Chapter 8

Using Multidisciplinary Research Experiences to Enhance STEM Learning through Undergraduate, Team-Based, Summer Research Projects for At-Risk Students

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EXECUTIVE SUMMARY

Undergraduate research can be one of the most important and influential learning experiences during a student's college career (Light, 2001). Significant retention value is achieved both through one-on-one contact with a faculty mentor (Campbell, 1997; Jacobi, 1991) and by interaction with peers in a learning community (Johnson, 2001). Colleges and universities are using undergraduate research experiences to help improve student retention, graduation, and success in Science, Technology,

Engineering, and Mathematics (STEM). However, undergraduate research is frequently reserved for the best and brightest students who have achieved junior or senior class status. This case study describes a team-based research experience designed for first-year, at-risk undergraduate students. For this project, the term "at-risk" is defined to be first-time, full-time freshman declared STEM majors with a weak mathematics background as measured by having an ACT-Mathematics sub score of 19 to 23, inclusive. In particular, this case study focuses on the multidisciplinary nature of some of the research projects and the benefits for the students in terms of confidence, depth of learning in STEM, and progress in understanding the scientific process.

ORGANIZATION BACKGROUND

This case took place at a public university in the Southeastern United States with an enrollment of approximately 25,000 students in 2012. Full-time undergraduate students made up 72% of the student population. Of these full-time undergraduate students, 21% declared a major in a science, technology, engineering, or mathematics (STEM) discipline. The number of males and females was almost perfectly balanced across the institution, but only 38% of undergraduate STEM majors were female. Minorities made up 31% of both the overall university population and undergraduate STEM majors.

Like many institutions of higher education, this university had shifted its focus to the retention of students to adjust to the state funding formulas that moved from "head count" to "outcomes." In particular, the university administrators are aware that the retention of students majoring in STEM fields was critical to meet the future workforce demands (Carnevale, Smith, & Strohl, 2010). University data showed that from 1999 to 2003 an average of 55% of students majoring in a STEM discipline progressed to their second year, and on average 35% progressed to their third year. In this same time period, only 16% of first-time, full-time students who started with a major in a STEM field actually graduated with a degree in a STEM field within six years.

To address the low graduation rate of students majoring in STEM fields, in 2010 the university applied for, and received, a $2 million, five-year National Science Foundation STEP 1.b grant called FirstSTEP: Mathematics as a FirstSTEP to Success in STEM (Grant No. 0969571). Recognizing that mathematics was often a barrier to student success in STEM disciplines, two of the grant's three components addressed student success in mathematics courses. The third component, called Summer Immersion, engaged low-achieving students in authentic undergraduate