

Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce Report – Implications for Historically Black Colleges and Universities (HBCUs)

Dr. Trina L. Fletcher, Florida International University

Dr. Fletcher is currently an Assistant Professor at Florida International University. Her research focus includes people of color and women in STEM and quality in K-12 and higher education. Prior to FIU, Dr. Fletcher served as the Senior Manager for the Summer Engineering Experience of Kids (SEEK) program and the Director of Pre-college Programs for NSBE. Additionally, she spent time in industry holding technical and operations-based roles and has experience with outreach projects focused on STEM education and mentoring.

Tina L. Fletcher, University of Pennsylvania

Tina L. Fletcher holds a Bachelor's degree in Political Science and African American Studies from the University of Arkansas and a Master's degree in Secondary Teacher Education from Harvard University. She served as a U.S. Government teacher at Anacostia Senior High School in Washington, D.C. where she was named the 2010 Teacher of the Year. She then served as a fundraiser and successfully raised over \$20 million for President Barack Obama's 2012 re-election campaign in addition to raising over \$300 thousand for St. Jude Children's Research Hospital on behalf of the NBA's Memphis Grizzlies. She has interned with the Southern Education Foundation, the Congressional Black Caucus on behalf of former U.S. Senator Blanche L. Lincoln and in the Office of the First Lady Michelle Obama. Tina has been named a Rising Political Leader by EmPower Magazine, a Visionary Arkansan by the Arkansas Times and received the Brown Girls Rock award for her work in the field of education. She is currently a doctoral student at the University of Pennsylvania where she studies education policy. To learn more, visit <https://www.linkedin.com/in/tinalfletcher>.

Dr. Janelle L. Williams, Penn Center for Minority Serving Institutions

Janelle L. Williams is the Assistant Director for Health Policy at The University of the Sciences in Philadelphia and a Visiting Scholar at the Penn Center for Minority Serving Institutions at the University of Pennsylvania. Additionally, she currently serves on the Board of Directors for the Cheyney University Foundation.

As a researcher and practitioner, Janelle is passionate, collaborative, and innovative. Her scholarship investigates college choice at historically Black colleges and universities (HBCUs), the intersectionality of race and college selection, culturally inclusive approaches to address challenges facing HBCU enrollment, and HBCU advocacy in the higher education landscape through qualitative inquiry. Her most recent work explores the factors that influence the enrollment of Black undergraduates who chose to attend HBCUs and has been published in *Diverse Issues in Higher Education*, *MSIs Unplugged*, and *The HBCU Times*. In addition, Janelle has been an invited panelist and presenter discussing topics relating to her research at national and international conferences including HICE, ICUE, and NACADA.

A first-generation college student, Janelle is a graduate of Cheyney University of Pennsylvania, America's oldest HBCU. She continued her education at The Pennsylvania State University (Penn State). While at Penn State, she earned a M.P.A in Public Policy and Administration, a certificate in Public Sector Human Resources Management and was certified as a Diversity Relations liaison. In addition, Janelle obtained a M.Ed. in Student Affairs Leadership from Widener University. Coupling her interest in social justice, education and policy, Janelle earned an Ed.D. from Widener University in Higher Education Administration and Policy.

Ms. Brianna Shani Benedict, Purdue University

Brianna Benedict is a Graduate Research Assistant in the School of Engineering Education at Purdue University. She completed her Bachelor's and Master's of Science in Industrial and Systems Engineering

at North Carolina Agricultural & Technical State University. Her research interest focuses on interdisciplinary students' identity development, belongingness in engineering, and recognition.

Miss Brittany Nicole Boyd, Morgan State University
Mr. Kevrick Watkins

Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce Report – Implications for Historically Black Colleges and Universities (HBCUs)

Abstract

In 2018, the National Academies of Science, Engineering, and Medicine released a report entitled, *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. The report highlighted the various academic, economic, and social benefits linked to Minority Serving Institutions (MSIs) and spotlighted their impact on their respective institutional and community stakeholders. The report affirmed that MSIs have not been adequately researched or utilized to increase future research and that MSIs should be prioritized. Historically Black Colleges and Universities (HBCUs), one of two MSI types that are historically and culturally defined, were researched and analyzed as a part of the report. Defined by federal law [1], an HBCU is a “college or university that was established prior to 1964, whose principal mission was, and is, the education of Black Americans.”

While only accounting for 3% of all post-secondary institutions in the U.S., HBCUs graduate 17% of all Black students. Within science, technology, engineering, and mathematics (STEM), 40% of Black students pursuing graduate degrees attended HBCUs for undergraduate study. Between 2002 and 2011, HBCUs saw year-over-year increases for the number of Blacks who went on to successfully complete doctorate degrees in science and engineering, with top producers from North Carolina A&T University, Florida A&M University, and Morgan State University. This is particularly important when considering that of the 631 ABET (Accreditation Board for Engineering and Technology) accredited institutions only 15 are HBCUs as of 2016.

Prior research and statistics have documented the significant role HBCUs play in the production of Black engineers; however, this report emphatically states that these institutions are not utilized at the level necessary for the U.S. to stay competitive within the STEM workforce. Therefore, this current study consists of a rigorous document analysis to summarize information from the report that is directly and/or indirectly connected to engineering education at HBCUs including, but not limited to, background of authors, the institutional selection process, review of literature cited, and recommendations. Results indicate that, first, there is a need for increased efforts to advance and expand quantitative research related to the role of HBCUs in graduating Black engineers including dual engineering programs with PWIs. Second, an analysis of research and practice-based funding allocations for engineering at HBCUs should be conducted.

Introduction

The National Academies of Science, Engineering, and Medicine (NASEM) released the pre-publication report titled, *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*, which centers the cultural diversity of the U.S. and how cultural diversity is directly linked to our ability (or inability) to be innovative and compete on a global level. The report originates from the conclusion that the United States is not on track to remain competitive without employing Minority Serving Institutions (MSIs) given the changing demographics of our nation. A committee was convened to examine and investigate the successes and challenges faced by the varying MSIs and their missions of advancing and contributing towards a diverse STEM workforce.

HBCUs are one of two *culturally and historically-defined* MSIs, all other MSIs are defined as based on their enrollment (*enrollment-defined*). Research on HBCUs continue to highlight their success in producing well-rounded, successful students, especially those identifying as Black or African American. After surveying 520 Black HBCU graduates and 1,758 non-HBCU graduates between 2014 and 2015, Gallup-Purdue index studies found statistically significant differences in outcomes in favor of HBCU graduates when it came to financial success, purpose, and well-being [2], [3]. Focusing on HBCUs role in STEM, according to the National Research Council (NRC) [4], "...HBCUs enroll smaller percentages of African American students in S&E majors than do PWIs but graduate a larger percentage speaks to the efficacy of these institutions in retaining these students" [p. 156]. This fact debunks the negative message communicated about HBCUs only graduating the highest number of Blacks in STEM due to the high percentage of Blacks enrolled. According to the NRC, the report highlights the effectiveness of HBCUs in increasing participation and success of minority students. Although HBCUs face challenges such as flat or declining enrollment because of an inability to compete with other more resourced institutions with scholarship funds for prospective students or online learning opportunities, they continue to be leaders in successfully graduating Blacks in STEM as well as matriculating them into graduate STEM academic programs [5].

Based on the workforce needs of the United States along with research from top organizations such as NASEM and NRC, this study will consist of a rigorous document analysis of the recent report *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce* with a special focus on the implications of the findings for engineering education at HBCUs. The results from this analysis will be synthesized with prior literature that will guide and support future research, policy and practice.

Literature Review

HBCUs vs. PWIs: Educating Blacks in STEM Education

HBCUs were essentially the only higher education option for Black Americans, enrolling upwards of 80%, until the mid-1900's when the Civil Rights Act changed the legal system that would result in legislative integration. The historic change impacted enrollment at HBCUs and

their role in educating a majority of the nation's Black population. Black Americans now had access institutions of higher learning including predominantly White institutions. Currently, HBCUs enroll approximately 8 % of Black college students in the United States while representing less than 3% of higher education institutions in the nation [6]. Focusing on STEM, Owens [7] reported that in 2009 37% of all bachelor degrees in STEM awarded to Black Americans were produced by HBCUs. Fiegenger & Proudfoot [5] produced a report concluding that 21 of the top 50 institutions for producing Black graduates who go on to receive their Ph.Ds in science and engineering were HBCUs. Further analysis shows that all but four of the remaining 29 institutions (all predominantly White institutions or PWIs) were a R1 or a *very high research activity* institution according to the Carnegie Classification of Institutions of Higher Education. None of the HBCUs on the list are R1 institutions or *doctoral universities with very high research activity*. For the next level, R2 status, or *doctoral universities with high research activities*, there are 11 HBCUs on the list. They include Howard University, Hampton University, Jackson State University, Florida A & M University, Delaware State University, Clark Atlanta University, University of Maryland at Eastern Shore, Morgan State University, Texas Southern University, Tennessee State University, and North Carolina A & T University. It is important to note that several PWIs enroll significant numbers of Black students (more than most HBCUs in the country) including Georgia State University whose Black student population is over 14,000 and the University of Memphis an institution with a Black student population of over 8,000 students. None of these PWIs made the top 50 list while holding several STEM academic programs including engineering. Among the total top 50 list of baccalaureate-origin institutions, HBCUs collectively produced 1,819 Black graduates who earned a doctorate in science or engineering, while PWIs collectively produced 1,600 Black graduates [5]. Essentially, the *HBCU academic success in STEM* story is partially the result of the supportive but demanding environment that HBCUs offer Black students among other attributes including intensive mentoring and initial high expectations set for new students, regardless of their situation or circumstances [8], [9].

HBCUs and Engineering Education

HBCUs provide a unique platform to research engineering education successes and challenges because they house instrumental information on Black students' experiences within the context of higher education [10]. As a traditional avenue into higher education for Blacks, HBCUs continue to top the list of the highest awarders of engineering bachelor degrees to Black students. For Blacks who went on to successfully complete doctorate degrees in engineering, 5 of the top 10 baccalaureate-origin institutions were HBCUs including the top three producers: North Carolina A&T University, Florida A&M University, and Morgan State University. As of 2019, although there are only 15 HBCUs with ABET accredited engineering programs, these institutions have consistently produced a significant portion of Black engineers [11]. Owens [7] found that HBCUs produced 45% of engineering degrees and 48% of all engineering technology

degrees awarded to Blacks when compared to all higher education institutions in 2009. A full list of the 15 ABET accredited HBCU engineering programs are listed below in Table 1 including Texas Southern University, which is on track to graduate their first group of engineers this year.

Table 1: 15 ABET Accredited HBCU Institutions, Academic Programs and Degree Levels as of 2019 [12]

	HBCU/Institution	Engineering / Computer science Academic Programs	Degree Levels
1	Alabama A&M University	Electrical, Mechanical, Civil, Computer science	BS, MS, PhD
2	Florida A&M University	Chemical, Civil, Electrical, Computer, Industrial & Mechanical	BS, MS, PhD
3	Hampton University*	Electrical & Computer, Chemical, Aviation, Computer science	BS, MS, PhD
4	Howard University*	Architecture, Chemical, Civil, Electrical, Computer, Mechanical & Systems & Computer science	BS, MS, PhD
5	Jackson State University	Civil, Environmental, Electrical, Biomedical, Computer, Computer science	BS, MS, PhD
6	Morgan State University	Civil, Electrical and Computer, Industrial and Systems, Transportation and Urban Infrastructure	BS, MS, PhD
7	Norfolk State University	Electronics, Optical, Computer science, Computer Engineering, Information Technology, Material Science	BS, MS, PhD
8	North Carolina A&T University	Architectural, Bioengineering, Biological, Chemical, Civil, Computer, Computer science, Electrical, Industrial/Systems, Mechanical	BS, MS, PhD
9	Prairie View A&M University	Chemical, Civil, Computer, Computer science, Electrical, Mechanical	BS, MS, PhD
10	Southern University	Civil, Electrical, Mechanical, Computer science	BS, MS

11	Tennessee State University	Architecture, Civil and Environmental, Electrical and Computer, Mechanical and Manufacturing, Aeronautical and Industrial Technology, Computer science, Computer and Information Systems	BS, MS, PhD
*	Texas Southern University	Civil, Electrical and Computer	BS
12	Tuskegee University	Aerospace Science, Chemical, Electrical, Material Science, Mechanical	BS, MS, PhD
13	University of the District of Columbia	Biomedical, Civil, Electrical, Computer, Mechanical, Computer science, Information Technology	BS, MS
14	University of Maryland at Eastern Shore	General Engineering	BS
15	Virginia State University	Computer, Manufacturing, Computer science	BS, MS

Demand for Engineering at HBCUs

Table 1 also highlights the 15 ABET accredited engineering programs at HBCUs. The list also includes Texas Southern University (TSU) in Houston, Texas; the institution was authorized by the Texas Higher Education Coordinating Board (THECB) to begin offering two new engineering programs during the fall of 2015 in civil engineering and electrical and computer engineering [13]. According to the school's enrollment database, TSU has seen consistent growth for both programs. Based on the 4-year and 6-year academic plan period, the institution should expect to see their first group of graduates complete the programs by Fall 2019 adding to the overall total and national percentage of Black students graduating with engineering degrees from HBCUs.

Table 2: TSU Enrollment Data [14]

	TSU Academic Program	Fall 2015	Fall 2016	Fall 2017
1	Civil Engineering	65	98	138

2	Electrical and Computer Engineering	17	90	138
---	-------------------------------------	----	----	-----

Case of Excellence: Morgan State University

In 1984, four years after Jimmy Carter signed Executive Order 12232, a federal program to strengthen HBCU capacity by increasing funding and upgrading facilities, Dr. Eugene DeLoatch was recruited to Morgan State University (MSU) to launch the Clarence M. Mitchell, Jr. School of Engineering as the inaugural dean. Dr. DeLoatch would go on to become the first Black American President of the American Society of Engineering Education (ASEE) in 2002; 109 years after the founding of the organization. Dr. DeLoatch was the first ASEE President from an HBCU and the only HBCU leader to date. The engineering programs' success at MSU in part is attributed to their Pre-Freshman Accelerated Curriculum in Engineering Program (PACE) and the Center for Academic Success and Achievement (CASA) Academy Summer Bridge programs. Essentially, the foundation that MSU has created within engineering has placed the institution as a top 3 producer of Blacks obtaining bachelor's degrees in engineering as well as a top 3 baccalaureate-origin institution of Blacks who go on to complete Ph.Ds. in engineering. Additionally, MSU is the top producer of Black engineers within the state of Maryland [5], [7]. In recognizing the need to stay competitive within today's higher education system, Morgan State University's Office of Student Success and Retention (OSSR) applied for and successfully received a \$100,000 grant from the Bill and Melinda Gates Foundation to implement the Integrated Planning and Advising Services (IPAS) system, an early alert and response system for faculty, staff, and students. They were one of 19 institutions selected and the only HBCU. In 2019, they were named as the newest HBCU to be upgraded from R3 to R2 status.

Report Overview

Purpose and Background

The 2018 report released by the National Academies of Sciences, Engineering, and Medicine [15], *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*, was a response to the nation's need to strengthen, expand, and diversify its STEM-capable workforce. This process began with the development of the *Committee on Closing the Equity Gap: Securing Our STEM Education and Workforce Readiness Infrastructure in the Nation's Minority Serving Institutions*. The committee was made up of 18 individuals who were considered members including two co-chairs, six individuals that served as the study staff, and six individuals that served as consultants bringing the total group to 30 individuals engaged in the report. The series of private and public organizations sponsored the study and charged the select group of individuals with reviewing "...the goals, successes, and challenges of MSIs and to identify the most promising programs and effective strategies that they use to increase the

quantity and quality of their STEM graduates” [p. 2]. Of the 30 members, study staff, and consultants that worked on the report, there were a total of seven who were alumni of or worked at HBCUs per their identification within the report or as represented by online sources including biographies on organizational websites and other websites such as LinkedIn. HBCU affiliates included Aprille J. Ericsson (Ph.D., Howard University), Lamont Hames (St. Augustine University and Bowie State University alumnus), William Spriggs (former faculty at North Carolina A&T and Norfolk State University), Dorothy C. Yancy (President Emerita, Johnson C. Smith University and Shaw University) and Lance Shipman Young (Associate Professor and Chair, Morehouse College). Of the six consultants, two had connections to HBCUs including prominent HBCU researcher, Marybeth Gasman (University of Pennsylvania) and Deshawn Preston (Morehouse College of Medicine administrator, Oakwood College and Howard University Alum).

Site Visits

One of the more significant contributions of the report consisted of site visits to nine select MSIs where information was gathered through various forms of data collection by a subset group of committee members. The visits took place over a three-month span in fall of 2017 with the goal of capturing “... promising models, policies, practices, and/or strategies to help propel more students toward degree attainment in science, technology, engineering, and mathematics (STEM) fields and toward strong preparation for success in STEM careers [14, p. 187].” The selection process of the nine institutions included discussions amongst individuals within organizations including the University of Pennsylvania’s Center on Minority Serving Institutions (CMSI), the United Negro College Fund, Hispanic Association of Colleges and Universities, American Indian Higher Education Consortium, and the Asian & Pacific Islander American Scholarship Fund. The report states that the committee did their best to create a list of institutions that was diverse in student population, size, and geographic location. Additionally, while the committee would have desired to visit and engage with more institutions for the report, financial and time-sensitive resources set the final count at that total.

Table 3: Selected Institutions and Demographic Information

	Institution	Designation	Governance	Type	Location
1	Dillard University*	HBCU	Private	Four-year	New Orleans, LA
2	Mission College	AANAPISI	Public	Two-year	Santa Clara, CA
3	Morgan State University*	HBCU	Public	Four-year	Baltimore, MD

4	North Carolina A&T University*	HBCU	Public	Four-year	Greensboro, NC
5	Salish Kootenai College	TCU	Public	Four-year	Pablo, MT
6	San Diego State University	HSI	Public	Four-year	San Diego, CA
7	University of Texas Rio Grande Valley	HSI	Public	Four-year	Pharr, TX
8	West Los Angeles College	HSI	Public	Two-year	Culver City, CA
9	Xavier University*	HBCU	Private	Four-year	New Orleans, LA

Note: *=*ABET accredited HBCU*

Based on the purpose and background of the report, data collection process and a review of the literature on STEM and engineering education at HBCUs, the following research question was investigated:

What are the potential implications for engineering education at Historically Black Colleges and Universities (HBCUs) as a result of the information shared within the Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce report?

Methodology

The document analysis research methodology was used to triangulate and examine the information from the National Academy of Science, Engineering, and Medicine report *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce* and other literature not used within the report. Document analysis is a systematic research methodology used for both qualitative and quantitative data analysis. In order to seek convergence and corroboration, researchers use at least two resources, which include different data sources and methods [16]. Corroborating findings across data sets can reduce the impact of potential bias by examining information collected through different methodologies. Overall, this study consists of a rigorous document analysis to summarize information directly tied to HBCUs including, but not limited to, background of authors, the institutional selection process, and review of literature cited, how HBCUs are represented and recommendations for future work. Research findings were compared to prior literature and synthesized to provide support and

guidance that will help add high-quality knowledge to the body of literature for future research, policy and practice.

Findings from the Report

Fundamental Information on HBCUs

The report focused on several areas including examining MSIs and the students they serve by institution type (e.g., HBCU, Hispanic Serving Institutions (HSIs), Tribal Colleges Universities (TCUs)), MSI investment and their institutional return on investment (ROI), successful strategies and policies at current MSIs, and provided recommendations for influential change through the use of MSIs in research, programming and education. To answer the research question, a rigorous document analysis of the report was conducted and synthesized with previous literature focused on STEM and engineering education, more specifically, at HBCUs. The authors begin by clearly articulating the difference between *enrollment-defined* and *historically-defined* MSIs with the latter representing HBCUs and TCUs. HBCUs were established with the purpose of providing access to higher education for Blacks [17]. Prior to the Civil War, Blacks, not yet recognized as American citizen, were denied access to established higher education throughout most of the United States.

Students, Faculty and Finances

Student Diversity and STEM Disciplines

An analysis of IPEDS data for the Fall 2016 semester showed that 43.7% of HBCU undergraduate enrollment were students pursuing STEM degrees versus non-MSIs (40.0%). Of the 43.7% HBCU STEM population, 81.2% identified as African American or Black whereas the remaining students identified as non-Black. Consequently, the non-African American and Black population on HBCU campuses has continued to grow [6]. Although the importance of two-year MSIs and STEM education and data surrounding their impact was shared in the report, the authors also identified the need for additional research on this subject [15, p. 55].

Faculty and Leadership Diversity

At two-year public HBCUs, 48.1% of the faculty were Black and at two-year private HBCUs, 88.7% were Black. For four-year HBCUs, 53% were Black at public institutions versus 63.7% at four-year private HBCUs. Overall, 48.9% of all STEM faculty at HBCUs identified as African American or Black compared to 3.0% at non-MSIs. They also noted that 64.5% of presidents at MSIs identified as White.

Students Financial Needs

When looking at Pell Grant eligibility, for both two-year and four-year HBCUs, public, and private, their students accounted for the highest percentage of those receiving funds of any ethnic groups and students at non-MSIs. For example, 65.6% of students at four-year public HBCUs and 74.3% of students at four-year private HBCUs were Pell Grant eligible compared to only 33.7% (public) and 35.3% (private) of students at four-year non-MSIs [15, pp. 60-62].

Investments in STEM at HBCUs

The Department of Education (DOE) is a major financial contributor MSIs and the funds processed through capacity-building grants under two designations: Title III and Title V of the Higher Education Act (HEA). The goal of the grants are to support and strengthen “...the institutions’ academic quality and provide expanded educational opportunities for low-income students through a specified list of allowable activities that include faculty development, facility construction, and academic programs [15, p. 79].” Title III, Part B is specifically focused on HBCUs [18]. The top six federal agencies providing STEM education related funds include Department of Health & Human Services, National Institutes of Health, National Science Foundation, Department of Defense, Department of Agriculture, Department of Energy, and National Aeronautics and Space Administration. In 2015, the total funds for science and engineering research, education, and infrastructure support was \$30.5 billion. MSIs received \$783 million of that total and \$539 million of those funds were awarded to 20 of the 700+ MSIs, according to a report by the National Science Foundation [19]. The report shared that 54% of public four-year HBCUs depend on government and federal funding in comparison to 38% of four-year non-HBCUs. HBCUs received less than 3.0% of each of the budgets from the six agencies listed above excluding the Department of Agriculture (12.0%).

Production of Blacks in STEM and Economic Impact

HBCUs awarded 15.6% of all STEM bachelor’s degrees awarded to Blacks and African Americans according to IPEDS data in 2016. Additionally, 10 HBCUs made the top 20 list for awarding the most science and engineering degrees to Blacks and North Carolina A & T University is the top producer for bachelor’s and master’s degrees in engineering. The report also highlighted similar findings shared previously in this report on the role of HBCUs being the top baccalaureate-origin institutions for Blacks who go on to successfully complete Ph.Ds. in science and engineering highlighting Howard University, Clark-Atlanta University, and Jackson State University. According to the United Negro College Fund [20], it is estimated that HBCU graduates will have an estimated \$130 billion dollar total in lifetime earnings. These figures are greatly influenced by the number of Blacks who go onto receive the terminal degrees mentioned above.

Campus Culture, Partnerships and Programming

The authors provide a thorough overview of the positive campus climate and supportive culture that HBCUs provide which as has well-documented in the literature. Higher levels of ongoing, sustained, and authentic relationships with faculty and staff are mentioned as key contributors towards HBCUs success in educating and graduating Blacks in STEM [9]. As a result of the well-documented success with HBCUs in STEM, several organizations, such as Northrop Grumman, Airbnb, Microsoft, Intel and Google, have partnered with the institutions. A \$6 million pledge from Boeing through the Thurgood Marshall College Fund (TMCf), an organization that focuses specifically on HBCUs. Other major partnerships and funded projects included Howard University and funding from the NSF along with major partnerships between Northrop Grumman Foundation and the National Society of Black Engineers (NSBE) geared at increasing the national number of Black engineers by 2025.

Moving Forward: Recommendation for Impactful Change

The authors close out the report [15] by highlighting the need for *intentionality* within the strategies shared as ways to shift and support MSIs as they work to contribute to the STEM workforce at higher capacities. The lack of rigorous research, program evaluation and other avenues for informing decisions linked to ‘what works’ at MSIs was stressed. The committee went on to challenge MSI stakeholders to “...*initiate a substantial, and potentially uncomfortable, shift in their thinking*” as well as asking the various individuals and partners involved on the project “... *to approach these recommendations with a heightened sense of urgency and an ever-present focus on intentionality*” [p. 160]. Following those notes, there were a total of 10 detailed recommendations made within the following four major categories: (1) cultivate a culture of success through strong leadership, (2) establish new and expand current public — and private — sector partnerships (3) create new and expand current financial investments and (4) improve the assessment of MSI performance and accountability.

Synthesized Literature with Report Findings

Research, Funding, Equity and Access

Of the 11 HBCUs with R2 status, seven have ABET accredited engineering programs. More importantly, all of the remaining four R2 HBCUs and an extensive list of other HBCUs have either a dual engineering program and/or computer science (CS) program feeding into an ABET engineering and CS programs at PWIs who are frequently listed as top institutions graduating high quantities of Black engineers including Georgia Tech University [21]. From a funding standpoint, according to Toldson & Preston [22], for fiscal year (FY) 2014, only 0.8% of all funds allocated to all higher education institutions for research and development purposes were given to HBCUs (\$34.8 million of \$4.1 billion). Additionally, HBCUs only held one grant out of 286 active ECR awards and only 4 of 3,302 active CAREER (non-education research) awards. With funds from NSF, Toldson [23] conducted two focus group interviews ($N = 8$ and $N = 7$)

with assistant and associate professors who currently held STEM faculty positions at HBCUs to better understand their drivers and barriers to success with submitting NSF proposals. Participants noted developing relationships and changing one's mindset as drivers for success, suspicions, and skepticism with the intentions of individuals at PWIs as well as certain faculty members within their own institutions as barriers to success.

Additionally, according to Mfume [24], there is little literature that focuses on large-scale retention and graduation strategies at HBCUs, overall, along with very few of those studies being conducted by HBCU faculty, staff or administrators. These findings feed into a larger conversation of funding and resource equity including state allocation of funds and other issues such as duplication of programs leading to declining enrollments at HBCUs [25].

In order for HBCUs to be competitive with the contemporary context of higher education, equitable funding models must be implemented on the federal and state levels. While there have been efforts to directly increase research capacity at HBCUs particularly within engineering education, this report stresses that there is still extensive work that needs to be done in order to better utilize HBCUs [26], [27].

The Role and Production of STEM Teachers

Despite the fact that many African American students have less access to adequate and/or advanced math and science courses during their high school careers, some go on to earn bachelor's, master's, and terminal degrees in STEM. Those who go on to earn an advanced or terminal degree in STEM are likely to be graduates of an HBCU. In fact, 21 HBCUs have provided the undergraduate education for 20 percent of all of the Black STEM doctorates conferred between 2002 and 2011 [5].

Even before Black terminal degree holders graduate, many of them have earned a bachelor's degree from an HBCU. At the turn of the century, studies indicated that 40% of African Americans graduating with a bachelor's degree in biological sciences matriculated at an HBCU [28]. This 40% finding is also true for bachelor's degrees awarded to African Americans in other STEM fields, including physics, chemistry, astronomy, environmental sciences, and mathematics [28].

To increase the number of Black students enrolling and graduating from STEM programs at the collegiate level, it is vital that students are properly prepared to take rigorous math, science, and engineering courses once they enroll in college. Just as the strength of HBCU faculty members and instructors play a significant role in a student's decisions to pursue an advanced STEM degree, strong K-12 math and science educators in urban schools are essential to the academic decisions of Black, oftentimes low-income, high school students who typically enroll in HBCUs

[29]. Thus K-12 educators of STEM subjects are essential to the process of properly preparing high school students for successfully completing rigorous STEM coursework when they arrive on college campuses.

In order to ensure there are strong K-12 STEM teachers in every high school in America, especially those lagging in resources and falling behind statistically based on standardized test scores, policy makers at the state and local levels must support teacher preparation programs effectively enrolling and graduating Black teachers. Founded primarily with the goal of training students to become teachers, HBCUs are training a “significant percentage” of the nation’s Black educators. They train just 2 percent of the nation’s teachers overall but 16 percent of African-American teaching candidates [30].

Though there have been federal programs aimed at answering the call for more minority teachers such as TEACH (Teacher Education and Compensation Helps) and the HBCU School Linkage Program [31], there is much work to be done. Supporting HBCU schools of education in their effort to strengthen the overall pipeline of minority teachers is vital for policy makers on the local, state, and federal levels. In order to close the STEM achievement gap, supporting teacher preparation programs that are successfully developing teachers of color must become a priority.

Policy Implications

One example of how this report can be used to the benefit of HBCUs pertains to current and future litigations against the government due to inequitable access to resources. Historically, there have been several lawsuits filed by HBCUs against states for reasons including inequitable funding and discrimination linked to program duplication. One example includes case 1:06-cv-02773-CCB court documents covering litigation between the Coalition for Equity and Excellence in Maryland Higher Education (MHEC), et. al. (Plaintiffs-Appellees) vs. Maryland Higher Education Commission, et. al. (Defendants-Appellants). This lawsuit filed by the four public HBCUs within the state of Maryland (Morgan State University, Coppin State University, Bowie State University, and the University of Maryland at Eastern Shore) for historic, ongoing inequitable funding practices and program duplications approved for PWIs including engineering degrees at Morgan State University. As stated in one case filing, “Defendant MHEC has approved programs in Engineering at the University of Maryland Baltimore County (UMBC) duplicating programs already in existence at Morgan State University. MHEC approved masters and doctorate engineering programs at UMBC, duplicating those programs offered by Morgan State since 1997” [29, p. 19]. When lawyers on this case reviewed and cited literature to assist plaintiffs with their lawsuit, research from Dr. Marybeth Gasman (a consult on the MSI report analyzed for this study) was included [33]. While analyzing the list of remaining references and comparing them with the *Minority Serving Institutions: America’s Underutilized Resource for*

Strengthening the STEM Workforce report, this study would have been one of the most informative and influential documents presented.

Discussion

The information and findings shared in the *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce* report have included much needed increased — and past due — visibility for HBCUs which should open the door to varying opportunities for HBCUs. Data related to enrollment numbers, graduation rates, fund allocations by MSI type, and success metrics were all included to highlight the overwhelming influential impact HBCUs have had within the United States. However, when focusing on engineering at HBCUs, very little new information was reported. This is not surprising, however, considering the report aimed to cover all of STEM education at the varying MSIs. Based on the findings from our rigorous document analysis of the report combined with synthesizing of current literature, there were two major conclusions drawn. First, there is a need for increased efforts to advance and expand quantitative research related to the role of HBCUs in graduating Black engineers including dual engineering programs with PWIs. Secondly, an analysis of research and practice-based funding allocations for engineering at HBCUs should be conducted.

Conclusion

By highlighting model programs and processes, thoroughly examining challenges faced by MSIs on their path to producing the diverse students needed in the STEM workforce, this report provided a thorough and in-depth synthesis of the current state of STEM at MSIs, an examination that was not previously available. Given the need to invest more in understanding and researching STEM education across the pipeline to increase access to innovative and sustainable techniques, this report provided a roadmap for researchers within both policy and practice to do so. For HBCUs, the *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce* report clearly articulates the importance of increasing capacity at HBCUs in STEM. Additional literature and research findings linked to HBCUs success in other academic areas and the policy implications linked to that suggest that more in-depth studies on HBCUs and other MSIs should be conducted with regard to this report. Essentially, the United States is negatively affected its own progress by not investing resources into these institutions and, if that is reversed, the nation would greatly benefit. This includes collaborations across MSIs and non-MSIs, increases in funding from the public and private sectors to HBCUs, and HBCUs obtaining the resources needed to focus more on broader STEM workforce opportunities. If the recommendations shared within the report are pursued by researchers at non-HBCUs (PWIs & other MSI types) through avenues such as research collaborations, partnerships and sharing of resources and best practices, HBCUs could greatly increase the number of students they recruit, retain, and graduate from STEM programs, especially in engineering. In closing, further research, qualitative, and quantitative surrounding the impact and role of HBCUs in the production of Black engineers could greatly influence and

affect the competitive advantage the U.S. has within the STEM workforce and add to the body of literature.

References

- [1] “20 USC § 1061,” *United States Code*, 2010. [Online]. Available: <https://www.govinfo.gov/content/pkg/USCODE-2010-title20/html/USCODE-2010-title20-chap28.htm>.
- [2] S. Seymour and J. Ray, “Grads of Historically Black Colleges Have Well-Being Edge,” *GALLUP*, 2015. [Online]. Available: <https://news.gallup.com/poll/186362/grads-historically-black-colleges-edge.aspx>. [Accessed: 02-Feb-2018].
- [3] J. New, “Positive News for HBCUs,” *Inside Higher ED*, 2015. .
- [4] National Research Council, “Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads,” Washington DC, 2011.
- [5] M. K. Fiegenger and S. L. Proudfoot, “Baccalaureate Origins of U . S . -trained S & E Doctorate Recipients (NSF 13-323),” Washington DC, 2013.
- [6] M. Gasman, “The Changing Face of Historically Black Colleges and Universities,” 2013.
- [7] E. W. Owens, A. J. Shelton, C. M. Bloom, and J. K. Caviel, “The significance of HBCUs to the production of STEM graduates: Answering the call.,” *Educ. Found.*, vol. 26, no. 3–4, pp. 33–47, 2012.
- [8] M. Gasman and T.-H. Nguyen, “Historically Black Colleges and Universities (HBCUs): Leading Our Nation’s Effort to Improve the Science, Technology, Engineering,” *Texas Educ. Rev.*, vol. 2, no. 1, pp. 75–89, 2014.
- [9] L. Perna *et al.*, “The contribution of HBCUs to the preparation of African American women for STEM careers: A case study,” *Res. High. Educ.*, vol. 50, no. 1, pp. 1–23, 2009.
- [10] G. Crisp, A. Nora, and A. Taggart, “Student characteristics, pre-college, college, and environmental factors as predictors of majoring in and earning a STEM degree: An analysis of students attending a Hispanic-serving institution.,” *Am. Educ. Res. J.*, vol. 46, pp. 924–942, 2009.
- [11] United States Commission on Civil Rights, “The educational effectiveness of historically Black colleges and universities,” Washington DC, 2010.
- [12] L. Deen, “The 15 ABET-Accredited Historically Black College and University Engineering Schools: Engineering Programs,” *U.S. Black Engineering & Information Technology*, 2019. .
- [13] H. Reports, “Texas Southern Adds Two New Engineering Degree Programs,” *HBCU Lifestyle*, 2014. [Online]. Available: <https://hbculifestyle.com/tsu-new-engineering-degrees/>.
- [14] Texas Southern University, “Enrollment Data,” 2019. [Online]. Available: <http://www.tsu.edu/about/administration/institutional-effectiveness/enrollment-data/>.
- [15] and M. National Academies of Sciences, Engineering, “Minority Serving Institutions: America’s Underutilized Resource for Strengthening the STEM Workforce,” Washington DC, 2019.
- [16] G. A. Bowen, “Document Analysis as a Qualitative Research Method,” *Qual. Res. J.*, vol.

- 9, no. 2, pp. 27–40, 2009.
- [17] M. Gasman, N. T., and C. F. Conrad, “Lives Intertwined: A Primer on the History and Emergence of Minority Serving Institutions,” *J. Divers. High. Educ.*, vol. 8, no. 2, pp. 120–138, 2015.
 - [18] L. Espinosa, J. M. Turk, and M. Taylor, “Pulling Back the Curtain: Enrollment and Outcomes at Minority Serving Institutions,” Washington DC, 2017.
 - [19] National Science Foundation, “Federal Science and Engineering Obligations to Universities and Colleges Declined 2% in FY 2015,” Washington DC, 2017.
 - [20] U. N. C. F. UNCF, “HBCUs Make America Strong: The positive economic impact of historically black colleges and universities,” Washington DC, 2017.
 - [21] C. K. Sidbury, J. S. Johnson, and R. Burton, “Spelman’s Dual-Degree Engineering Program: A path for engineering diversification,” in *Changing the Face of Engineering: The African American Experience*, J. B. Slaughter, Y. Tao, and W. J. Pearson, Eds. Baltimore, MD: John Hopkins University Press, 2015, pp. 335–353.
 - [22] I. Toldson and D. Preston, “How HBCUs Can Get Federal Sponsorship from the National Science Foundation,” *White House Initiative on Historically Black Colleges and Universities*, 2015. [Online]. Available: <https://sites.ed.gov/whhbcu/2015/08/17/how-hbcus-can-get-federal-sponsorship-from-the-national-science-foundation/>.
 - [23] I. A. Toldson, “Drivers and Barriers of Success of HBCU Researchers Submitting STEM Proposals to the National Science Foundation,” *J. Negro Educ.*, vol. 86, no. 4, pp. 415–421, 2017.
 - [24] T. B. Mfume, *What works at Historically Black Colleges and Universities (HBCUs): Nine Strategies for Increasing Retention and Graduation Rates*. Rowman & Littlefield, 2015.
 - [25] K. Woodhouse, “An HBCU Fights to Survive,” *Inside Higher ED*, 2015. .
 - [26] Y. L. Watson and N. L. Fortenberry, “Work in Progress: Strengthening Engineering Education Research at Historically Black Colleges and Universities,” in *Proceedings. Frontiers in Education. 36th Annual Conference*, 2006.
 - [27] E. T. Cady and N. L. Fortenberry, “Work in Progress- strengthening HBCU engineering education research capacity,” in *2007 37th Annual Frontiers in Education Conference- Global Engineering: Knowledge without borders, Opportunities without passports*, 2007.
 - [28] W. Cronkite and F. Frankel, *America’s Investment in the future: NSF celebrating 50 years*. Arlington: National Science Foundation, 2000.
 - [29] M. Gasman, “Comprehensive Funding Approaches for Historically Black Colleges and Universities,” 2010.
 - [30] N. Roberts, “HBCUs Have Unique Role In Training Skilled Black Educators,” *News One*, 2017. .
 - [31] L. Walker, “Top 10 HBCUs that Produce Teachers,” *HBCU Lifestyle*, 2015. [Online]. Available: <https://hbculifestyle.com/top-10-hbcu-teachers/>.
 - [32] U. S. D. C.-D. of Maryland, “The COALITION FOR EQUITY AND EXCELLENCE IN MARYLAND HIGHER EDUCATION, INC. vs. MARYLAND HIGHER EDUCATION COMMISSION,” 2015.
 - [33] U. S. C. of A. for the F. Circuit, “THE COALITION FOR EQUITY AND EXCELLENCE IN MARYLAND HIGHER EDUCATION, et al., Plaintiffs-Appellees, vs. MARYLAND HIGHER EDUCATION COMMISSION, et al., Defendants-Appellants.,” 2018.

