STEM Career Readiness at HBCUs to Enhance Occupational Diversity

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Abstract

STEM workforce diversity problems still exist despite incremental improvements. To improve STEM career readiness outcomes and sufficiently prepare minority students for employment, historically black colleges and universities (HBCUs) must increase the number of on-campus faculty-mentored undergraduate research experiences and student participation in off-campus internships. STEM career readiness refers to preparing students to get a job in today's labor market by ensuring comprehension and application of essential content knowledge and professional skills. There is a lack of research-based evidence that explores the impact of HBCU student off-campus company-based internship participation on career development parameters and career outcomes.

Keywords: career readiness, STEM, diversity, internship, workforce

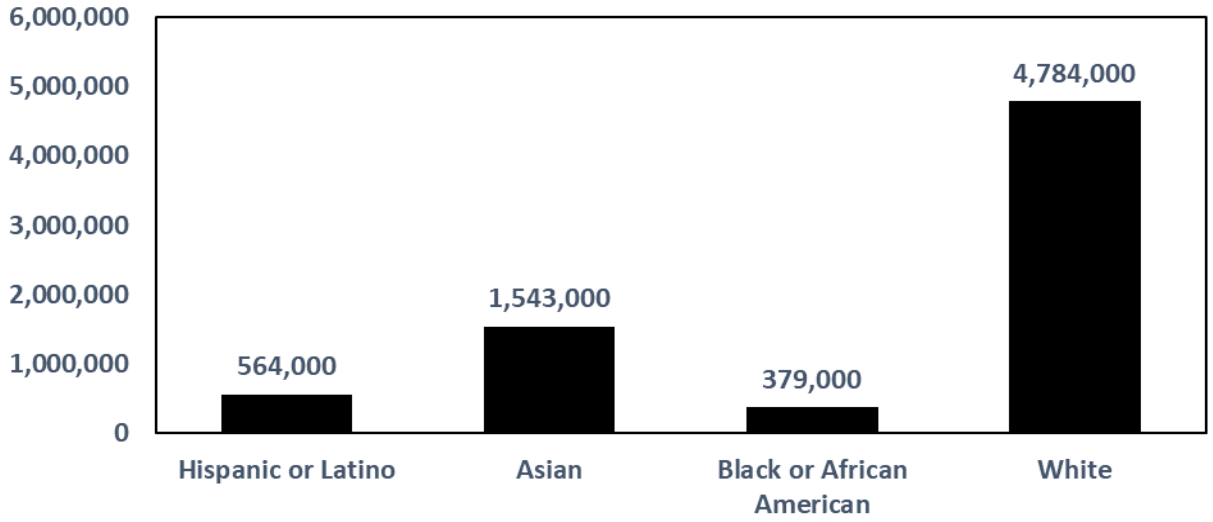
Introduction

Increasing diversity at every level of the STEM pipeline continues to be a central issue for various stakeholders. Established broadening participation initiatives at the state and federal level have played significant roles in increasing the representation of minorities in the STEM disciplines and workforce. However, despite the increase in underrepresented minorities who were awarded Bachelor's degrees and doctorates in STEM from 2008-2018, underrepresented minorities continue to significantly lag far behind their white and Asian counterparts in obtaining STEM employment in the United States(Table 1 - numbers in the table represent individual scientists and engineers) (National Science Foundation, 2021). Moreover, reports from the United States Department of Labor indicate that there will be a substantial increase in the number of STEM jobs in the United States in the next several years. The federal government estimates an approximately 8% increase in STEM job growth from 2019-2029 (Zilberman & Ice, 2021). Thus, it is imperative that HBCUs understand the importance of adequately preparing students for the STEM occupational challenges and opportunities they will encounter in the future.

Decades of research have elucidated the factors that impact the underrepresentation and retention of minorities in STEM disciplines (Flowers, 2017; Flowers, Moore, Flowers, 2016; Hrabowski & Pearson, 1993). Additionally, educational research literature contains ample examples of best practices, broadening participation programs, and other interventions designed to promote the success of minorities in STEM education and careers (Karukstis, 2008; Kendricks, Arment, Nedunuri, & Lowell, 2019; Rybarczyk, Lerea, Lund, Whittington, & Dykstra, 2011). It is clear from the research and anecdotal evidence that quality teaching, undergraduate research experiences, and other critical professional development activities significantly affect the trajectory of underrepresented minorities toward STEM employment. To facilitate HBCU student understanding of essential knowledge and competencies that affect entry and

retention in the workforce, STEM academic departments must expose students to various specialized work development experiences during their undergraduate career. Professional development experiences should be aligned with current STEM career development research studies, company job tasks, and career development best practices.

Table 1. Scientists and Engineers Employment Data by Race



Career Readiness

An oft-cited rationale for underrepresentation in STEM careers is the lack of preparation of minority college graduates (Schneider, 2000; Tyson, Lee, Borman, & Hanson, 2007). However, there is a scarcity of research studies that focus on HBCU STEM students' career readiness. Most contemporary research studies on student career readiness target high school students (Bozick, Srinivasan, & Gottfried, 2017; Erdogan & Stuessy, 2016). The main reason for the lack of studies on HBCU students stems from the absence of a reliable and valid instrument to measure STEM career readiness at the college level. Many studies examining STEM career preparation are not grounded in a career readiness theory or a practical conceptual framework. Identification of career readiness factors may be a key element in improving HBCU student participation in STEM careers. For the current article, we define STEM career readiness as the requisite professional experiences, skills, and knowledge students must acquire to obtain employment in a STEM field after graduation. The utilization of on-campus undergraduate research and off-campus company-based internships can improve career readiness at HBCUs.

Undergraduate Research

Since the turn of the century, stakeholders have strongly recommended that institutions of higher learning create intensive career preparation opportunities to enrich undergraduate education outcomes (Association of American Colleges and Universities, 2007; Boyer Commission on Educating Undergraduates in the Research University, 2001). Not surprisingly, there has been a fair amount of literature that demonstrates that minority student participation in undergraduate research promotes academic success, higher persistence rates in STEM, greater success in graduate school, and stronger commitment to pursue a STEM career when compared to control populations (Fakayode, Yakubu, Adeyeye, Pollard, & Mohammed, 2014; Jones, Barlow, & Villarejo, 2010). Lopatto (2007) surveyed over 2000 students using the Survey of Undergraduate Research Experiences (SURE) and found that over 90% of the students reported that their engagement in a summer undergraduate research experience either maintained or improved their interest to pursue a science career. Using longitudinal evidence Jones, Barlow, and Villarejo (2010) further substantiated the link between minority undergraduate career preparation activities and student persistence and academic attainment. Their data compared retention and academic success of multiple ethnic groups and found that minority students showed higher statistical gains versus other ethnic groups.

Villarejo, Barlow, Kogan, Veazey, & Sweeney (2008) also provided supportive evidence that underrepresented students' participation in career readiness programs promotes a sustained interest in pursuing a STEM career after graduation. The researchers performed a longitudinal study on alumni who participated in an undergraduate biology enrichment program for minorities and graduated with a degree in biology to demonstrate a causal link between

research experiences and career choice and employment outcomes. Results of the study confirmed similar findings that participation in STEM employment preparation experiences was a transformative endeavor in steering minority undergraduates to a research career in the biomedical sciences.

Fakayode et al. (2014) analyzed survey results of students who completed a summer undergraduate research program and noted that program participants had higher retention rates compared to non-program students enrolling at the same time. The work of Fakayode et al. is constructive; however, unlike Villarejo et al. (2008), their work did not focus on career decisions and did not track the participants after graduation to explore longitudinal outcomes. Unfortunately, evidence regarding the effects of undergraduate research experiences and internships on HBCU student career development issues and products (e.g., career readiness) is somewhat limited and thus reinforces the need for STEM education researchers to address the problems through the use of mixed methods research studies.

Internships

According to Kolb's experiential learning theory, internships are an example of a beneficial learning activity where knowledge is acquired through targeted work-related experiences and facilitates a thorough understanding of real-life work requirements (Kolb, 1984). Not surprisingly, the educational literature is replete with evidence demonstrating the positive effects of STEM-based internships on academic success and career outcomes of college students attending majority institutions (Honda, Pazmino, Hickman, & Varma, 2015; Knouse, Tanner, & Harris, 1999; Kopteva, Arkowski, Craft, 2015). Undergraduates who participate in an internship have a significantly higher GPA than students who do not participate in an internship during their undergraduate careers.

In another study, Wright, Wu, Frye, Mathur, and Patrick (2007) found that a biomedical engineering summer research internship significantly improved the participants' knowledge of medical principles and STEM fundamentals. Internships are targeted training endeavors monitored by an appropriate supervisor or team and are often a prerequisite for a technical profession. Internships come in various forms, can be completed during the academic year or the summer, and involve part-time or full-time vocational commitments. Moreover, the inclusion of internship experiences at the undergraduate level show significantly improved retention, academic success, and employment outcomes (Callahan & Benzing, 2004). Data on the effects of internships on HBCU STEM students is limited; however, a small subset of studies have examined how internship exposure affects African American students.

Internships provide students with a unique opportunity to gain practical experience in a particular field and reinforce one's understanding of the inner workings of distinct occupations. Moreover, internships connect academic content to career applications and help students refine their career interests and evaluate their vocational strengths and weaknesses. Successful internship experiences can also lead to the formation of valuable long-term professional networks, strong letters of recommendation, and higher-quality resumes and cover letters. The comprehensive understanding gained from completing an internship can lead to an informed career decision that can affect employability (Knouse & Fontenot, 2008). While academic or on-campus internships are beneficial, off-campus internships are critical to student development. It is our contention that HBCUs should focus on increasing the number of off-campus internships opportunities for students. An off-campus internship is a supervised preparatory work experience performed by undergraduate students at an external, non-academic environment (e.g., industry, company, government lab) designed to transmit fundamental knowledge of specific careers and prepare students for entry-level positions in STEM.

Conclusion

Preparing HBCU undergraduate students for successful post-graduation occupational endeavors requires focused professional development objectives at the department level. Many national reports show that African Americans are severely underrepresented in the STEM workforce in the United States. Due to the effects of internships on a wide variety of student outcomes, higher education stakeholders have recommended the inclusion of internships or experiential learning activities in collegiate curricula. This article stresses the importance of HBCU student participation in off-campus internships at STEM-based companies or government-sponsored research laboratories. Off-campus internships and campus-specific research experiences will positively augment students' career readiness and ultimately improve diversity in STEM careers. Unfortunately, the impact of off-campus internships on HBCU students is a poorly studied area. An infusion of studies in this area could inform HBCU faculty and administrators and lead campus-wide strategies to improve career readiness and mitigate low graduate rates in STEM disciplines.

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