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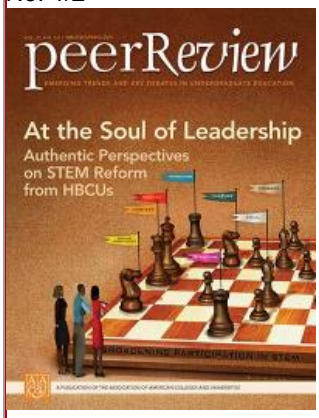

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Faculty Perceptions of Designing and Implementing Course-Based Research Experiences to Broaden Participation in STEM at an HBCU

By: Isi Ero-Tolliver

Over time, the population of the United States has become increasingly diverse. Such a population would benefit from having STEM professionals from diverse backgrounds working on cutting-edge research, but in 2012, Blacks accounted for only 7.5 percent of all STEM undergraduate degrees and only 4.5 percent of doctoral degrees (NCES 2012). Overall, underrepresented minority students enter college at the undergraduate and graduate level with an intent to major in STEM at the same rate as their White counterparts, but they have higher attrition rates (DePass and Chubin 2014) and lower STEM-degree completion rates (Anderson and Kim 2006; Higher Education Research Institute 2010).

The President's Council of Advisors on Science and Technology (2012) predicts the need for a million more STEM professionals by 2022 to meet growing economic and global demands in STEM fields and to create a larger and more diverse STEM workforce. Additionally, the American Association for the Advancement of Science (2011) has issued a national call for introducing more equitable ways of making research accessible for the diverse populations of undergraduate researchers.

To address these national calls that encourage diversity, underrepresented populations must be supported in their progress toward attaining STEM degrees. Therefore, it is important to create opportunities that contribute to the degree attainment, retention, and preparation of underrepresented students to create a strong and diverse workforce (National Science Board 2007; Griffith 2010).

Faculty Development Institute

Although there have been large amounts of data published on diversifying STEM fields and undergraduate research experiences, there has not been significant literature on professional development of faculty members at Historically Black Colleges and Universities (HBCUs) as a means of increasing research productivity and students' access to undergraduate research experiences.

Most faculty members agree with the need for effective and constant professional development workshops to stay

Reducing Attrition from STEM Disciplines: Understanding the Student Athlete's Perspective

Using Adaptive Learning Courseware as a High-Impact Practice to Improve Students' Learning Outcomes in General Chemistry II at an HBCU

Implementing a Corequisite Algebra Gateway Course

Overcoming Advising Barriers to Retain STEM Majors

HBCUs and Black STEM Student Success

current within the field. Since some HBCUs are gravitating toward the research-intensive model, there is an increased need for faculty to secure grant funding and publish their findings. Faculty members at minority-serving institutions benefit from faculty development opportunities that assist in scholarly activities that include grant writing, manuscript preparation, and discussions about internal and external collaborations. Although HBCU faculty members are held to high standards for productivity in teaching, research, and service like their counterparts at predominantly White institutions (PWIs), they tend to have comparatively higher teaching loads and fewer opportunities to fully engage in their research during the academic year. While HBCU faculty members continue to perform research and publish scholarly work, their productivity could benefit from the introduction of additional or alternative ways of maximizing their current teaching and research efforts.

What are Course-Based Research Experiences and who benefits FrOM THEM?

Research experiences are pivotal in the education and professional development of undergraduate science majors (Laursen et al. 2010; Lopatto 2007). Course-based research experiences (CREs) were developed to reach a critical mass of students, expose them to the practices of STEM professionals, and provide research experiences. To meet the increasing demands for undergraduate research experiences, faculty developed CRE projects that engage whole classes of students in addressing a variety of scientific research questions (Jordan et al. 2014; Shaffer et al. 2014; Wei and Woodin 2011). CREs engage undergraduate students in authentic research experiences while increasing the opportunities for faculty members to continue their research and publish with a critical mass of students within their classroom spaces.

Advocates of CREs argue that they offer a variety of advantages for students that include access to research for the whole class and not just a few select individuals (Bangera and Brownell 2014), unlike the traditional research internship (Auchincloss et al. 2014). For instance, there are many more undergraduates in the life sciences than can be accommodated through traditional research internships, which involve one-on-one mentoring by faculty members (Auchincloss et al. 2014; Wei and Woodin 2011). Although it has been shown that participation in traditional research experiences improves student interest in pursuing graduate degrees in STEM specifically (Seymour et al. 2004; Russell, Hancock, and McCullough 2007), CREs represent a scalable and affordable way to retain more undergraduate STEM majors and improve student STEM competencies (Rodenbusch et al. 2016).

Although previous work has been published about the benefits and challenges of CREs for PWIs (Shortlidge and Brownell 2016), there is not yet significant literature about the design, implementation, and challenges of CREs at HBCUs. To add to the existing literature and provide insight into alternative perspectives, this article will address the faculty-perceived barriers and successes of implementation of CREs at Hampton University.

HBCUs account for 3 percent of US colleges and universities and yet produce 27 percent of the African American students earning bachelor's degrees in STEM fields (US Department of Education 2016). Hampton University is a privately endowed, coeducational HBCU with approximately 3,200 undergraduate students. Hampton's current enrollment is approximately 92 percent Black (non-Hispanic), with 54 percent of the population identifying as Black females, 38 percent as Black males, and 8 percent identifying as other races or ethnicities. The university ranks highly when compared with institutions in the South and Southeast due to its selectivity in admissions, high standards of teaching, rigorous curricula, high graduation rates, and professional activities of the faculty.

CRE Institute Participants

The participants were diverse in faculty rank and level of experience and included thirteen males and nine females. Faculty participants included six associate professors, twelve assistant professors, one lecturer, one instructor, one course coordinator, and one program officer (two of the faculty members were department chairs). Overall, there were nineteen faculty members from the biology department, one from mathematics, one from psychology, and one from science education; most of the participants (fourteen out of twenty-two) were from HBCUs; six were from PWIs; one was from a community college; and one was from another institution.

Methodology

In order to establish the CRE professional development workshop with our STEM faculty, we worked with Erin Dolan, the principal investigator of the original CURENet—a network of people and programs that are creating course-based undergraduate research experiences (CUREs). Although there are CREs already in existence at these institutions, we cowrote a grant that was funded specifically to introduce CREs at different types of underserved institutions—including HBCUs and Minority-Serving Institutions—by hosting mobile institutes for faculty development.

Hampton, with the assistance of campus administrators, became the first site to launch the mobile CRE institute. There were thirty-two applicants from various STEM disciplines who applied to participate in our CRE institute, and we selected twenty-two from various institutions. Of the twenty-two participants, six were junior, nontenured STEM faculty members from Hampton University. Those six faculty members were asked to answer four open-ended questions before and after the CRE institute. The themes of the questions were: (1) preconceived notions of CRE; (2) feasibility of implementation of CREs; (3) perceived barriers of CREs at home institutions; (4) perceived support for CREs at home institutions; and (5) other reservations about CREs.

Our overall goal was to investigate faculty members' perception of the feasibility of implementing CREs, especially at HBCUs. We initially hoped to identify faculty members' preconceived notions of what CREs were and

whether they would feel comfortable implementing CREs prior to and after the faculty development workshop.

Participants in the institute also discussed faculty access to preexisting CREs, definitions of CREs, the difficulty and successes in funding preexisting CREs, the use of CREs created at other institutions, student and faculty buy-in, launching personal research in classrooms versus performing the traditional labs with no research experiences, data collection and trusting materials and data produced by students, and launching research and modules on websites before they are published (and whether they would count as scholarly productivity at their respective institutions).

Key Findings

Faculty Interests
Through our application process, we realized that many faculty members, locally and nationally, were eager to engage in this faculty development opportunity. They had multiple reasons that included updating their outdated introductory lab courses; creating exciting research opportunities for students that involved discoveries, inquiry, and the scientific methodology of having no predetermined answers; and using authentic research as a pedagogical tool to engage students in critical-thinking skills that will help them in all STEM disciplines and career trajectories.

Barriers and Opportunities
Although all responses from the participants were valued, perceptions of HBCU faculty members about the barriers and supports associated with CREs were the most interesting for this article (table 1).

Table 1. Perceptions of Faculty Members about the Barriers and Supports Associated with CRE

Faculty-perceived barriers for CREs
Consistent funding to support CREs
Lack of departmental buy-in
Students that are not receptive to the idea of research in the classroom
Time commitment
Internal support systems to deal with students' questions during CREs
Faculty-perceived supports for CREs
CRE facilitators and hosts
Current CURENet websites
Initial departmental funds
Pilot studies to generate data for grant proposals
Other CRE institute attendees internal and external to their institutions

There were many concerns from faculty related to CRE implementation, their research, and time commitment. Participants mentioned the need for peer mentors and graduate assistants. Different scenarios and cases were acted out to simulate the troubleshooting of situations that may arise during CREs. Faculty members were

encouraged to think out loud about ways to handle potential issues.

Different stakeholders came with different expectations for the faculty development institute. The facilitators were most focused on producing a lesson that could be published online from the institute. Faculty participants were most focused on the need to design a lesson that they felt accurately represented some of the concepts they thought would be covered in the typical curriculum. Some faculty members spoke of creating lessons that could be progressive, with students continuing their research from their first year to sophomore year. They hoped their colleagues would buy in and allow the lessons to continue as students progressed through their undergraduate educations. The faculty also seemed concerned about whether this work would be counted toward promotion and tenure, and about authorship for the students involved.

Faculty members also cited some of the challenges to implementing their newly designed CREs on campus, including other faculty members who were resistant to change. Participants noted that some faculty were not willing to deviate from what they typically do. Others focused on junior faculty who were afraid to try something new, fearing that they could be perceived as troublemakers. There was also noteworthy discussion about determining which faculty members were seasoned or solid enough to introduce change to their departments. Finally, participating faculty members discussed grading and assessing their CRE participants fairly compared to the non-CRE participants in their classrooms.

Faculty who designed their lessons were hopeful about cross-institutional and cross-disciplinary collaborations to effect change across the curriculum.

Outcomes

At the end of the institute, faculty members created their CREs in different disciplines—with the assistance of web designers, facilitators, and the author—published their CREs online, and the site was launched shortly after on the CURENet2 website for free public access.

Other outcomes for our focus group showed that Hampton faculty members had a 100 percent success rate in designing and publishing CREs. They also formed an interdisciplinary education committee to work on sustaining their newly designed and published CREs within their respective departments.

Overall, faculty members felt equipped and empowered to implement and design more CURES after the institute, even faculty that had no previous knowledge of CURES before the institute. Testimonials from CRE institute participants showed excitement about creating new research opportunities for students:

- “Very excited to learn new ideas that I can implement in a course that I am redesigning. I had thought about it, but never tried to implement it.”
- “The CURE institute was great because it gave me a clearer idea of how to incorporate undergraduate

research to generate data sets for future studies."

Conclusions

Due to barriers and limitations on resources (funding, personnel, etc.), we anticipate that some, but not all, faculty members will be able to fully implement CREs and sustain them within their departments. We will continue to track these participants to collect data on the institutional and individual successes, barriers, and suggestions for implementation of their CREs at their home institutions.

The implementation and sustainment of CREs demand multiple supportive stakeholders, including students, faculty, administrators, and lab coordinators. Making faculty members feel supported in their endeavors to create lessons and programs that may be instrumental for their students' success starts with support from institutional leaders and the administration. Institutional change can occur only when administrators participate in conscious and consistent efforts to listen to the concerns of their faculty members and support them in many ways that include, but are not limited to, providing faculty development workshops and other resources that create opportunities for their faculty members to create and sustain programs within the university.

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