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Exploring the Success of HBCU's Development of Black Students Earning Engineering and Computing Graduate Degrees

Dr. Jay Phillip Jefferson, Florida International University

I am currently a Postdoc within SUCCEED at Florida International University. My research passions are centered at the intersections of equity in higher education, advocacy, social justice, and overall allowing for the expression of an authentic self in educational spaces in route to achieving student success.

Dr. Alexandra Coso Strong, Florida International University

As an assistant professor of engineering education at Florida International University, Dr. Alexandra Coso Strong works and teaches at the intersection of engineering education, faculty development, and complex systems design. Alexandra completed her doctorate in aerospace engineering at Georgia Tech. Prior to attending Georgia Tech, Alexandra received a bachelor's degree in aerospace engineering from MIT and a master's degree in systems engineering from the University of Virginia. Alexandra comes to FIU after completing a postdoctoral fellowship at Georgia Tech's Center for the Enhancement of Teaching and Learning (CETL) and three years as a faculty member at Olin College of Engineering in Massachusetts. Alexandra's research aims to amplify the voices and work of students, educators, and Minority-Serving Institutions (MSIs) overall and support continued educational innovation within engineering at these institutions. Specifically, she focuses on (1) educational and professional development of graduate students and faculty, (2) critical transitions in education and career pathways, and (3) design as central to educational and global change.

Dr. Trina L. Fletcher, Florida International University

Dr. Fletcher is currently an Assistant Professor at Florida International University. Her research focus equity and inclusion within STEM education, STEM at HBCUs and K-12 STEM education. Prior to FIU, Dr. Fletcher served as the Director of Pre-college Programs for the National Society of Black Engineers (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.

Ms. Jade R. Moten, Florida International University

Jade R. Moten is a graduate student at Florida International University in Miami, Florida. Her research interests include expanding diversity, equity, and inclusion practices in engineering education, policy development, TRIO programs, and quality tool implementation.

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Introduction and Background

Historically Black Colleges and Universities (HBCUs) have played an outsized role in the production of African American and Black students in science, technology, engineering, and mathematics (STEM). Factors that contribute to observed student success in STEM at HBCUs include impactful student-faculty relationships and overall sense of belonging on supportive campuses [1, 2] as well as various STEM initiatives designed to increase undergraduate achievement and retention at these institutions [3]. These practices and the contributions of HBCUs to fields, such as engineering, have been critical in advancing diversity in education despite continued underrepresentation in many fields [4]. As an example, the National Science Foundation (NSF) found that the top ten baccalaureate-origin institutions for Black students who went on to obtain a doctorate degree in science and engineering between 2002 through 2011 were all HBCUs. Additionally, between 2005-2010, approximately a third of Black STEM Ph.D. earners reported that their STEM academic journey began at an HBCU [5].

However, there remains a need to further support HBCUs along with other Minority Serving Institutions (MSIs) in ensuring that broadening participation efforts are not only effective, but also contribute to the overall academic success and achievement for Black students in STEM [6]. Moreover, Crewe [7] has noted that the extraordinary teaching, mentorship, and undergraduate preparation of HBCUs can be marginalized when considering success cases of HBCU Alumni. Taken together, this highlights the importance of placing these experiences as central to graduate pathway narratives and our understanding of the academic journeys that promote and produce Black professional excellence in engineering and STEM more broadly.

The following paper summarizes our progress on an NSF funded research project aimed at investigating the under-explored success of HBCUs, who graduate the highest number of Black students who go on to obtain graduate degrees in science and engineering. The purpose of this study is centered upon 1) the identification of institutional and cultural factors that support the matriculation and successful completion of graduate engineering and computing programs by Black students from HBCUs, 2) characterization of individual, institutional, and cultural factors influencing Black students from HBCUs' interest and pursuit of a graduate degree, and 3) a dissemination framework for engaging Black HBCU students, alumni, administrators, faculty, staff and relevant non-HBCU stakeholders in activities and discussions about graduate education in engineering and computing for Black students.

Executive Summary

Project Significance and Research Design

To achieve the purpose of this study, we designed a three-phase project that considers the perceptions and experiences of a multiple stakeholders (e.g., current students, alumni, administrators, faculty, staff) to deeply explore the HBCU experience and address four research questions:

RQ1. How do Black HBCU undergraduate students in engineering and computing experience preparing for, deciding on, and enrolling in graduate school?

RQ2. What are the general perceptions of graduate school for current Black undergraduate HBCU alumni?

RQ3. What factors do engineering and computing Black HBCU undergraduate students and other stakeholders believe could influence the students' graduate school experiences?

RQ4. What individual, institutional, and cultural factors contribute towards Black undergraduate HBCU students' interest, pursuit and successful completion of engineering and computer science graduate degrees?

First, Phase I seeks breadth by collecting survey data from alumni of HBCUs that majored in engineering and computer science backgrounds (we also survey STEM majors overall). Phase II will serve to develop rich insights about three HBCUs through in-depth, interview-based case studies. The institutions selected for Phase II will be informed by the responses and experiences shared through our Phase I survey. Phase III will involve sharing the integrated results from Phases I and II with HBCU students and stakeholders during a validation workshop at the National Society of Black Engineers (NSBE) National Convention. The empirically informed dissemination workshops will also seek to increase underrepresented minority students' interest and preparedness for graduate programs.

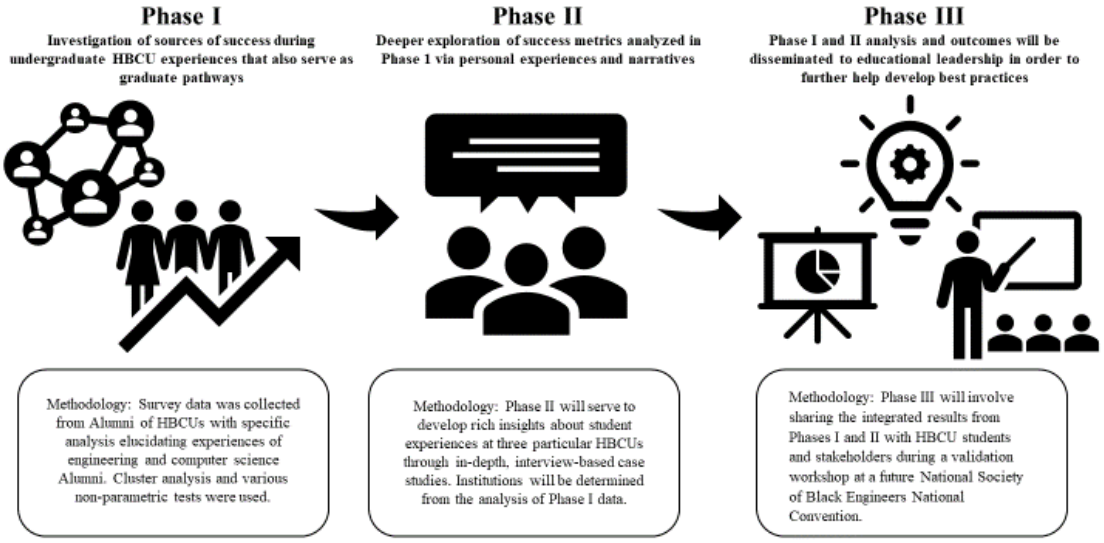

Figure 1: Overview of project phases and their methodology

In Phase I, we developed our survey using the Qualtrics software platform, which was approved by our internal research team – deployed and completed by advisory board members and a select group of internal and external research affiliates to develop evidence of validity. The survey instrument was designed to gather data on three areas: (1) the dimensions of institutional climate for HBCU alumni, (2) respondent perceptions of their graduate school pathways (including preparation for graduate school while an undergraduate at their HBCU), and (3) the dimensions of institutional climate and their individual success during our respondents' graduate school experiences. These areas were grounded in previous work exploring Black student experiences in

engineering [8]. Likert items, Select-All-That-Apply, and open-ended questions were utilized in the final disseminated survey. Cluster analysis will be performed on the results to determine emerging themes and factors from survey responses. Further details regarding Phase I's methodology can be found in our ASEE paper published this year documenting the development of our survey instrument [9].

In Phase II, we will conduct a series of individual interview-based case studies as part of our mixed-methods approach for this study. Based on the findings from Phase I, we will choose three institutions as sites for these case studies. At each of these sites, we will conduct interviews with a series of stakeholders: students, alumni, administrators, faculty. Semi-structured interview protocol will be developed based on the dimensions of institutional climate [10] and will include more general questions about the staff and administrator's perceptions of the HBCU engineering student experience preparing for graduate school. The results of this phase will inform the Phase III dissemination workshops.

In Phase III, a validation workshop will be conducted at a NSBE National Convention. HBCU stakeholders (i.e., students, faculty, staff, and alumni) will engage in a variety of activities to explore the graduate school process and experience to co-develop an understanding of HBCU students' experiences preparing for and pursuing graduate study. Artifacts from the workshop will be collected for analysis by the research team to build a cross-institutional understanding of the HBCU engineering and computer science student population. Subsequent data analysis will seek to develop a narrative about HBCU students' experiences preparing for, deciding on, and pursuing graduate study as well as how that narrative evolves over time and across different types of HBCUs.

Project Status and Future Work

To date, we have completed our Phase I survey and have initiated survey marketing and outreach strategies to help optimize survey deployment during these unprecedented times within academic research. To construct our survey instrument, we met with a diverse field of scholars from HBCUs and MSIs dedicated to STEM education, equity, as well as experts in quantitative research. For example, throughout our development process we received insightful review and feedback from an expert in quantitative research and psychometrics whose focus is graduate engineering education. Their expertise in graduate student development was of primary importance in refining the scope of our instrument as well as in item selection. We began piloting the Phase I survey in late June 2020, including the recruitment of pilot testers that fit within our target population for the final survey using snowball sampling. Additionally, a cognitive interview was conducted to further validate the survey during development. Feedback from all pilot study participants was incorporated into the survey were approved by the internal research team.

The Phase I survey deployed late October 2020 to HBCU current students headed to graduate school and undergraduate engineering and computing HBCU alum who are currently in graduate school. Survey recruitment also utilized snowball sampling, using a combination of social media marketing and emails. Outreach focused primarily on various HBCU Alumni Associations, industry affinity groups, as well as student and professional organizations relevant to our target participants. Social media platforms included Twitter, Facebook, and Instagram, with our social media presence and survey distribution managed by our research team. Data collection has been

recently completed with analyses expected to be completed within the first half of 2021. One-hundred and fifty-one HBCU alumni from 37 HBCUs participated in our survey. Demographics include 58% of our participants reporting as female-identifying, 99% as African American or Black, 33% as first-generation, and 41% having received an undergraduate bachelor's degree in engineering (with an additional 42% representing a non-engineering STEM major). Our preliminary findings from our Phase I survey factor and cluster analysis will be included for our poster presentation and discussion.

Additionally, our poster presentation will provide insightful discussion around the selection logistics required for transitioning to our Phase II interviews at the three HBCUs decided via our analysis from Phase I. For example, initial criteria for the HBCU institutions under consideration for study recruitment include having an ABET accredited engineering program within their institution and are on NSF's list of top 50 baccalaureate origin institutions who graduate the most undergraduates who go on to receive a PhD in science or engineering.

Research responses from our Phase I survey as well as from the interviews developed for Phase II will be used to produce evidence-based insights and recommendations towards (1) increasing underrepresented minority students' interest in graduate STEM degrees, (2) retaining and graduating Black students in those programs, and (3) documenting best practices for others to use in supporting student success. Furthermore, our study along with dissemination workshops will advance current scholarship in two main ways. First, our research will add to the literature by gaining knowledge directly from HBCU students and other stakeholders on how and why HBCUs have been so successful with matriculating Black students into graduate engineering and computer science programs. Second, this research will add to our understanding of the experiences of Black students at HBCUs more generally including the contribution of administrators, faculty and staff towards their students' interest, eventual pursuit and completion of engineering and computer science graduate degrees.

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