Chapter 22
Constructing Conducive Environment for Women of Color in Engineering Undergraduate Education

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ABSTRACT

The engineering field, in particular, struggles to recruit and retain students, especially women of color. Thus, consideration of how academic environments, such as treatment by faculty and peers, interaction with faculty, and available resources for learning and tutoring, uniquely affect women of color is examined. Several theories, such as critical racial theory, intersectionality, and campus climate framework, highlight the importance of examining individual characteristics and details of the environmental context. This study used data from a sample of 850 women students in 120 U.S. engineering undergraduate programs from 31 four-year institutions. Black women engineering students experienced and perceived more differential treatment because of their race/ethnicity but interacted more with faculty than White women students. This study provides critical implications for policy and practice regarding how administrators and faculty members can design engineering programs to create better climate and offer resources for women of color students.

INTRODUCTION

Women of color have been severely underrepresented in Science, Technology, Engineering, and Mathematics (STEM) fields. Despite the gender gap in U.S. colleges and universities closing as women become the majority in enrollment and attainment numbers in most fields (Burge, 2011), achievement levels are unequal among women college students in engineering (Huang, Taddese, & Walter, 2000). In a two

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decade span (1983-2002), the percent of women holding engineering degrees in the United States only increased from 13.3 percent to 20.9 percent (National Science Board, 2009). Furthermore, the lack of racial/ethnic diversity within undergraduate engineering is of particular concern. From 2002 to 2012, the percentage of historically underrepresented minority students earning bachelor's degrees in engineering rose only slightly from 12.3% to 12.9%; the percentage of African Americans actually declined from 5.3% to 4.2%, and the percentage of Hispanic Americans rose from 7.3% to 9.3% (National Science Foundation, 2015). Given the low participation in engineering by women and racial minorities, a look at underrepresented women undergraduates' enrollment and degree completion in engineering is even more discouraging. The National Center for Education Statistics (2011) reported that 18.3 percent of all bachelor's degrees in engineering awarded in 2010 went to women. Of those, White women received 11.4 percent and Asian women 2.8 percent. As a comparison, together, African American, Latina, and Native American women completed 2.8 percent of degrees. It is obvious that efforts to attract and retain underrepresented women as well as White women to engineering programs are still necessary.

Research indicates that women of color have struggled partly because of being in a double bind – that is being both female and minority (Malcolm, Hall, and Brown, 1976) in terms of disparities in access, disadvantages in experiences, and differences in outcomes (Ong, Wright, Espinosa, and Orfield, 2011). Individual as well as institutional factors are associated with the struggles of women of color students in engineering fields. Many studies and policy reports focus on individual factors, for example, parental socioeconomic status or academic preparedness and their influence on students' access, persistence, and degree completion in STEM disciplines. Larger educational systems, such as STEM programs' climates and resources for academic success have been emphasized in research and policy reports because the chilly climate, lack of diversity, and homogenous environment are negatively associated with women and racial minority students' college experience and outcomes (Seymour and Hewitt, 1997).

Much of the literature has overlooked potentially informative aspects. First, many studies aggregate STEM fields although each discipline may each have their own unique academic policy and culture (Ferrini-Mundy & Güçler, 2009). Women of color in engineering might have different experiences and perceptions from those in physics because each department has its unique faculty cultures, academic and co-curricular programs, and organizational structures, policies, and practices (Terenzini and Reason, 2005, 2010; Lattuca, Terenzini, Harper, & Yin, 2010). Second, the constant need to call attention to access, persistence, and degree completion may distract from the equally important need to address climate with specificity to certain students' perception of treatment by others and available resources for academic success. While recent studies have focused on the access, persistence, and degree completion among specific students such as racial minority men and women students in undergraduate engineering (Lord et al., 2009; Lord et al., 2011; Ohland et al., 2011), they have examined these groups separately and not with a focus on the climate. Third, many STEM studies, including engineering education studies and climate studies focus on student experiences among the entire student body or only delineate between two groups (i.e. male/female, racial minority/non-racial minority) or racial categories. Researchers, however, have not focused much on minority women students' perception of climate in engineering or STEM disciplines, except for a few qualitative studies (e.g., Johnson, 2007, Johnson, 2012). This intersection between gender and race/ethnicity is critical in engineering fields because specific challenges such as mistreatment, discrimination, or access to resources might be missed when groups are examined in isolation (Crenshaw, 2014; Malcolm et al., 1976). Thus, based on the sociohistorical context and realities of inequitable treatment in engineering undergraduate programs (Malicky, 2003; Sosnowski, 2002; Varma & Hahn, 2007), this study chose to address the gap in research by examining women students'