed the factors that lead to doctoral STEM persistence of Women of Color, considering the intersection of gender and ethnicity. Furthermore, the current study has implications that may lead to success for this particular demographic, with recommendations for programmatic and departmental changes by learning from those who have been successful. Outside of the traditional factors outlined by existing literature and theories, our study makes a case for the need to integrate group affiliation and external support systems in an effort to retain this population. By doing so, the implications of this current study could enhance the persistence of Women of Color in STEM doctoral programs.

References

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