

The Contribution of HBCU's to the Production of African American Female Undergraduate STEM Graduates

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ABSTRACT

Despite national efforts to broaden participation in science, technology, engineering, and mathematics (STEM), African American women remain underrepresented in several high-demand STEM disciplines, particularly engineering, computer science, and the physical sciences. This study examines the role of Historically Black Colleges and Universities (HBCUs) in the production of STEM bachelor's degrees among African American females using national data from the Integrated Postsecondary Education Data System (IPEDS) from 2014 to 2023. Grounded in critical race-informed STEM frameworks and Black feminist thought, the study draws on theories of intersectionality, belonging, persistence, and identity development to document longitudinal trends across institutional types and disciplines. Findings reveal that HBCUs produce a disproportionately large share of African American female STEM graduates—nearly one in four nationally—despite enrolling a relatively small proportion of students. HBCUs demonstrate particularly strong contributions in biomedical sciences, engineering, mathematics, and the physical sciences. These findings underscore the importance of institutional context in fostering persistence and success among African American women in STEM and position HBCUs as essential national infrastructure for advancing both racial and gender equity in STEM education.

Keywords: Historically Black Colleges and Universities; STEM education; African American males; degree attainment; critical race theory; institutional context; IPEDS; equity in higher education

Introduction

The demand for a highly skilled workforce in science, technology, engineering, and mathematics (STEM) continues to grow in the United States; however, higher education institutions have not produced STEM graduates in sufficient numbers or with sufficient racial and gender equity to meet national workforce needs (National Science Board, 2024; National Academies of Sciences, Engineering, and Medicine [NASEM], 2011). Although overall STEM degree production has increased, African American women remain significantly underrepresented in several STEM fields, particularly engineering, computer science, mathematics, and the physical sciences, reflecting persistent structural inequities in access, persistence, and degree completion (NASEM, 2016; Ong et al., 2011).

These disparities are not attributable to individual deficits in ability or aspiration but are instead the result of systemic and institutional barriers embedded within historically exclusionary STEM educational environments. Critical race and intersectional STEM scholarship demonstrates that African American women experience layered forms of marginalization shaped by both racism and sexism, often encountering environments that question their competence, limit their access to mentorship, and undermine their sense of belonging (Collins, 2000; Crenshaw, 1989; McGee, 2020).

Even when African American women enter college with strong academic preparation and STEM aspirations, they are disproportionately filtered out through competitive “gatekeeper” courses, grading practices, and departmental cultures that privilege dominant norms of whiteness and masculinity (Carlone & Johnson, 2007; NASEM, 2016). These conditions contribute to intersectional attrition in STEM majors and reinforce patterns of exclusion within high-demand disciplines.

Within this context, Historically Black Colleges and Universities (HBCUs) play a critical and often underrecognized role in supporting African American women in STEM. Despite enrolling a relatively small proportion of the national undergraduate population, HBCUs produce a disproportionate share of African American STEM graduates, including women across engineering, health sciences, and technology fields (Perna et al., 2009). These institutions function as culturally responsive and identity-affirming environments that promote academic integration, belonging, and STEM identity development (Harper, 2010; Strayhorn, 2019; Weidman, 1989).

Using national degree-completion data from the Integrated Postsecondary Education Data System (IPEDS), this study examines the role of HBCUs in producing undergraduate STEM degrees among African American women between 2014 and 2023. Grounded in critical race

theory and Black feminist epistemology, this analysis situates STEM degree production within broader systems of power, institutional context, and historical inequity. By disaggregating outcomes by discipline and institutional type, the study provides empirical evidence of how HBCUs continue to serve as vital contributors to STEM workforce diversification and Black women's educational advancement.

Review of Literature

Persistent Racial and Gender Inequities in Undergraduate STEM Education

Despite decades of national initiatives aimed at broadening participation in science, technology, engineering, and mathematics (STEM), significant inequities persist at the intersection of race and gender. African American women remain underrepresented in high-demand STEM disciplines such as engineering, computer science, mathematics, and the physical sciences, even as overall STEM degree production has increased (NASEM, 2011, 2016). This pattern indicates that expansion in STEM education has not translated into equitable access or representation.

Scholars argue that these inequities are not the result of differences in ability or interest but are instead rooted in the structural and cultural organization of STEM education, which continues to reflect norms associated with whiteness, masculinity, and elite institutional culture (McGee, 2020; Ong et al., 2011). African American women in STEM navigate systems that simultaneously racialize and gender their identities, shaping how they are perceived, supported, and evaluated within academic environments.

Black feminist thought (Collins, 2000) and intersectionality theory (Crenshaw, 1989) provide essential frameworks for understanding these dynamics. African American women often experience “intersectional invisibility,” wherein their experiences are marginalized within both racial and gender hierarchies, rendering their contributions less visible and less recognized in STEM spaces (Ong et al., 2011).

Gatekeeping, Attrition, and Intersectional Barriers in STEM Pathways

Early undergraduate STEM coursework—particularly in mathematics, science, and engineering serves as a primary site of attrition. These “gatekeeper” courses are often characterized by high-stakes assessment structures, limited instructional support, and competitive academic cultures that disproportionately disadvantage underrepresented students (NASEM, 2016).

For African American women, these barriers are intensified by intersectional dynamics that shape both academic performance and identity development. Traditional persistence models,

such as Tinto's theory of academic integration (Tinto, 2012), emphasize institutional engagement but often fail to account for how race and gender shape access to integration opportunities.

Critical STEM scholarship extends these models by demonstrating that attrition reflects not only academic preparation but also structural exclusion from mentoring networks, research opportunities, and identity-affirming spaces (McGee, 2020; Ong et al., 2011). These exclusionary conditions contribute to diminished STEM self-efficacy, weakened sense of belonging, and increased likelihood of switching out of STEM majors among African American women.

Sense of Belonging, STEM Identity, and Black Feminist Perspectives

Sense of belonging is a central predictor of persistence in higher education. Strayhorn (2019) defines belonging as the extent to which students feel accepted, supported, and valued within academic environments. For African American women in STEM, however, belonging is shaped by structural conditions rather than individual perception alone.

Science identity research highlights the importance of recognition in STEM persistence. Carlone and Johnson (2007) argue that STEM identity is constructed through competence, performance, and recognition. African American women often demonstrate strong competence and performance but are denied recognition in environments shaped by racialized and gendered expectations of scientific legitimacy.

From a Black feminist perspective, STEM identity formation must be understood as an intersectional process in which African American women navigate both racial and gender oppression while asserting their intellectual authority (Collins, 2000; Ong et al., 2011). In the absence of institutional validation, these students often experience identity strain that can hinder persistence.

Conversely, identity-safe environments that affirm both racial and gender identities have been shown to strengthen STEM persistence. Such environments foster confidence, academic engagement, and long-term commitment to STEM pathways.

HBCUs as Intersectional Counter-Spaces in STEM Education

Historically Black Colleges and Universities (HBCUs) play a vital role in supporting African American women in STEM. Although they enroll a relatively small share of the national undergraduate population, HBCUs produce a disproportionately high share of African American STEM graduates, including women across multiple disciplines (Perna et al., 2009).

HBCUs function as institutional counter-spaces that challenge dominant deficit narratives and affirm Black intellectual identity (Harper, 2010; McGee, 2020). From a Black feminist STEM perspective, these institutions provide intersectional support by addressing both racial and gendered marginalization.

Key institutional features—such as close faculty mentoring, culturally responsive pedagogy, and mission-driven commitments to Black excellence—promote academic and social integration (Weidman, 1989). These environments enhance STEM identity development by providing recognition, validation, and access to supportive academic networks.

Empirical research suggests that African American women in HBCUs experience stronger belonging and persistence in STEM fields compared to peers in predominantly White institutions (PWIs), particularly in high-demand disciplines such as biomedical sciences, engineering, and health-related STEM fields (Perna et al., 2009).

Gaps in the Literature and Study Contribution

While existing research has documented STEM disparities and the role of HBCUs, several gaps remain. First, African American women are often under-centered in STEM persistence research, which frequently aggregates racial groups or focuses primarily on men. Second, much of the literature relies on case studies or limited institutional samples, restricting generalizability.

Additionally, few studies examine longitudinal, national-level data that disaggregate STEM outcomes by both discipline and institutional type. As a result, the mechanisms through which HBCUs support African American women in STEM remain underexplored at scale.

This study addresses these gaps by using IPEDS national degree-completion data (2014–2023) to examine STEM outcomes for African American women across institutional contexts. Grounded in critical race theory and Black feminist epistemology, this analysis provides a national-level empirical assessment of how HBCUs contribute to STEM degree attainment among African American women across disciplines.

Methods

The data for this study were derived from the Integrated Postsecondary Education Data System (IPEDS) for the academic years 2014 through 2023, as compiled by the U.S. Department of Education (2024). IPEDS, managed by the National Center for Education Statistics (NCES), serves as a comprehensive national database, offering detailed information on postsecondary institutions in the United States. The dataset provides insights into institutional characteristics, enrollment, degree completions, and demographic profiles of graduates, making it an ideal

source for examining patterns in STEM degree conferrals among African American male students.

Sample Selection

The study focused specifically on African American female students who earned undergraduate degrees in science, technology, engineering, and mathematics (STEM) fields. The sample was limited to four-year postsecondary institutions that conferred bachelor's degrees or higher. Institutions classified as two-year or less-than-two-year were excluded from the analysis.

Using institutional characteristics data from IPEDS, a total of 2,726 degree-granting institutions met the inclusion criteria. These included public (n = 733), private not-for-profit (n = 1,536), and private for-profit (n = 457) institutions. Among this group, 90 institutions were designated as Historically Black Colleges and Universities (HBCUs), as defined by the U.S. Department of Education.

Identification of STEM Fields

STEM fields were identified using the Classification of Instructional Programs (CIP) codes, which categorize academic programs by discipline. Seven major CIP codes were selected to represent STEM fields based on guidelines from the National Science Foundation (NSF, 2023). These included:

- CIP Code 11: Computer and Information Sciences and Support Services Includes programs in general computer science, programming, data processing, information science, software applications, networking, and systems management.
- CIP Code 14: Engineering Encompasses a broad array of sub-disciplines, including aerospace, biomedical, civil, chemical, electrical, mechanical, computer, and materials engineering.
- CIP Code 15: Engineering Technologies and Engineering-Related Fields Includes architectural, civil, electrical, nuclear, and industrial engineering technology programs, as well as quality control and safety.
- CIP Code 26: Biological and Biomedical Sciences Covers biology, biochemistry, botany, cell biology, zoology, pharmacology, genetics, bioinformatics, and related areas.
- CIP Code 40: Physical Sciences Includes programs in chemistry, physics, astronomy, atmospheric sciences, geology, and earth sciences.

Programs classified under science technologies (e.g., CIP Code 41) were excluded from the analysis due to the relatively small number of degrees awarded in this area during the study period.

Data Analysis

The primary objective of the analysis was to assess the contribution of HBCUs to the production of African American male graduates in STEM disciplines. To achieve this, the study employed a quantitative, descriptive approach. Frequency counts were conducted to identify the total number of STEM degrees awarded to African American female students between 2014 and 2023 across all eligible institutions. These counts were disaggregated by institutional classification (HBCU vs. non-HBCU) and by STEM field as defined by CIP code.

Subsequently, percentage distributions were calculated to determine the proportion of African American male STEM graduates who earned degrees from HBCUs compared to those who graduated from non-HBCUs. This enabled a comparative assessment of the relative impact of HBCUs on the national pool of African American male STEM graduates over the ten-year study period.

Results

The results presented in Table 1 highlight the significant and sustained role of Historically Black Colleges and Universities (HBCUs) in the production of African American female graduates in STEM fields over a ten-year period (2014–2023). Across all universities, the total number of bachelor's degrees awarded to African American females in STEM increased steadily from 8,775 in 2014 to 13,847 in 2023, reflecting a substantial growth in overall participation and degree attainment within this population.

HBCUs contributed a notable portion of these graduates each year. In 2014, HBCUs awarded 2,580 STEM degrees to African American females, accounting for 29% of the national total. Although the absolute number of degrees awarded by HBCUs remained relatively stable—with some fluctuation and a peak of 3,132 in 2021—their proportional contribution declined over time. By 2023, HBCUs awarded 2,999 degrees, representing 22% of all such degrees conferred nationwide.

Over the full study period, HBCUs produced 27,317 African American female STEM graduates out of a total of 114,598 degrees awarded across all institutions, accounting for approximately 24% of the total. This indicates that nearly one in four African American women earning STEM bachelor's degrees graduated from an HBCU.

The observed trend suggests that while predominantly White institutions (PWIs) and other non-HBCU institutions have increased their production of African American female STEM graduates at a faster rate, HBCUs continue to play a critical and disproportionate role relative to their size and enrollment. Despite representing a small fraction of U.S. higher education institutions, HBCUs consistently contribute a substantial share of African American female STEM graduates.

In summary, the data underscore the enduring importance of HBCUs as key institutional contributors to the STEM pipeline for African American women. While their proportional share has modestly declined due to broader increases across all universities, their absolute contributions remain strong, reaffirming their central role in advancing diversity within STEM fields.

Table 1: Number of Bachelor's Degrees Awarded to African Americans Females in STEM Programs: Comparison of All Universities vs. HBCUs

Year	All Universities	HBCUs	Percent from HBCUs
2014	8,775	2,580	29%
2015	9,210	2,444	27%
2016	9,752	2,516	26%
2017	10,477	2,592	25%
2018	10,982	2,615	24%
2019	11,686	2,605	22%
2020	12,494	2,815	23%
2021	13,692	3,132	23%
2022	13,683	3,019	22%
2023	13,847	2,999	22%
Total	114,598	27,317	24%

Note. Data sourced from Integrated Postsecondary Education Data System (IPEDS), U.S. Department of Education (2024).

The results in Table 2 provide a comprehensive overview of the distribution and growth of African American female graduates across STEM disciplines at all universities between 2014 and 2023. Overall, the total number of graduates increased steadily from 8,775 in 2014 to 13,847 in 2023, yielding a cumulative total of 114,598 degrees awarded during the ten-year period. This upward trajectory reflects continued expansion in STEM participation among African American women across higher education institutions.

Across all STEM fields, Biomedical Science emerged as the dominant discipline, accounting for the largest share of degrees awarded each year. The number of graduates in this field grew substantially from 5,086 in 2014 to 7,922 in 2023, with a total of 67,203 degrees over the study period. This represents well over half of all STEM degrees earned by African American females, indicating a strong concentration in health- and life science-related fields.

Computer Science also demonstrated notable growth, increasing from 1,249 graduates in 2014 to 2,809 in 2023. With a total of 18,783 degrees awarded, this field reflects one of the fastest-growing areas of participation, particularly in the latter half of the decade. Similarly, Engineering showed steady gains, rising from 918 graduates in 2014 to a peak of 1,625 in 2022 before slightly declining to 1,584 in 2023, contributing a total of 12,770 degrees.

In contrast, other STEM fields exhibited more modest or fluctuating trends. Physical Sciences remained relatively stable over time, with slight variation year to year and a total of 8,360 graduates. Mathematics showed a gradual decline overall, decreasing from 496 graduates in 2014 to 437 in 2023, with a total of 4,818 degrees. Engineering Technology maintained the smallest share among the disciplines, with minor fluctuations and a total of 2,664 graduates across the ten-year span.

In summary, the data indicate that while African American female participation in STEM has increased overall, this growth is not evenly distributed across disciplines. Biomedical Science continues to dominate degree attainment, while fields such as Computer Science and Engineering are experiencing meaningful growth. Conversely, Mathematics and some applied technical fields show stagnation or decline. These patterns suggest both progress and persistent disparities in field representation, highlighting areas for targeted intervention to broaden participation across the full spectrum of STEM disciplines.

Table 2: Number of African American Females Graduates by STEM Program at All Universities

STEM Program	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Engineering	918	950	1032	1092	1238	1300	1491	1540	1625	1584	12,770
Engineering Tec	218	257	268	269	249	286	283	295	265	274	2,664
Mathematics	496	494	467	473	490	478	499	515	469	437	4,818
Biomedical Science	5086	5442	5887	6311	6412	6863	7343	8012	7925	7922	67,203
Physical Sci	808	761	751	839	908	851	872	923	826	821	8,360
Computer	1249	1306	1347	1493	1685	1908	2006	2407	2573	2809	18,783
Total	8,775	9,210	9,752	10,477	10,982	11,686	12,494	13,692	13,683	13,847	114,598

Note. Data sourced from Integrated Postsecondary Education Data System (IPEDS), U.S.

Table 3: Number of African American Females Graduates Bachelor's Degrees Awarded in Computer Science: Comparing All Universities vs. HBCUs

Year	All Universities	HBCUs	Percent from HBCUs
2014	1249	261	21%
2015	1306	233	18%
2016	1347	229	17%
2017	1493	233	16%
2018	2006	210	10%
2019	1908	231	12%
2020	1685	251	15%
2021	2407	355	15%

2022	2573	330	13%
2023	2809	350	12%
Total	18,783	2,683	14%

Table 3 presents the number of bachelor's degrees awarded to African American women in computer science from 2014 to 2023, comparing all U.S. universities with Historically Black Colleges and Universities (HBCU), using data from the Integrated Postsecondary Education Data System (IPEDS).

Across the decade, computer science degree production for African American females increased, rising from 1249 degrees in 2014 to 2809 degrees in 2023. Despite this overall growth, HBCUs consistently accounted for a relatively modest but stable share of national computer science degree production. Over the ten-year period, HBCUs 2,683 computer science degrees, representing 14% of all computer science degrees earned by African American women.

The proportion of computer science degrees awarded by HBCUs has declined slightly over time, from 21% in 2014 to 12% in 2023. This trend reflects the rapid expansion of computer science programs at non HBCU institutions, particularly large research universities and technology focused programs, rather than a decrease in production at HBCUs themselves. In absolute terms, the number of computer science degrees conferred by HBCUs remained relatively stable during this period.

From an institutional perspective, these findings indicate that HBCUs continue to play a crucial role in producing computer science graduates, particularly for African American women, even as their relative share of degrees has been limited by structural barriers. African American women in STEM face unique challenges, including limited access to cutting edge computing infrastructure, fewer industry partnerships and mentorship opportunities, and the underrepresentation in high profile research programs that can facilitate career advancement. Despite these systemic obstacles, the sustained contribution of HBCUs highlights their ongoing importance in supporting African American women in entering and thriving within the competitive field of computer science.

Table 4: Number of African American Females Graduates Bachelor's Degrees Awarded in Biomedical Science: Comparing All Universities vs. HBCUs

Year	All Universities	HBCUs	Percent from HBCUs
2014	5086	1574	31%
2015	5442	1494	27%
2016	5887	1651	28%
2017	6311	1689	27%
2018	6412	1700	27%
2019	6863	1716	25%
2020	7343	1849	25%
2021	8012	2048	26%
2022	7925	1976	25%
2023	7922	1953	25%
Total	67,203	17,650	26%

Table 4 presents the number of bachelor's degrees awarded to African American women in biomedical science from 2014 to 2023, comparing all U.S. universities with Historically Black Colleges and Universities (HBCUs), using data from the Integrated Postsecondary Education Data System (IPEDS).

Over the ten-year period, the production of biomedical science degrees for African American women remained relatively stable nationally, with modest year-to-year fluctuations. During this time, a total of 67,203 biomedical science bachelor's degrees were awarded to African American women, of which 17,650 (26%) were conferred by HBCUs one of the strongest proportional contributions by HBCUs across all STEM fields examined. Although the proportion of degrees awarded by HBCUs declined slightly from 31% in 2014 to 25% in 2023, HBCUs consistently produced a substantial share of African American women graduates in biomedical science. This

sustained contribution contrasts with trends in computer science, highlighting disciplinary differences in the role of HBCUs within the STEM pipeline.

From an institutional and equity-oriented perspective, HBCUs' strength in biomedical sciences reflects their historical alignment with health-related fields, including preparation for medical, dental, and allied health professions. Biomedical science programs at HBCUs often provide structured advising, close faculty mentorship, and cohort-based learning environments practices shown to support persistence, professional identity development, and a sense of belonging among African American women in STEM.

African American women pursuing STEM degrees frequently encounter barriers such as underrepresentation in rigorous research opportunities, limited access to mentorship and professional networks, and the psychological pressures of stereotype threat and implicit bias. Within biomedical sciences, HBCUs help mitigate some of these challenges by fostering supportive academic environments that enhance retention and success.

Taken together, these findings underscore that HBCUs serve as critical sites for the academic and professional advancement of African American women in biomedical science, a field that provides a primary gateway to advanced study and careers in health and medicine. These results further highlight the importance of institutional context in promoting equitable STEM degree outcomes and addressing persistent structural and social barriers faced by underrepresented groups.

Table 5: Number of African American Females Graduates Bachelor' s Degrees Awarded in Engineering: Comparing All Universities vs. HBCUs

Year	All Universities	HBCUs	Percent from HBCUs
2014	918	215	23%
2015	950	222	23%
2016	1032	224	22%
2017	1092	219	20%
2018	1238	246	20%
2019	1300	240	18%

2020	1491	303	20%
2021	1540	276	18%
2022	1625	329	20%
2023	1584	303	19%
Total	12,770	2,577	20%

Table 5 presents the number of bachelor's degrees awarded to African American women in engineering from 2014 to 2023, comparing all U.S. universities with Historically Black Colleges and Universities (HBCUs), using data from the Integrated Postsecondary Education Data System (IPEDS).

Over the ten-year period, engineering degree production for African American women increased steadily at the national level, rising from 918 degrees in 2014 to a peak of 1,625 degrees in 2022, before slightly declining to 1,584 degrees in 2023. Across all years, a total of 12,770 engineering bachelor's degrees were awarded to African American women nationwide. HBCUs conferred 2,577 of these degrees, representing 20% of all engineering degrees earned by African American women during the study period. This contribution is particularly notable given the relatively small number of engineering programs at HBCUs and the high resource demands associated with engineering education. Although the proportion of degrees awarded by HBCUs declined slightly—from 23–22% in the mid-2010s to roughly 19% in recent years—their contribution remained consistently substantial throughout the decade.

Engineering is widely recognized as one of the most structurally challenging STEM disciplines, characterized by intensive mathematics prerequisites, sequenced curricula, and competitive academic environments. African American women pursuing engineering often encounter additional barriers, including underrepresentation in rigorous research and internship opportunities, limited access to mentorship and professional networks, and the cumulative effects of stereotype threat and implicit bias. From a critical race-informed perspective, the sustained contribution of HBCUs challenges deficit-oriented narratives that attribute underrepresentation to student preparation or ability. Instead, these findings highlight the importance of institutional

context, including supportive pedagogical approaches, structured mentoring, and mission-driven commitments to African American student success.

The results in Table 5 provide strong empirical support for the role of HBCUs as essential institutional anchors for African American women's persistence and degree completion in engineering. Despite operating in a higher education landscape marked by unequal resource distribution, HBCUs continue to be significant producers of engineering talent, underscoring their central role in broadening participation and promoting equity in STEM.

Table 6 presents the number of bachelor's degrees awarded to African American females in engineering technology from 2014 to 2023, comparing all U.S. universities with Historically Black Colleges and Universities (HBCUs), using data from the Integrated Postsecondary Education Data System (IPEDS).

Throughout the ten-year period, a total of 2,664 engineering technology bachelor's degrees were awarded to African American females nationwide. Out of that number, 693 degrees, or 26%, were awarded by HBCUs. This represents the highest percentage contribution by HBCUs across all STEM disciplines examined in this study. This finding clearly shows the strong role HBCUs play in applied and practice-based STEM fields.

Although the total number of degrees awarded by HBCUs in engineering technology slightly declined over time—from 82 in 2014 to 56 in 2023—their proportional contribution remained substantial, decreasing from 38% to 26%. This change reflects broader national trends in engineering technology enrollment, not a lack of involvement from HBCUs.

Engineering technology programs are often built around hands-on learning, clear program structures, and strong relationships between faculty and students. From an institutional and equity perspective, these elements matter. Research shows that African American females are more likely to stay and succeed in STEM environments that offer clear career pathways, real-world application, and consistent support through mentoring. Because of this, the success of HBCUs in engineering technology highlights how the way a program is designed and taught can help reduce barriers that students often face in more abstract or highly competitive STEM fields.

Overall, the findings in Table 6 reinforce that HBCUs play a unique and important role across the STEM landscape. Their impact is especially strong in areas that balance technical skills with applied learning. These results also show why it is important to look at STEM degree outcomes by specific disciplines and by the type of institution, rather than viewing STEM as one general category.

Table 6: Number of African American Females Graduates Bachelor's Degrees Awarded in Engineering Technology Comparing All Universities vs HBCUs.

Year	All Universities	HBCU's	Percent from HBCU's
2014	218	82	38%
2015	257	68	26%
2016	268	68	25%
2017	269	82	30%
2018	249	63	25%
2019	286	70	24%
2020	283	64	23%
2021	295	70	24%
2022	265	70	26%
2023	274	56	20%
Total	2664	693	26%

Table 7 presents the number of bachelor's degrees awarded to African American females in mathematics from 2014 to 2023, comparing all U.S. universities with Historically Black Colleges and Universities (HBCUs), using data from the Integrated Postsecondary Education Data System (IPEDS).

Throughout the ten-year period, a total of 4,818 mathematics bachelor's degrees were awarded to African American females nationwide. Of these, 1,287 degrees (27%) were awarded by HBCUs, reflecting strong proportional contributions in a discipline widely recognized as a foundational gateway to STEM fields. Although mathematics represents a smaller share of total degrees compared to other STEM disciplines, it demonstrated one of the highest HBCU shares across the study period.

Although the percentage of mathematics degrees awarded by HBCUs declined over time—from 33% in 2014 to 23% in 2023—their overall impact remained meaningful. This decrease reflects broader national trends in mathematics degree attainment rather than a decline in HBCU engagement. Instead, it suggests shifts in enrollment patterns and differences in growth across institutional sectors within STEM.

From a critical race-informed perspective, mathematics is not only a gateway but also a barrier to advanced STEM study. African American females often face higher levels of attrition in this field, especially in environments where support and inclusion are limited. The continued proportional contributions of HBCUs in mathematics highlight the importance of learning environments that foster belonging, recognition, and academic confidence. These elements are

critical in helping students persist in disciplines that have historically been shaped by exclusionary norms.

Taken together, the findings in Table 7 reinforce that HBCUs play a critical and necessary role in supporting African American female success in mathematics. These results further highlight that equitable outcomes in STEM are closely connected to institutional environment, mission, and support systems not just student ability.

Table 7: Number of African American Females Graduates Bachelor's Degrees Awarded in Mathematics Comparing All Universities vs HBCUs.

Year	All Universities	HBCU's	Percent from HBCU's
2014	496	163	33%
2015	494	168	34%
2016	467	128	27%
2017	473	149	32%
2018	490	126	26%
2019	478	115	24%
2020	499	113	23%
2021	515	123	24%
2022	469	100	21%
2023	437	102	23%
Total	4818	1287	27%

Table 8 presents the number of bachelor's degrees awarded to African American females in the physical sciences from 2014 to 2023, comparing all U.S. universities with Historically Black Colleges and Universities (HBCUs), using data from the Integrated Postsecondary Education Data System (IPEDS).

Throughout the ten-year period, a total of 8,360 physical science bachelor's degrees were awarded to African American females nationwide. Of these, 2,455 degrees (29%) were awarded by HBCUs, reflecting strong proportional contributions in a discipline often known for rigorous coursework, intensive lab requirements, and competitive academic environments.

Although the percentage of physical science degrees awarded by HBCUs declined over time—from 35% in 2014 to 29% in 2023—their overall impact remained consistent. This trend reflects broader national shifts in STEM enrollment and degree production rather than a reduced role of HBCUs. Notably, HBCUs continued to award between 29% and 35% of all physical science degrees earned by African American females across the decade, highlighting their steady and sustained presence in this field.

From an equity-oriented and critical race-informed perspective, the strength of HBCU contributions in the physical sciences is especially significant. These disciplines have historically limited access for African American females, particularly at predominantly White institutions. Physical science programs often serve as early gatekeepers within STEM pathways. The continued proportional contributions of HBCUs point to the importance of environments that provide mentorship, affirmation, and academic integration. These factors help foster belonging, recognition, and academic confidence, which are essential for persistence in fields that have traditionally been less inclusive.

Taken together, the findings in Table 8 further reinforce that HBCUs play a critical and consistent role in supporting African American female degree attainment across a wide range of STEM disciplines, including those known for high levels of difficulty and attrition.

Table 8: Number of African American Females Graduates Bachelor's Degrees Awarded in Physical Sciences Comparing All Universities vs HBCUs

Year	All Universities	HBCU's	Percent from HBCU's
2014	808	285	35%
2015	761	289	38%
2016	751	216	29%
2017	839	220	26%
2018	908	270	30%
2019	851	233	27%
2020	872	233	27%
2021	923	260	28%
2022	826	214	26%
2023	821	235	29%
Total	8360	2455	29%

The results highlight the leading Historically Black Colleges and Universities (HBCUs) contributing to the production of African American female graduates across major STEM disciplines. These findings underscore the concentration of degree production within a select group of institutions that consistently serve as critical pipelines for African American women in STEM.

In Computer Science, North Carolina A&T State University emerged as the top producer, graduating 417 African American females, followed by Saint Augustine's University with 188 graduates. Other notable contributors include Grambling State University (153), Spelman College (137), Johnson C. Smith University (133), and Alabama State University (131), further illustrating the role of these institutions in expanding participation in computing fields.

In Engineering, Saint Augustine's University stands out as the leading producer with 553 graduates, followed by Cheyney University of Pennsylvania with 302. Additional top institutions include Grambling State University (199), North Carolina A&T State University (181), and Johnson C. Smith University (180), demonstrating a strong cluster of HBCUs contributing to engineering degree attainment.

Within Engineering Technology, Saint Augustine's University again leads with 63 graduates. Other key institutions include Texas College (56), Hampton University (51), North Carolina A&T State University (48), and Texas Southern University (47), indicating a geographically diverse group of contributors.

In Biomedical Science, Xavier University of Louisiana is the dominant institution, producing 944 graduates—by far the highest in this category. It is followed by Grambling State University (848), Simmons College of Kentucky (672), Oakwood University (666), and Spelman College (557). These institutions collectively represent a substantial share of African American female graduates in health-related STEM fields.

For Mathematics and Statistics, LeMoyne-Owen College leads with 90 graduates, followed closely by Spelman College with 85. Additional contributors include Hampton University (53), Alabama State University (45), and Saint Augustine's University (41), reflecting more modest production levels relative to other STEM fields.

Finally, in Physical Sciences, Xavier University of Louisiana again leads with 275 graduates, followed by Simmons College of Kentucky (175), Grambling State University (112), Alabama State University (97), and Spelman College (85).

Overall, the data reveal that a relatively small group of HBCUs consistently appear across multiple STEM disciplines as top producers of African American female graduates. Institutions such as Saint Augustine's University, Grambling State University, Spelman College, and Xavier University of Louisiana demonstrate particularly strong and consistent contributions. This pattern underscores the pivotal role these institutions play in advancing African American female representation across diverse STEM fields.

Table 9: Top Producing HBCU STEM Programs for African-American Female

STEM Discipline	Institution	Number of Graduates
Computer Science	North Carolina A&T State University	417
	Saint Augustine's University	188
	Grambling State University	153
	Spelman College	137
	Johnson C Smith University	133
	Alabama State University	131
Engineering	Saint Augustine's University	553
	Cheyney University of Pennsylvania	302
	Grambling State University	199
	North Carolina A & T State University	181
	Johnson C Smith University	180
Engineering Technology	Cheyney University of Pennsylvania	302
	Texas College	56
	Hampton University	51
	North Carolina A & T State University	48
	Texas Southern University	47
Biomedical Science	Xavier University of Louisiana	944
	Grambling State University	848

STEM Discipline	Institution	Number of Graduates
	Simmons College of Kentucky	672
	Oakwood University	666
	Spelman College	557
Mathematics/Statistics	Le Moyne-Owen College	90
	Spelman College	85
	Hampton University	53
	Alabama State University	45
	Saint Augustine's University	41
Physical Science	Xavier University of Louisiana	275
	Simmons College of Kentucky	175
	Grambling State University	112
	Alabama State University	97
	Spelman College	85

Discussion

The findings of this study provide strong empirical evidence that Historically Black Colleges and Universities (HBCUs) serve as critical institutional sites for the production and advancement of African American women in STEM. Across the ten-year period, African American female participation in STEM increased substantially; however, this growth was uneven across disciplines and institutional contexts. While non-HBCU institutions expanded overall degree production, HBCUs consistently produced a disproportionately large share of African American female STEM graduates relative to their size.

A key finding is the concentration of African American women in biomedical sciences, which accounted for the majority of degrees awarded. In contrast, participation in engineering, computer science, and mathematics remains comparatively lower, reflecting persistent structural barriers within these fields. From a Black feminist STEM perspective, this disciplinary stratification reflects not only access issues but also the ways in which certain STEM fields are culturally and institutionally structured to exclude women of color (Ong et al., 2011).

The strong and sustained contributions of HBCUs in fields such as engineering, mathematics, and the physical sciences challenge deficit-oriented narratives that attribute underrepresentation to student preparation or ability. Instead, these findings highlight the importance of institutional environments that foster belonging, provide sustained mentorship, and affirm the intellectual identities of African American women. HBCUs create conditions that mitigate the intersectional challenges of race and gender by promoting recognition, validation, and academic integration.

Consistent with Black feminist thought, these findings underscore that African American women's success in STEM is not solely an individual achievement but is shaped by collective, relational, and institutional support systems (Collins, 2000). At HBCUs, African American women are more likely to experience faculty engagement, peer support, and culturally responsive pedagogy—factors that contribute to persistence in rigorous STEM disciplines.

At the same time, the declining proportional share of HBCU contributions in rapidly expanding fields such as computer science reflects broader systemic inequities, including disparities in funding, infrastructure, and access to research opportunities. These structural limitations constrain the capacity of HBCUs to scale their impact despite their demonstrated effectiveness. Addressing these inequities requires policy interventions that recognize and support HBCUs as central contributors to the national STEM ecosystem.

Conclusion

This study highlights the critical and enduring role of Historically Black Colleges and Universities in advancing African American women's participation and success in STEM education. Despite representing a small proportion of higher education institutions, HBCUs consistently produce a substantial share of African American female STEM graduates, underscoring their importance as institutional anchors within the national STEM pipeline.

The findings reveal both progress and persistent challenges. While African American women's participation in STEM has increased over time, disparities remain across disciplines, particularly in engineering, computer science, and mathematics. These patterns reflect the intersection of race, gender, and institutional context in shaping STEM pathways.

From a policy perspective, these results call for sustained investment in HBCUs as essential national STEM infrastructure. Expanding mentorship opportunities, strengthening research capacity, and fostering inclusive institutional climates across all universities are critical steps toward achieving equity. Importantly, efforts to broaden participation must move beyond access and address the structural and cultural conditions that influence persistence and success.

Future research should continue to apply intersectional and Black feminist frameworks to examine how African American women navigate STEM pathways across educational and professional contexts. Achieving equity in STEM requires not only increasing representation but transforming into the institutional environments that shape who persists, succeeds, and leads in these fields.

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