

## Historically Black Colleges and Universities Can Promote Leadership and Excellence in STEM

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In 2012, President Barack Obama introduced a plan to increase the number of science, technology, engineering and math (STEM) graduates by 1 million over the next 10 years through the President's Council of Advisors on Science and Technology initiative (Seadler, 2012). Historically Black colleges and universities (HBCUs) play a pivotal role in helping the United States of America achieve a national priority to expand careers in STEM disciplines. HBCUs graduate 40 percent of Black students graduating with degrees in biological science, physics, chemistry, astronomy, environment sciences and mathematics (Jackson, 2013; Owens et al., 2012; Palmer, Davis, & Thompson, 2010).

The purpose of this article is to elucidate factors that are important to the long-term success of HBCUs in preparing STEM students, by summarizes data from the Minority Male STEM Initiative (MMSI), which was collected by The Association of Public and Land-grant Universities (APLU). Although the surveys focused on the needs of minority males, both male and female STEM students participated in the surveys. The purpose of the MMSI surveys were to understand how university administrators, STEM faculty, and students of color in STEM disciplines currently navigate the path to recruiting, retaining and graduating underrepresented students in STEM disciplines.

The original study focused on STEM students from 1,442 underrepresented students across 14 institutions, including 3 HBCUs. However, this report will outline findings that are relevant to HBCUs. Details of the survey instruments, procedures, methods of recruitment, and participants are available in *A Quest for Excellence* (Toldson & Esters, 2012). Survey results revealed a variety of characteristics and practices of the institutions, faculty, and administrators who prepare minority students for STEM fields.

### LESSON LEARNED FROM STEM FACULTY AND UNIVERSITY ADMINISTRATORS

Content analysis methods were used to summarize faculty members' and administrators' optional open-ended comments regarding their universities' commitment to recruiting, retaining and graduating minority students in STEM fields. The number of unique comments made about university practices were identified and then manually sorted into three broad categories: *proactive practices*, *ambivalence* or *indifference*, and *obstructive practices*. SPSS Text Analysis for Surveys was used to facilitate manual coding and sorting of the comments into more discrete categories.

### RECRUITMENT AND OUTREACH

Faculty and administrators were asked to describe any recruitment or outreach activities by their institution specifically designed to encourage underrepresented students to consider a major and career in the STEM disciplines. Of the more than 200 faculty members and administrators who took the survey, only 33 provided a response to this inquiry.

Institutions with proactive practices were able to list specific programs and initiatives that bolstered outreach efforts. Specific programs listed included the National Science Foundation (NSF) Bridge to the Doctorate Program, Alliance for Minority Participation (AMP), Upward Bound, and university-initiated minority programs. Many other university representatives gave statements that reiterated their commitment, which listed specific programs. Several respondents noted that they were not aware of any university initiatives to recruit students of color in STEM disciplines. Key terms included scholarships, mentors, faculty, community, research experiences, and learning community.

## EVALUATING SUCCESS

Faculty and administrators were asked how their institution evaluates the success of its efforts to attract, recruit, retain, and graduate students of color in STEM fields. In total, 43 participating faculty members and administrators responded to the inquiry. Most of the respondents who indicated that they have a formal evaluation process were mandated to collect data to maintain external funding. Only six respondents explicitly stated that their institution collects data on graduation rates by race and gender. Other participants acknowledged using anecdotal evidence of program effectiveness, such as using success stories of individual students. Four institutional representatives indicated that their school did not have a formal mechanism to evaluate their success in graduating students of color in STEM fields.

## COMMITMENT TO DIVERSITY

University administrators responded to a series of Likert-scale items about their attitudes and beliefs on their institutions' commitment to diversity. Most administrators strongly agreed that diversity enriches teaching and learning and their institution is generally committed to achieving racial/ethnic diversity on campus. Among the 12 items rated, the administrators rated four items as less than "4" indicating that the majority did *not* agree with the statement. These statements included: (1) Diverse experiences and views are included in the curriculum; (2) There are opportunities for cultural competence and sensitivity training; (3) My institution does a good job of recruiting, retaining, and graduating men of color in STEM; and (4) Adequate resources are dedicated to recruiting, retaining, and graduating men of color in STEM.

Faculty members rated a similar set of items, and their responses were similar to administrators. Generally, they strongly agreed that diversity enriches the teaching environment and there is support for diversity among faculty and administrators. The mean rating of faculty participants was less than 4 (agree) for four items: (1) My department is tolerant of different views and experiences; (2) Adequate resources are dedicated to recruiting, retaining, and graduating men of color in STEM (3) Faculty in my department work to include diverse experiences and views within the curriculum; and (4) My department does a good job of recruiting, retaining, and graduating men of color in STEM.

## IDENTIFYING NEXT STEPS

Participants were asked, "What are the next critical steps for your institution in recruiting, retaining, and graduating students of color in the STEM fields?" Forty-four faculty members and administrators responded. High frequency terms in responses included, "programs," "enhance," "funding," "support," and "problem." Of the respondents, only one listed specific steps which included: (1) Continue to support statewide dissemination of STEM curriculum in public schools through "Project Lead the Way;" (2) Continue to strengthen articulation agreements with community colleges; (3) Commit funding to support students success in math courses at community colleges (boot camps) and university to address underprepared students who want to enter STEM; and (4) Continue to support the "Integrated Learning Community" model for entering freshman.

More participants responded to the inquiry by stating institutional needs, which can be summarized as the following: (1) more funding to hire diverse faculty members and engage students in research; (2) formal programs to prepare students for STEM education; (3) better marketing and support of existing programs; and (4) better community outreach. One participant suggested sending minority male students back to their high schools to help recruit. Many also expressed issues of faculty diversity and engagement. One participant stated, "We need to shift faculty culture to one that is more learning-focused and one in which faculty members' efforts to support retention are rewarded through the tenure/promotion process."

Funding was a major overarching theme when participants noted obstacles to recruiting, retaining and graduating students of color. An example of this sentiment was reflected in the statement: "Our taxpayers have decided that they can no longer afford our educational system. Our

institution's budget is down 17% from its peak, while enrollment keeps climbing. The most important step is to convince our taxpayers that STEM education is a worthwhile effort and the benefiits will pay back their investments."

When asked to describe programs at their institution specifically designed to support the success of men of color in the STEM disciplines, 22 participants responded. Specific programs included, the Student African American Brotherhood, tutoring, "B-MEN," National Society of Black Engineers, National Society of Professional Engineers, Men on the Move, Alliance for Minority Participation, and an unspecified Black Male Initiative. Seven of the 22 who responded indicated that their institution did not have specific programs to support the success of men of color.

Faculty and administrators also stated some of the major challenges faced by their institutions in recruiting, retaining, and graduating students of color in the STEM fields. The 43 challenges identified can be summarized as follows: (1) budget cuts; (2) lack of institutional commitment; (3) lack of scholarships; (4) lack of diversity in faculty; (5) small pool of interested and qualified applicants; and (6) inadequate college preparation in high school.

### LESSON LEARNED FROM STEM STUDENTS

The students participating in this study attended the following university types: predominantly White institutions (PWIs); historically Black colleges and universities (HBCUs); Hispanic (Latino) serving institutions (HSIs); tribal colleges and universities (TCUs); and institutions with large native Alaskan student populations or large percentages of Pacific Islanders (Asian). Table 1 displays the percent of students attending the various institution types across race/ethnicity. With the exception of American Indian/Alaskan Native, all race groups had the largest percent of students attending an institution that historically services their race.

**Table 1**

*Percent of Students Attending the Various Institution Types across Race/Ethnicity*

	<b>American Indian/Alaskan Native</b>	<b>Asian</b>	<b>Black</b>	<b>Hispanic</b>
PWI	10.6%	38.6%	28.7%	9.4%
HBCU	.0%	.4%	35.4%	1.2%
TCU	31.9%	.9%	9.9%	2.1%
Asian	23.4%	48.5%	8.8%	9.6%
HSI	34.0%	11.6%	17.1%	77.7%

*Note.* Three predominantly White institutions (PWIs); 3 historically Black colleges and universities (HBCUs); 3 Hispanic serving institutions (HSIs); 2 tribal colleges and universities (TCUs); 3 institutions with large native Alaskan student populations or large percentages of Pacific Islanders (Asian).

To reduce data, principal components analysis (PCA) was used to examine the underlying dimensions of the 18 continuous items on the survey questionnaire that measured the university experiences. Factor structure was explored with principal components analysis with Varimax rotation and Kaiser normalization. All three factors were accepted based on their eigenvalue that exceeded 1, and the logical arrangement of items. The three-factor solution explained 59.8 percent of the total variance. Based on the arrangement of items, as presented in Table 2, the names given to the four factors were: (1) Faculty Relationships, (2) Belonging, and (3) Academic Pressure. Using regression estimates, a factor score was assigned to each participant, which were used to compare means across institution types. Results indicated that students at HBCUs were significantly more likely to have better relationships with faculty and to have a higher sense of "belonging." Students at PWIs reported their relationships with faculty to be significantly lower (See Figure 1a and 1b). Academic pressures were not significantly different across institution types.

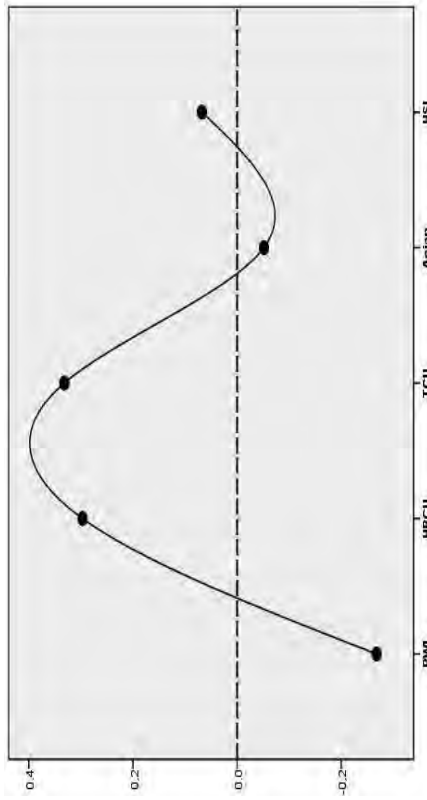
Table 2

*F-ratios and P values of University Experiences Items and Factors across Institution Type\**

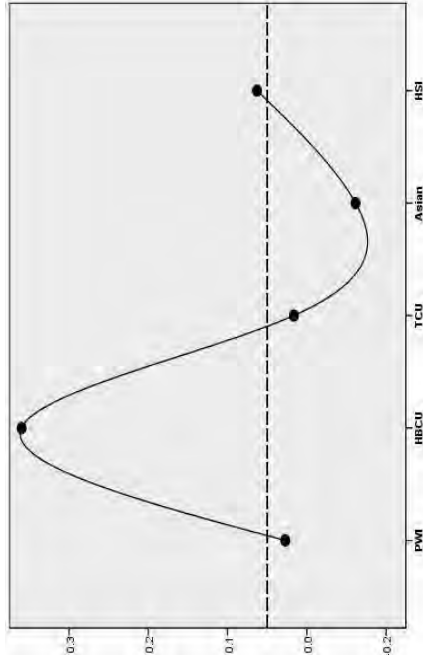
Factors	University Experience	F-Ratio (df = 4)	P Value
<b>Factor 1**</b>			
<i>Faculty Relationships</i> ( $F = 7.5$ , $df = 4$ , $p < .01$ )	My professors are sensitive to my academic needs	5.1	.00
	My professors are supportive of my academic aspirations	5.7	.00
	My professors are available/approachable when I have questions	6.1	.00**
	Overall, my interactions with STEM faculty members have been positive	4.6	.00
	I feel supported by faculty in my major department/program	6.8	.00
	My professors encourage me to seek help when needed	2.5	.04
	My professors are sensitive to my cultural background	6.1	.00**
	I feel supported by the administrators/staff in my major school/college	6.4	.00
	Faculty includes diverse experiences and views in course readings, assignments, or discussions	2.8	.02
	Overall, I enjoy my STEM courses	12.9	.00**
<b>Factor 2**</b>			
<i>Belonging</i> ( $F = 2.7$ , $df = 4$ , $p < .05$ )	I feel a sense of belonging on campus	3.7	.01
	In general, the campus environment is welcoming to me and people like me	5.4	.00
	I would choose this same college/university again	0.5	.77 (ns)
	I feel someone on campus would miss me if I left the institution	8.8	.00
	I feel support from my peers in STEM courses	7.2	.00**
<b>Factor 3</b>			
<i>Academic Pressure</i> ( $F = 1.5$ , $df = 4$ , ns)	I feel the need to "prove myself" to professors	4.6	.00
	I feel the need to "prove myself" to classmates	1.2	.33 (ns)
	My STEM classes are very competitive as compared with my non-major classes	0.6	.63 (ns)

*Note.* \*Three predominantly White institutions (PWIs); 3 historically Black colleges and universities (HBCUs); 3 Hispanic serving institutions (HSIs); 2 tribal colleges and universities (TCUs); 3 institutions with large native Alaskan student populations or large percentages of Pacific Islanders (Asian); \*\* A visual depiction of this item/factor is displayed in Figure 1; ns = non-significant difference.

**Factor 1: Faculty Relationships**



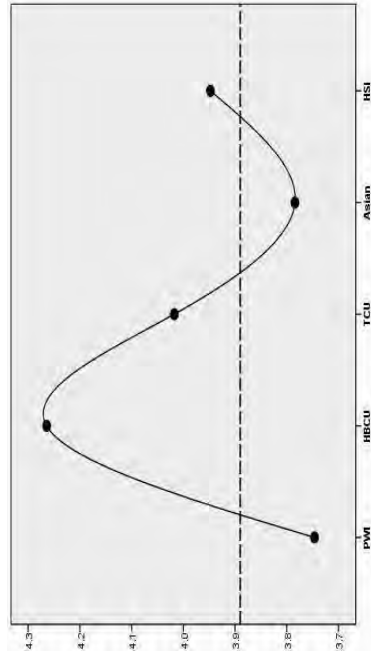
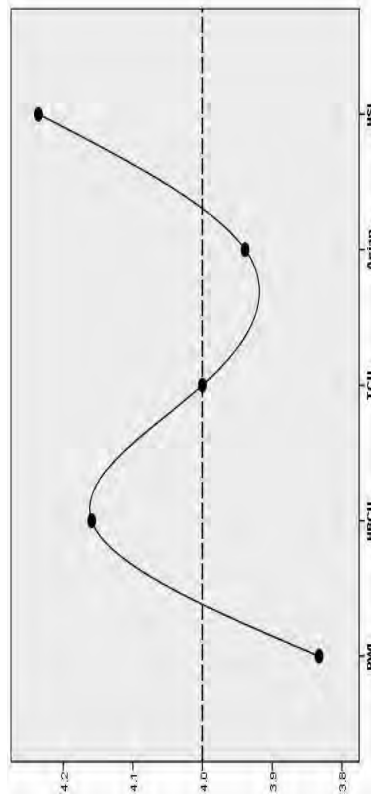
**Factor 2: Belonging**



**FIGURE 1a & 1b. Means plots of UNIVERSITY EXPERIENCE FACTORS (X Axis) on INSTITUTION TYPE (Y Axis) among minority male students.**  
*Note.* Three predominantly White institutions (PWI); 3 historically Black colleges and universities (HBCUs); 3 Hispanic serving institutions (HSIs); 2 tribal colleges and Universities (TCUs); 3 institutions with large native Alaskan student populations or large percentages of Pacific Islanders (Asian). The dashed reference line on the Y-axis marks the estimated mean of the dependent variable.

Overall, I enjoy my STEM courses

I feel support from my peers in STEM courses

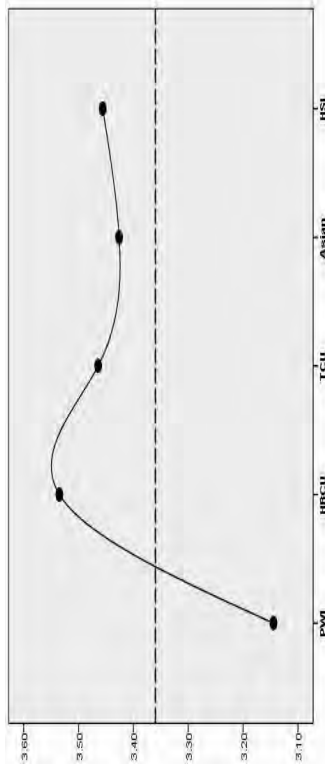


**FIGURE 2a & 2b. Means plots of PERCEPTION OF STEM COURSES (X Axis) on INSTITUTION TYPE (Y Axis) among minority male students.**

Note. Three predominantly White institutions (PWI); 3 historically Black colleges and universities (HBCUs); 3 Hispanic serving institutions (HSIs); 2 tribal colleges and Universities (TCUs); 3 institutions with large native Alaskan student populations or large percentages of Pacific Islanders (Asian). The dashed reference line on the Y-axis marks the estimated mean of the dependent variable.

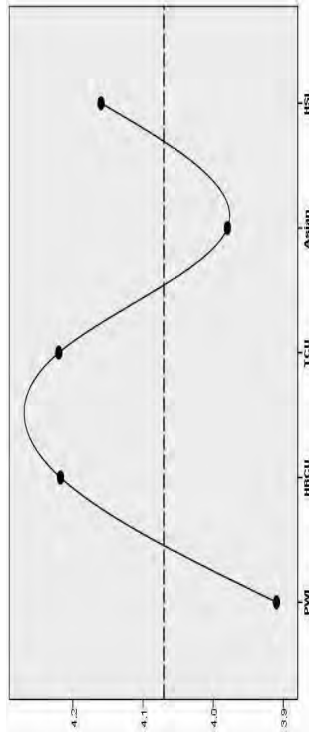
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**My professors are sensitive to my cultural background**



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**My professors are available/approachable when I have questions**



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**FIGURE 3a & 3b. Means plots of PERCEPTION OF STEM FACULTY (X Axis) on INSTITUTION TYPE (Y Axis) among minority male students. Note.** Three predominantly White institutions (PWIs); 3 historically Black colleges and universities (HBCUs); 3 Hispanic serving institutions (HSIs); 2 tribal colleges and Universities (TCUs); 3 institutions with large native Alaskan student populations or large percentages of Pacific Islanders (Asian). The dashed reference line on the Y-axis marks the estimated mean of the dependent variable.

Table 2 also displays the *F*-ratios and significance of university experiences with a hypothesized relationship with institution type among minority male STEM students. The table marks variables that are significant by institution type. Of the 18 items analyzed, 15 had a significant relationship with institution type. Visual depictions of selected university experiences items are displayed in Figures 2a, 2b, 3a, and 3b.

## SUMMARY AND CONCLUSIONS

Compared to students attending PWIs, students at HBCUs were significantly more likely to have more positive relationships with their faculty. Students at HBCUs generally felt that their faculty members were sensitive to their academic needs and aspirations, approachable and sensitive to their cultural background. Students at HBCUs were also more likely to report a sense of “belonging” on their campuses, as demonstrated by feeling that the campus environment was welcoming, feeling support from other students, and feeling that the institution would “miss” them if they left without completing.

Findings also suggest few institutions have formal programs to recruit minority students in STEM. Only about 10 percent of the faculty and administrators who responded to the survey items were able to identify specific outreach programs to recruit minority students in STEM fields. Most of those who identified specific initiatives, described national programs, which were tied to external funding. Only three institutional representatives indicated that their institution designed a program to fit their unique recruitment and retention needs. From the findings, successful recruitment initiatives for HBCUs depend on having scholarships, mentoring, faculty participation, community outreach, research experiences, and strategies to build learning communities.

Another issue, which impedes institutions' best efforts to recruit, retain, and graduate minority students in STEM, is that few institutions indicated that they have a formal process to evaluate their efforts. Similar to outreach efforts, many of the institutions with a formal evaluation process were mandated to evaluate programs for external funders. Institutional representatives also had difficulty articulating the steps they were taking to recruit and retain minority students in STEM fields. Among the survey respondents, only one university administrator was able to list specific steps his or her university was taking. Most respondents answered the inquiry about steps their university was taking by loosely stating their university's needs. Clearly, most respondents felt that their best chance of recruiting, retaining and graduating STEM students would be to diversify their faculty and staff, have specific programs for STEM students, have better support for existing programs, and stronger community outreach efforts.

Overall, faculty and administrators had clear ideas about their challenges with recruiting, retaining and graduating STEM students, but very vague ideas about how to respond to the challenges. The six identified threats were budget cuts, lack of institutional commitment, lack of scholarships, lack of diversity in faculty, small pool of interested and qualified applicants, and inadequate college preparation in high school.

Generally, HBCU faculty and administrators are steadfast in their view that cultural and gender diversity enriches the university experience and that their universities are committed to achieving diversity on campus. However, survey respondents at institutions generally were less confident about their ability to achieve diversity. Specifically, faculty and administrators were less confident that diverse experiences are included in the curriculum, that university personnel had adequate opportunities for cultural competence, or that the university had adequate resources to recruit, retain, and graduate students of color. These are opportunities for HBCUs to provide critical leadership in STEM.

HBCUs can promote leadership and excellence in STEM when faculty and administrators understand the importance of achieving racial and gender diversity on campus. They understand that Black STEM graduates lack adequate representation in society and desire an inclusive environment on campus. HBCUs success also comes from an understanding that achieving



diversity in STEM will not occur through happenstance or “business-as-usual” practices, and that some internal and external resources are required to create a representative environment.

## REFERENCES

- Jackson, D. L. (2013). A balancing act: Impacting and initiating the success of African American female community college transfer students in STEM in to the HBCU environment. *The Journal of Negro Education*, 82, 255-271.
- Owens, E. W., Shelton, A. J., Bloom, C. M., & Cavi, J. K. (2012). The significance of HBCUs to the production of STEM graduates: Answering the call. *Educational Foundations*, 26, 33-47.
- Palmer, R. T., Davis, R. J., & Thompson, T.. (2010). Theory meets practice: HBCU initiatives that promote academic success among African Americans in STEM. *Journal of College Student Development*, 51(4), 440-443. doi: 10.1353/csd.0.0146
- Seadler, Abby. (2012). Obama introduces plan to increase U.S. STEM undergraduates. *Earth*, 57(6), 27.
- Toldson, I. A., & Esters, L. L. (2012). *The quest for excellence: Supporting the academic success of minority males in science, technology, engineering, and mathematics (STEM) disciplines*. Washington, DC: Association of Public and Land-grant Universities.

*Dr. Ivory A. Toldson was recently appointed by President Obama as the Deputy Director of the White House Initiative on Historically Black Colleges and Universities (HBCUs). He is currently on leave from his post as associate professor at Howard University. He continues to serve as editor-in-chief of The Journal of Negro Education.*