

Chapter 2

The Effects of Using Open Educational Resources on Minority Achievement in Undergraduate Mathematics

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ABSTRACT

Prominent in the public debate on college affordability is the rising cost of textbooks. Owing to limited finances or mounting college debt, many students fail to purchase required course textbooks. Among the perils students without textbooks face are delayed course enrollment, high failure or dropout rates, and extended time to graduation. At Fort Valley State University, an Historically Black University within the University System of Georgia, the mathematics faculty first observed increasing numbers of college algebra students without textbooks, then, similarly, with upper division students. As a cost-savings measure, the faculty redesigned eight courses using open educational resources (OER). This chapter highlights the four-year results of faculty and students' OER course experiences. OER students have better grades, lower failure rates, and better attendance records than those using traditional textbooks. The attitude of OER students towards mathematics also improved. A total cost savings of \$197,780 was realized with an average, per student savings of \$198.

INTRODUCTION

K-16 curricular redesign and instructional reform projects yield promising achievement outcomes for minority students studying science, technology, engineering, and mathematics (STEM). However, to diversify more fully the pool of highly qualified American scientists and engineers, there is a contin-

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ued need to examine the impact of minority achievement in mathematics. For many minority students, mathematics serves a gatekeeping function, limiting access to STEM disciplines. With undergraduate mathematics a prerequisite for all STEM majors and considering the persistent minority achievement gap in mathematics, the need is more urgent for in-depth investigations of other possible factors inhibiting minority success. A plethora of studies explore academic-related topics on the minority achievement gap in mathematics, focusing on such topics as preparedness, student engagement, and efficacy. Few, if any such studies, have examined the effects of nonacademic factors, such as the high cost of mathematics textbooks, on minority achievement, specifically in undergraduate mathematics.

This chapter describes the authors' response to this void in the literature. Results are reported on the four-year, cost-savings efforts undertaken by three teams of faculty in the Department of Mathematics and Computer Sciences at Fort Valley State University (FVSU). One of three historically black colleges and universities (HBCU) in the University System of Georgia (USG), FVSU enrolls many first-generation college students, most of whom are on financial aid.

In fall 2014, an unusual trend was observed. An increasing number of students enrolled in college algebra and precalculus classes failed to purchase their textbooks. Their subscriptions to MyMathLab (MML), the learning management system required for the laboratory components of these courses, were not being renewed after the free trial period, due to the cost. This trend of students not purchasing textbooks and related MML course materials was soon observed in other course offerings within the department. It became clear that the quality of students' preparation for and participation in class was clearly being compromised by their financial situations. Therefore, the mathematics faculty teaching these courses elected to pursue an alternative course of action.

Concomitantly, college affordability was being addressed as a major concern of the USG. The system's Affordable Learning Georgia (ALG) grants provided funding for faculty development and course transformation efforts using open educational resources (OER). From 2015 to 2018, three teams of FVSU mathematics faculty received ALG grants to redesign eight mathematics courses using OER. The transformed courses included college algebra, precalculus (inclusive of trigonometry), calculus I, calculus II, calculus III, business calculus and economics, statistics, and differential equations.

In this chapter, the authors present a retrospective view of the impact of this course transformation process. First, an analysis is provided of the lessons and gains attained from the faculty development and implementation components of the ALG course transformation process. Second, an analysis is provided of the effects of the transformed OER course experiences on minority (primarily African American) students' success in the targeted undergraduate mathematics courses.

BACKGROUND

In response to public concerns over the rising cost of a college education, the state of Georgia provided funding to USG to undertake ALG, a textbook transformation initiative. In spring 2015, the first round of ALG grants was awarded to USG faculty for the development and use of OER. ALG grants continue to be awarded in support of released time and professional development opportunities. This funding enables USG faculty to explore ways to lower students' cost of textbooks and related course materials (<https://www.affordablelearninggeorgia.org/>).

At some institutions and owing to uncertainty about course enrollment, students only learn about the textbook(s) required for their class (es) at the beginning of the semester. Due to these time constraints,

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