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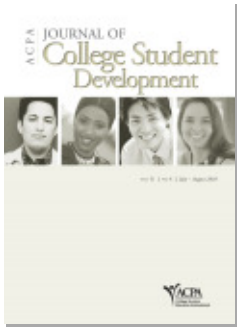

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Theory Meets Practice: HBCU Initiatives That Promote Academic Success Among African Americans in STEM

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In the current postindustrial era, increasing the number of minorities in science, technology, engineering, and mathematics (STEM) is critically important for the United States' economic growth and its position in the global marketplace (Guess, 2008; Moore, 2006; Öztürk, 2007). Given the U.S. Census Bureau's (2008) projection that the population of minorities is expected to increase by 2050, comprising 50% of the U.S. population, while White percentages are projected to decline, it is critical that research document programmatic initiatives that promote and support the success of underrepresented racial/ethnic minorities in STEM. To this end, we interviewed STEM program coordinators at an historically Black college and university (HBCU) in a mid-Atlantic state to gain insight about the uniqueness of their STEM initiatives and the impact they are having on student success in STEM fields. What makes these STEM initiatives unique is that they are undergirded by student affairs retention theories. In this article, we will present four STEM initiatives and provide context about the retention theories. We will also discuss what college administrators, specifically STEM coordinators, might learn and be able to implement from the initiatives discussed in this article.

DESCRIPTION OF STEM INITIATIVES

Although this HBCU has been chronically underfunded compared to its White counterparts, historically this university has a reputation for producing the most Black graduates in STEM fields in its state. The university has implemented a wide array of initiatives designed to support Black students pursuing STEM. One initiative that the university implemented to support Blacks in STEM is the Pre-Accelerated Curriculum in Engineering (PACE) Program. PACE is a 6-week intensive precollege summer program, for admitted freshmen, who have yet to take college-level courses in the engineering program. The primary purpose of PACE is to help students strengthen their skills in math and critical thinking so they can test out of developmental mathematics when they take the university's placement exam. This program exposes engineering students to critical thinking skills, advanced mathematics courses, English courses, mandatory tutorial support, and research/training. PACE introduces students to the engineering curriculum and facilitates engagement with engineering undergraduate students and faculty. The engineering program also provides students with peer tutoring/

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mentoring support. To this end, upper-class students assist faculty in providing freshmen and sophomores with the academic support to help them develop the self-efficacy and academic skills required to successfully complete the engineering courses. Research has shown that programs structured in this way help to enhance students' collegiate academic preparedness (Pascarella & Terenzini, 2005). According to STEM coordinators at the university, students participating in PACE have an 80% probability of testing into calculus, a gatekeeper course, at the end of the program instead of enrolling in developmental mathematics. Thus, participation in the PACE program significantly increases students' rate of persistence to graduation.

The Foundations of Mathematics (FOM) is a second STEM initiative that is similar to PACE in terms of helping students enhance their academic preparedness in STEM, specifically engineering. With FOM, students admitted to the university, but who have yet to take college courses, have the option of participating in an online course that assists them in enhancing their knowledge and skills in mathematical concepts. The central goal of this initiative is to help new students pass the university's placement examination with the highest score possible, thereby eliminating the need to take developmental mathematics. Removing this step can be critical as research has shown that the consequence of participating in developmental mathematics has the propensity to delay a students' time of graduation (Deil-Amen & Rosenbaum, 2002).

The tenets of FOM are not unique to engineering STEM majors. In fact, faculty and staff in the sciences have implemented a third STEM initiative that is analogous to the FOM. Specifically, they introduced WebWork—an online-based teaching and assessment system for difficult mathematics courses, such as precalculus, calculus, and differential equations. Faculty and staff implemented this after conducting a survey, which revealed that students were failing mathematics courses because they lacked a way to access instructors or tutors when they needed to verify mathematics procedures while studying or completing homework. WebWork provides students with immediate feedback regarding their math problems. The primary goal of this implementation is to increase the number of students successfully completing mathematics courses, which, in turn, will have a positive influence on retention and graduation in the STEM disciplines. According to STEM coordinators, in analyzing pre- and posttest data, the online mathematic courses offered through the FOM and WebWork initiatives have helped STEM students increase their academic performance and pass rates of various math courses from 10% to at least 15%.

The fourth STEM initiative that the university promulgated is Fast Track, which is a program that recruits upper-class students to work closely with freshmen students. In this context, the upper-class students engage groups of freshmen in a variety of workshops centered on three themes: "Mastering Mathematics," "Making It in Engineering," and "Planning to Graduate." The workshop gives successful upper-class students an opportunity to speak to freshmen about their collegiate journey, focusing specifically on how they made the adjustment to the engineering curriculum, how they performed academically, and how they used their freshmen year to craft a strong foundation of academic achievement in STEM.

Aside from the four STEM initiatives, the university has also promulgated departmental tutorial units in STEM fields, where students can receive peer tutorial support and assistance to help them achieve academically. Finally, each STEM major has retention counselors who serve as the students' primary academic advisor until students become juniors. The

number of students in the major determines the number of retention counselors in each academic unit. These student-centered retention staff/academic advisors play a vital role in the students' persistence. Collectively, the four STEM initiatives and supplemental services work in concert to increase academic preparation and achievement for students in STEM areas, particularly prior to and during students' first year in college.

THEORIES UNDERGIRDING STEM INITIATIVES

As discussed previously, one of the factors that makes these programs unique is the fact that they were strategically predicated on the theoretical frameworks of Tinto's (1993) theory of student departure and Astin's (1985) theory of student involvement. Although many researchers (e.g., Guiffrida, 2006; Hurtado, Carter, & Spuler, 1996; Nora & Cabrera, 1996) have criticized Tinto's theory of student departure because it emphasizes that students must "break away" from their former communities to fully integrate into their new communities—that is, the college—research has shown that student involvement (Harper, 2005) and emphasis on academic and social integration, without arguing that students disconnect themselves from their former communities (Flowers, 2004-2005; Palmer & Young, 2008- 2009), facilitates the success of minority students at predominantly White institutions (PWIs; Harper) as well as HBCUs (Palmer & Young). The central tenet of Tinto's theory is that students must be academically or socially integrated into the college context. He emphasized that academic and social integration helps students become cognizant of essential campus resources and develop healthy relationship with students, faculty, and administrators, which are vital for student retention and persistence.

In many respects, Astin's theory of student involvement is similar to Tinto's theory of student departure. Astin (1985) defined student involvement as the amount of physical and psychological energy that a student devotes to the academic experience. Astin mentioned that the more students engage in studying, participate in organizations, and interact with faculty, the more successful and satisfied they would be with their college experience.

RELATIONSHIP BETWEEN STEM INITIATIVES AND RETENTION THEORIES

The programs implemented by the STEM majors aim to foster students' academic and social integration by helping them adapt to the rigors of the STEM curricula and expectations of faculty and introduce them to support resources that can help them maximize their potential. Furthermore, the research/training components at the university help students become involved in STEM activities, increasing their chances of academic success. The mentoring component helps students become involved in the campus, which increases their exposure to support systems inside and outside of the classroom, facilitates the development of relationships with role models, and enhances their commitment to the university.

According to the STEM coordinators, these initiatives have helped to promote success in STEM fields at this university. Although it would be difficult to determine all factors that played a role in the success of STEM students, STEM coordinators referenced their analysis of pre- and posttest data to explain that since the implementation of the four initiatives, anchored by the retention theories, student retention, and overall success, as measured by student semester and cumulative grade point average (GPA) for STEM majors, have increased by at

least 18%. Graduation rates in STEM fields of study have increased by at least 15%. In addition, the STEM coordinators affirmed that these STEM initiatives have made a positive contribution to the success of these students at the university. In presenting information about the STEM initiatives at this HBCU, we wanted to showcase the impact of using student affairs approaches in concert with academic affairs. In doing so, we hope to encourage other STEM coordinators at HBCUs and PWIs to not only consider adopting similar student retention theories to improve the retention and persistence of their STEM students but also encourage them to think "outside the box" about nontraditional philosophies and approaches to positively enhance the success of students in STEM majors.

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