Extended Abstract-Stopping Leaks, Increasing Diversity in STEM: The Case of a STEM Enrichment Program

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***Abstract* - Due to changing national demographics, demands of technological innovation, and a globally competitive market, the United States is in need of diversifying its Science, Technology, Engineering, and Mathematics educational and vocational pipeline. STEM comprehensive programs have shown great promise in sustaining science interest and preparing academically at-risk students for postsecondary education. Research also indicates that STEM program participants are more academically and socially integrated than non-participants. The purpose of this study is to investigate how a STEM enrichment program aids in the retention of academically underprepared, underrepresented minorities at a predominantly White, large public research university. Using an explanatory, single case study approach, this study will examine the strategies and practices employed to retain its student population. The theoretical framework that will situate this study is Raymond Padilla's Expertise Model of Student Success. This framework contends that identification of barriers, knowledge, and actions are central to understanding the student experience and student retention. This study will examine how the STEM enrichment program applies the aforementioned concepts, using the following methods: focus groups and semi-structured interviews with program staff , current students and alumni; observation of program activities (e.g., classroom interactions, seminars); and analysis of program documents. Furthermore, this extended abstract sheds light on how a recent iteration of the Comprehensive STEM Program (pseudonym) summer bridge program component was improved to help students overcome barriers with math placement. It concludes with the significance of the study and next steps of the research.**

Index Terms-Diversity, STEM enrichment programs, Student success, Academic preparation

INTRODUCTION

The purpose of this extended abstract is to highlight the outcomes of a recent iteration of the summer bridge program, one of the program components included in the Comprehensive STEM Program (CSP) (pseudonym) at Jefferson State University (pseudonym). The summer bridge program is six-week, pre-freshman summer bridge program that has worked across historical organizational boundaries to develop an intervention that engages marginalized students and enriches their academic and social experience in Science, Technology, Engineering, and Mathematics (STEM) disciplines. CSP has existed for four years. However, during the most recent iteration, the program forged the expertise and influence of various institutional stakeholders to enhance the program and improve the student's college experience and likelihood of persistence, retention, and academic success in STEM disciplines.

OVERVIEW OF THE LITERATURE

Postsecondary education institutions are increasingly adopting programs and services to support student retention. Many of these programs and services are designed for the general student population (i.e., majority students; non-STEM majors). Scholars and student affairs administrators contend that there needs to be more specialized programming. In fact, Seymour & Hewitt [7] found that campus-wide programs were detrimental to the retention of students of color in STEM.

Significant attention has been devoted to the recruitment and retention of underrepresented minorities (URM) in the STEM fields [5]. Yet their retention and graduation rates are consistently lower than Whites and Asians. Only 24% of African American, Latino, and Native Americans earn a science bachelor's degree in six years, compared to their White counterparts at 40% [2]. STEM enrichment programs have shown promise in sustaining underrepresented minorities students' science interest and strengthening their preparation for college level work [3], [4]. According to Tsui [10], features of successful comprehensive programs include recruitment strategies, academic advising, tutoring in math and science courses, and summer experiences.

STEM enrichment programs such as the Meyerhoff Scholars Program and the Louis Stokes Alliance for Minority Participation (LSAMP) have garnered national attention and support for making significant strides in increasing the number of URMs pursuing STEM degrees. Most notably, Dr. Freeman Hrabowski, president of University of

Maryland, Baltimore County, was recognized for having the most African American PhDs in science and engineering [8]. Although the Meyerhoff Scholars Program has received much praise for its program and its students, critics assert that the success of the program is a result of its "cherry picking" approach to student selection [4]. Many of the students in the program have high standardized tests scores, strong high school GPAs, and substantial involvement in pre-college programs [4]. Their reasoning for only selecting "high-achieving" students is that without their intervention these students would still be unlikely to complete college or earn a STEM degree. However, there is a growing number of students enrolling in higher education from first-generation backgrounds and from underperforming, under-resourced high schools. As a result, many more students will begin their college careers in developmental math classes [1]. Research, however, shows that developmental math starters can still be successful with intentionally designed support.

COMPREHENSIVE STEM PROGRAM

The Comprehensive STEM Program (CSP, pseudonym) was established in 2009 with a grant from the National Science Foundation. CSP is part of a consortium of public flagship institutions in the state that have achieved the Carnegie classification of doctorate-granting research university with very high research activity. This consortium is known as the Louis Stokes Alliance for Minority Student Participation. CSP contains the following program components: a six-week academic intensive residential summer bridge program, clustered math classes weekly recitation sessions, academic advising, freshman seminar, and participation in summer research opportunities.

Many of the CSP students begin their college careers in developmental math courses. Yet 95% of the first cohort was retained in engineering through their first year, and they surpassed their predicted GPAs (2.903 vs. 2.56). Additionally, students who attended 80-90% of the recitations obtained a median cumulative GPA of 3.45. This data demonstrates that CSP eases the transition from high school to college for underrepresented groups. Some faculty contend that students of color are not retained in STEM, because they are unmotivated [9]. On the contrary, Seymour and Hewitt [7] found that academic preparation was a more significant predictor to the progress of students of color. The program efforts of CSP seek to address the latter.

RESEARCH QUESTION

The primary research question that guides this study is: How does a Science, Technology, Engineering, and Mathematics (STEM) enrichment program (the Comprehensive STEM Program) aid in the retention of academically underprepared, underrepresented minorities (URMs) at Jefferson State University (pseudonym), a predominantly White, large public research university? Using Raymond Padilla's Expertise Model of Student Success (EMSS), the explanatory case study will examine strategies and practices employed with CSP at Jefferson State. Padilla [6] argues that the college experience is a black box inherent with barriers. Successful students must possess both heuristic (i.e., institution-specific) and academic (i.e., content-specific) knowledge, and they must employ purposeful actions to overcome these barriers.

COLLABORATION THAT MAKES SENSE

Each summer, the bridge program component of CSP offers intensive mathematics support in a manner that allows participants to overcome gaps and deficiencies in their conceptual and operational knowledge. In prior years, students were unable to capitalize on this improved status due to institutional policies that disregarded cognitive development ascertained from summer bridge program interventions. According to university policy, a student was required to take a math placement exam prior to enrollment, and the corresponding score dictated the student's placement for his or her subsequent fall academic schedule. Last summer, the program administrators worked with the mathematics department to allow students to retake their math placement exams following the summer bridge intervention. At the end of the program, 88% of the participants increased their math placement scores. Many of the students were able to bypass one to three math courses. These academic movements improved time to degree, persistence, and graduation rates. Institutional data and the literature support that students who start their college careers in higher math courses are more likely to be retained and earn their STEM degrees [10]. Likewise, the aforementioned successful outcomes contribute to occupational and self-identity development. Students who perform better in gateway courses, such as mathematics, have higher self-confidence and more salient science identity [5]. These factors are important for "becoming" future scientists and engineers [11]. Another key feature of this program adjustment is that the staff identified a barrier that was affecting student persistence and took appropriate action. Often times, students will leave the sciences if they are disinterested in the courses [11]. For instance, if students are prepared for the next level of math courses and the university requires these students to complete rudimentary coursework, they may be less inclined to work hard or engage in the course. Furthermore, students were grateful that the mathematics department administrators and CSP developed this policy change, as evidenced in the following comment from a participant in last year's program. "Truthfully, I don't know how I would have done without [CSP]. I would've been in a lower math class, with the same gaps in my education, without anyone to show me where they were" (*Cohort D participant*).

DATA COLLECTION AND POTENTIAL FINDINGS

Data collection on all program components and multiple cohorts began June 2013. Comprehensive STEM Program staff and instructors, current students, and alumni (i.e., STEM graduates who are former participants of CSP) will be invited to participate in this study. To render triangulation and strengthen the trustworthiness of the data, I will use several forms of data collection, including focus groups, semi-structured interviews, participant-observations, and document analysis.

Based on the literature, this study may result in the following findings. In addition to inadequate academic preparation and challenges with competences in mathematics, study participants may identify campus climate and culture and disengaging classroom environments as impediments to their success in STEM. To counteract these barriers, program staff may employ academic support, psychological support, and undergraduate research opportunities for students to affirm their science identity and make them feel more comfortable in STEM settings. Likewise, successful students actively participate in CSP's programming and take advantage of services.

SIGNIFICANCE OF STUDY

Many students of color enter higher education interested in pursuing a STEM degree; unfortunately, many of these students are underprepared to complete the rigorous curriculum. This lack of preparation warrants institutional support to improve the likelihood of student retention and success. Purposefully designed STEM enrichment programs can be instrumental in helping URM STEM students overcome academic and context-specific barriers. However, more scholarship is needed on STEM enrichment programs, not only to describe what these programs do, but also to explain how these programs assist underrepresented students and why they employ particular strategies and practices to do so. Such findings may help with establishing best practices and replication of services at other institutions.

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