The Journal of Negro Education, 86 (4), 415-421

Drivers and Barriers of Success for HBCU Researchers Submitting STEM Proposals to the National Science Foundation

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The purpose of this investigation is to gain a better understanding of the drivers and barriers of success for HBCU researcher submitting STEM proposals to NSF. Grants and contracts are essential for an institution's long-term viability; reducing tuition dependence and providing important funding for research, services and programs. However, in 2014, HBCUs accounted for only 0.8 percent of all funds allocated to all institutions of higher education for Research and Development. This investigation used organizational learning theory and focus group research to understand the process through which HBCUs acquire knowledge and translate knowledge into dynamic capabilities to prepare successful proposals to NSF. After analyzing the focus group content, the 5 big ideas related to grant funding success were: develop relationships; take advantage of opportunities, learn as much as you can, change personal mindset, and change institutional culture. Recommendations, based on the results, to overcome barriers to successful proposal submission among HBCUs are provided.

Historically Black colleges and universities (HBCUs) play a prominent role in the science, technology, engineering, and mathematics (STEM) education of African Americans, a role that is disproportionate to their representation among the nation's institutions of higher education. Although HBCUs represent less than 3% of America's institutions of higher education, they enroll 9% of all Black students in the United States (NCES, 2011). In 2011, nearly 24 percent of Black science and engineering (S&E) doctorate recipients obtained their bachelor's degrees from HBCUs (Fiegener & Proudfoot, 2013). This publication also noted that among U.S. baccalaureate-origin institutions of Black S&E doctorate recipients for the period 2002–2011, 21 of the top 50 institutions, were HBCUs. These statistics illustrate the critical role that HBCUs play in the production of Black recipients of S&E doctorates. To expand the role of HBCUs, especially in STEM areas, the faculty must be well-prepared to provide educational and research experiences that will position their students to successfully pursue graduate study or join the country's STEM workforce.

HBCUs have a unique understanding of the experiences and needs of African American students in STEM and are ideally placed to undertake research investigations that appropriately reflect/address major issues that their community face, yet they continue to struggle for research dollars. In FY 2014, HBCUs accounted for only 0.8 percent ($34.8 million of $4.1 billions) of all funds allocated to all institutions of higher education (IHEs) for Research and Development (Toldson & Preston, 2015). Also, HBCUs are underrepresented in NSF's education research-focused programs. A recent review of active NSF awards show that for HER CORE RESEARCH (ECR)–286 Active Awards–1 awarded to an HBCU (LeMoyne-Owen College); and for CAREER–3,302 Active Awards–4 awarded (not Ed research-focused) to three HBCUs (2 at Howard University, 1 at NC A&T and 1 at Fisk University; National Science Foundation, 2018).

As the nation's population becomes increasingly diverse, it is important that the STEM workforce and body of scholars who will define and implement the STEM research agenda reflect that diversity. A scarcity of HBCU faculty in STEM research and workforce has implications for research on issues that disproportionately affect their population. The purpose of this investigation is to gain a better understanding of the drivers and barriers of success for HBCU researcher submitting STEM proposals to NSF.

CONCEPTUAL FRAMEWORK

Investigators used organizational learning theory to understand the process through which universities acquire knowledge, translate knowledge into action, and derive positive outcomes from

these actions. The underlying premise is that colleges and universities are cognitive entities capable of experimenting, observing, and modifying their actions to improve performance in a specific area (Robey, Boudreau, & Rose, 2000).

In this view, we hypothesized that HBCU faculty members will foster their learning at two distinct levels: (a) content-oriented knowledge, which targets content-specific learning, knowledge transfer, and knowledge sharing; and (b) dynamic capabilities, which are related to participants' higher-level acquisition of skills that enable them to access resources and modify systems associated with their scholarly productivity.

The underlying assumption is that HBCU researchers are not autonomous learners who are exclusively striving to advance themselves professionally. Rather, they are interdependent units of dynamic institutions. Their success at developing their research agenda depends on their ability to influence institutional systems, and their individual success contributes to the larger mission and goals of their home institution. The research questions guiding our investigation are:

1. What content-oriented knowledge drives success for HBCU researchers submitting STEM proposals to NSF, and what are the barriers to knowledge acquisition?
2. What dynamic capabilities are necessary for HBCU researchers to successfully submit STEM proposals to NSF, and what are the barriers to acquiring these capabilities?

METHOD

Setting

In August 2017, The Quality Education for Minorities (QEM) Network received a two-year award from NSF's Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) to provide technical assistance to STEM faculty at HBCUs through a series of workshops to increase their participation and competitiveness in the Foundation's education research-focused programs.

The first workshop under this grant was conducted on September 18-19, 2017, in Crystal City, Virginia. The workshop supported 15 institutional teams (14 two-person teams; and one 3-person team) consisting of STEM faculty members and education researchers/social science faculty members interested in submitting proposals to the Broadening Participation in Research (BPR) program. Four individuals with expertise in education research, technical assistance, preparing/reviewing NSF proposals, and leading initiatives specific to STEM research capacity building at HBCUs served as consultants at the workshop. Two focus groups were conducted at this proposal development workshop. The external evaluator, Dr. Rodney Hopson of George Mason University, led two 45-minute discussions on opportunities and threats for HBCU faculty developing proposals to NSF. Participation was voluntary and no identifying information was shared in any reporting.

Procedure

The aims of this research were to gain a deeper understanding of the experiences and backgrounds of primary investigators (PIs) and research faculty at HBCUs as well as on opportunities and barriers they face navigating proposal review processes. The focus group was part of a larger assessment process that QEM conducted to understand the underlying issues that may be attributed to fewer federal funded projects at HBCUs.

During the second day of the BPR workshop in September, participants were informed about the focus group sessions that QEM planned on conducting with at least a member of each institutional team represented. To assign random participants to the focus groups, a spreadsheet was sorted in ascending order based on the second to last three digits of their phone number. The first institutional team member on the sorted list was selected to participate in the focus group for a total of 15 participants (one representative per institution). In one case, one team member substituted for another. At the conclusion of the BPR workshop, two focus group sessions ($N = 8$; and $N = 7$) were

conducted by the project's external evaluator. The facilitator, an African American male, was not an instructor at any of the participating institutions, so participating faculty were not his colleagues.

Two focus group sessions with eight and seven participants, respectively, were conducted. Focus group discussions lasted for 45 minutes. The discussions were recorded and the transcripts sent out to an external entity for cleaning. Upon return of the transcript, the external evaluator further reviewed and cleaned the data before coding into emerging themes. Simple thematic analysis was conducted from the focus group transcriptions.

Participants

Of the 15 focus group participants, nine were female and six were male; eight were education/social science faculty; six were STEM faculty; and one was cross discipline (STEM/social science). Six were associate professors: five were assistant professors; three were full professors; and one was chair/associate professor.

Participating institutions included: Alabama State University; Alcorn State University; Bethune-Cookman University; Clark Atlanta University; Edward Waters College; Elizabeth City State University; Florida A&M University; Fort Valley State University; Hampton University; Kentucky State University; Lawson State Community College; Norfolk State University; Southern University; Tuskegee University; and University of Maryland, Eastern Shore.

Instrumentation

Data were gathered through eight primary open-ended questions with additional probing questions, where necessary, that allowed faculty to provide direct quotations. The moderator stimulated discussions that covered a range of topics including: history of proposal submissions and award; key factors in attracting or seeking external funding; barriers that hinder opportunities for seeking or obtaining external funding; funding or networking opportunities that participants would be interested in exploring further as a result of the workshop, and so forth (see Table 1 for the full list of focus group questions).

Table 1

Broadening Participation in Research (BPR) focus group questions

Institutional Roles & Responsibilities

1) What is your current position title within your institution/organization?
2) What are your major responsibilities in this position?
3) How long have you been in this position?

Background to and Understanding of Funded-Proposal Experiences

4) How long have you been submitting proposals and awards in your career? Describe your career background in seeking external funding.
5) What are the major agencies in which you have sought funding support?
    a. NSF? Other federal agencies?
6) What have been the key factors in attracting or seeking external funding?
    a. Consider the role of agencies, colleagues, previous experiences
    b. Explore tools for navigating institutional/individual barriers
7) What barriers hinder opportunities for seeking or obtaining external funding?
    a. Consider the role of agencies, colleagues, previous experiences
    b. Explore real and perceived implicit biases in the proposal solicitation, submission, and review process
        i. Consider the impact of these biases on efficacy and success of HBCU investigators
8) What funding or networking opportunities are you interested in exploring further as a result of this workshop?

RESULTS

Drivers of Success

During a focus group, we gained insight from HBCU faculty members, who were successful at obtaining external funding, into the drivers of success. After analyzing the transcripts, the five big ideas related to grant funding success were: develop relationships; take advantage of opportunities, learn as much as you can, change personal mindset, and change institutional culture.

Develop relationships involves forming a community with other researchers. Focus group participants advised to view new relationships as potential for collaborations; not competition. They also stressed the value in developing a relationship with the office of grants and sponsored programs. Relationships with organizations, foundations and government agencies that provide funding and assistance with proposal preparation are also important. One participant declared:

> I think the three Rs. Relationship, relationship, relationship. I cannot express that any louder than that. People have to know who you are. And once they can put a face with the name, you can dazzle them with your writing. I think everyone here is confident and can write and can do all of the wonderful things that we allege we can do based on our proposals. But when you see a person and you can shake their hand and you can sit down and have a discussion with them about the value of this grant and how it's going to transform the campus, then they can really get to the meat of it.

Take advantage of opportunities, involves regularly seeking out and participating in training opportunities. Also, gathering material and ask questions at conferences, workshops, or during visits to funding agencies. One focus group participant noted that QEM is a good example of an opportunity, stating, "I met so many people coming to these workshops here at QEM that have reached out and wanted to collaborate or share research or give me tidbits of information on which direction I need to go."

Learn as much as you can, in summary, is deepening understanding of what reviewers are looking for, and broadening understanding of the grant application process. Following instructions succinctly, is vital to proposal success, and learning instructions is key. One participant noted:

> Just comprehending something as simple as sticking to the instructions. Just do what we've asked you to do. Nothing fancy but just get right to it, be succinct and just get to what we've asked for. Just that alone gives you that confidence. I can read this. I can understand it, and just do what it says.

Change personal mindset suggests that feeling motivated and encouraged can reduce perceived barriers, so think positive thoughts. Focus group participants advised to view rejection as a necessary part of the process of getting funded. Own your expertise, and take agency over the process. Joining a community of other HBCU researchers can help to shape a positive scholarly identity. One participant expressed:

> There is a community of interest, of likeminded people. It's an encouragement. You can keep on going. You're doing solid work. And yes, you're in the classroom with your three, four, five, six courses per semester. But you're doing it and just keep doing it. I would say this kind of forum encourages that feeling of community. When you're back and you have to do four loads, you remember that yes, I can do this. This is for me and my students and my institution.

Change institutional culture. The focus group participants noted that institutional leadership should hire consultants to work with junior faculty for at least one day. They also advised to expose faculty members to program officers. Connecting faculty research to the broader mission of the institution and creating a supportive environment that incentivizes success are also important. One participant explained how one person can positively change the institutional dynamic.

> We had a professor come from another institution where he mostly wrote grants. He's helped with the culture of getting involved and writing grants and staying on top of things like this. Now we're presented

with opportunities that we never thought about before he came; having the culture of someone who does research and can help you understand how to do proposals. So, now we feel a little bit more encouraged that someone has the experience in doing it, and it's easier to step out and try to do it now.

Barriers to Success

Analyses of the focus group content revealed many barriers to HBCU researchers realizing the drivers indicated in the previous section. This section summarizes the barriers to each driver.

Barriers to developing relationships. Focus group participants indicated that it is harder for underrepresented minorities to make connections outside of the university, because "people tend to connect better with people who look like them." This was especially true when trying to relate to White colleagues. Making connections within the institution also presented challenges to some focus group participants, because they were in academic departments with few faculty members with grant preparation experience. Seeing colleagues as competition was another barrier for forming relationships.

Others indicated that some cross-divisional collaborations were not authentic because they are often formed solely to compete for grants. One participant stated, "A lot of people will say, 'Hey, NSF has this grant for x amount of money. Let's see if we can put together something and grab for it.' As opposed to 'I've got this research idea that I want to take through fruition. Let's see who can fund the idea.'"

Barriers to taking advantage of opportunities. External funders' real and perceived biases against HBCUs were reported as barriers to taking advantage of opportunities to gain funding. Many focus group participants reported that external agencies lacked knowledge of HBCU culture, and do not consider the multiple responsibilities and personal sacrifices of HBCU faculty. They also noted that many of the program directors and review panels lack diversity and members value name recognition and show biases toward predominantly White institutions (PWIs). Many of the barriers associated with building relationships also limited opportunities. For instance, focus group members noted that personal connections lead to some researchers having greater advantages in the proposal review process. However, the participants also acknowledged that a big barrier to opportunities among HBCU researchers is simply overlooking or minimizing the significant opportunities that arise.

Barriers to learning as much as you can. HBCU researchers in the focus group reported that the time that it takes to manage high teaching loads and provide administrative leadership limited the time they could spend learning about the grant process. They also suggested that the feedback they received on rejected proposals did not have the sufficient level of detail to enable them to learn from their mistakes. In addition, they reported receiving feedback that revealed bias or inadequate knowledge about the research they were proposing. One respondent stated, "It didn't get funded, and I read the reviews one and two, ok, I see what they're saying. But three and four, did they read the same proposal?"

Barriers to changing personal mindset. Focus group participants indicated that racial biases and racialized hegemonies between HBCUs and PWIs can influence the mindset of HBCU researchers. Candidly, some focus group participants admitted that some HBCU researchers have an inferiority complex. Some reported resistance to ask for help when faced with challenges for fear of reinforcing racial stereotypes. They also exhibited fear and skepticism about collaborating with neighboring PWIs, or PWIs in general, because of fears of losing autonomy and suspicions about the motives of PWIs who are interested in working with HBCUs. "They feel like they have to put an HBCU in, so it will look like they're doing something diversified; instead of saying these are our strengths, these are your weaknesses, and this is what we can do to help, and vice versa."

Barriers to changing institutional culture. Focus group participants reported many institutional barriers to successfully competing for external funding. Instable leadership was one barriers. The participants also stated that highly politicized environments, whereby faculty competition and allegiances overshadowed collaboration and camaraderie, corrupted institutional culture. Some participants lamented their institutions IRB process; specifically lack of transparency and unfair

preferences in the process. Inadequate institutional infrastructure to prepare proposal and lack of incentives, including release time, for writing grants also presented barriers to cultivating a conducive institutional culture. "For example," one respondent noted, "when we get a grant award, there's no distribution of ICR [indirect cost rate] to the faculty or to the division. . . . It all goes into the general funded." Some focus group participants suggested that the process of preparing proposals at an HBCU can be a lonely process with researchers working in silos.

DISCUSSION

Grants and contracts are essential for an institution's long-term viability; reducing tuition dependence and providing important funding for research, services, and programs. Funding disparities create a caste system in higher education, whereby students at better funded institutions benefit from enhanced facilities, equipment, and opportunities to earn income while studying. HBCUs that are more successful at competing for grants and contracts typically have more robust offices of grants and sponsored programs, better incentives for faculty and staff who write grant proposals, a clear statement of capability, and campus leaders that actively promote their university's research and programs to potential funders. However, selection biases at the programmatic level of federal funding opportunities require robust strategies that not only teach skills, but also advocate for meaningful systemic changes. To that end, these are some recommendations to overcome barriers to successful proposal submission among HBCUs.

First, high-quality proposal development workshops are necessary to provide targeted pathways for STEM faculty at HBCUs to learn about and participate more broadly in research initiatives focused on increasing the participation of groups historically underrepresented in STEM education and workforce. QEM's workshops, for example support the STEM faculty member's scholarly progression from capacity-building through projects to developing and identifying funding opportunities.

Importantly, most workshops primarily target "content-oriented knowledge," therefore enhanced strategies must be implemented to address "dynamic capabilities." To facilitate dynamic capabilities, prior to, during, and after target support, facilitators should stress the importance of volunteering to serve as NSF grant reviewers and encourage all participants to apply for the reviewer positions. Facilitators and coordinators should also share the NSF link that provide information on how to become a reviewer as well as additional links to articles that describe the benefits that can be experienced through the process. Targeted interventions with HBCUs should also stress the "disruptive" nature of infusing HBCU talents in the NSF's peer review portfolio; meaning, the presence of HBCU reviewers serves as a strategy to reduce bias in the review process and level the playing field for HBCU applicants.

More research is necessary to fully understand HBCU's experiences with obtaining funding for research from NSF, other government agencies, and nongovernment foundations. The investigators recommend continuing to collect qualitative and quantitative information in controlled settings for HBCU researchers to share their views on the fairness of the NSF review process, and challenges they may have encountered in their attempt to seek grant funding. Reports of the issues and suggestions identified by such research should be shared with NSF program officers to solicit feedback on the best way to deal with these concerns.

HBCUs and other minority serving institutions serve a vital role in educating low income and first-generation college students in our nation, which is becoming increasing more diverse. Even with limited resources, HBCUs are among the top producers of institutions of higher education that are the baccalaureate origin of Black students who receive a Ph.D. in science and mathematics. However, the true promise of HBCU innovation will never be fully realized without sincere investments from the federal, state, and local governments, as well as private foundations. Unleashing the potential of HBCUs, through grants and contracts, could open up new channels of opportunity to more than 300,000 students; leading to a fairer higher education marketplace, more income equality and new scientific discoveries.

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The author gratefully acknowledges Dr. Mercy Mugo, QEM Research Associate, and Imani Wiltshire for helping to conduct and code the focus group data.