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Academic Success for STEM and Non-STEM Majors

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Enrollment in STEM majors has improved recently, but there continues to be concern over retention in those majors, especially of women and minority students. The purpose of this study is to develop an integrated understanding of how multiple predictor variables affect student degree attainment and to ascertain how the variables impact is regulated by whether students are in STEM or non-STEM majors. Six-year cohort retention/graduation outcomes are predicted for all students in STEM and non-STEM majors, and are adjusted separately for whether students remain in, or shift into or away from, STEM majors. Long-term retention/graduation is predicted significantly by cumulative grade point average, financial need, aid (work-study, loan, and gift), gender, ethnicity, years living on campus, high school rank (HSR), ACT composite, out-of-state residence, and STEM status. For students starting out in non-STEM majors, six-year graduation/retention also is predicted significantly by learning community participation and whether the student switches to a STEM major.

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Enrollment in STEM majors has improved recently, but there continues to be concern over retention in those majors, especially of women and minority students. The purpose of this study is to develop an integrated understanding of how multiple predictor variables affect student degree attainment and to ascertain how the variables' impact is regulated by whether students are in STEM or non-STEM majors. Six-year cohort retention/graduation outcomes are predicted for all students in STEM and non-STEM majors, and are adjusted separately for whether students remain in, or shift into or away from, STEM majors. Long-term retention/graduation is predicted significantly by cumulative grade point average, financial need, aid (work-study, loan, and gift), gender, ethnicity, years living on campus, high school rank (HSR), ACT composite, out-of-state residence, and STEM status. For students starting out in non-STEM majors, six-year graduation/retention also is predicted significantly by learning community participation and whether the student switches to a STEM major.

1. Literature Review

Previous research (Daempfle, 2003; McShannon, 2001; Seymour & Hewitt, 1997) has shown concern for the number of students who choose and maintain a science major in colleges and universities. Astin and Astin (1993) used four-year longitudinal data from over 27,000 students and multivariable analyses to study how institutional traits and background characteristics of students affect their interest in studying science and majoring in science-related fields. They found that the number of students majoring in science, mathematics, and engineering declined from the freshman year to the senior year, from 28.7% to 17.4%, a 40% relative decline. Individual mathematics courses taken and overall college preparation played a large role in students persisting in those majors.

Subsequently, enrollment of students in Science, Technology, Engineering, and Mathematics (STEM) fields has increased somewhat (Huang, Taddese, & Walter, 2000; Seymour, 2002; Toulmin & Groome, 2007), but not at a pace to meet the goal of a leading business organization, Tapping America's Potential (TAP), to double the number of STEM graduates by 2015 (Reid, 2008).

While interest and ability are major considerations in students choosing a STEM major, Takruri-Rizk et al. (2008) found that having family members in the engineering or technology industry also played an important part in students' degree choice. It is more difficult to understand why students may not be drawn to STEM fields. Robinson (2003) indicated that students who took an advanced placement (AP) course in science or calculus selected STEM careers at a higher rate than they picked other careers. But even though more students may enroll in a STEM major, persistence of students in STEM majors remains a problem (Daempfle, 2003). Seymour (1995) noted that the quality of teaching in science classes has an impact on persistence. Some attrition has been explained by students being unprepared (Seymour & Hewitt, 1997; Strenta, Elliott, Adair, Matier, & Scott, 1994), yet even well-prepared students have been found to leave science, mathematics, and engineering majors because of what they perceived as poor instruction, undesirable curricular structure using one-way lectures, and faculty who valued their research above teaching (Seymour & Hewitt, 1997). Springer, Stanne, and Donovan (1999) summarized a number of efforts to improve STEM courses, such as small-group learning.

1.1 Underrepresented students (women and minorities) in STEM majors

Maintaining a diverse enrollment to include women and minorities in STEM majors is also a concern (Tan, 2002). The Astin and Astin (1993) Higher Education Research Institute (HERI) studies documented higher loss rates for students in STEM majors among Hispanic, African American, or Native American students, using data collected by the Cooperative Institutional Research Program (CIRP) at UCLA. National data from the 1980s found poor persistence by minority students compared with majority students in engineering majors (Morrison & Williams, 1993) and in science and mathematics (Culotta, 1992).

However, data from the National Science Foundation have indicated some narrowing of the gap in representation of women and minorities among science and engineering bachelor's degree recipients in the United States (Hill, 2007; Huang et al., 2000). Yet underrepresentation of women and minorities is reaffirmed in a report by Cassell and Slaughter (2006), who cite 2004 data from the National Center for Education Statistics indicating a continuing gap in degree attainment by students in STEM enrollment and degree attainment. The same authors cite National Science Board statistics indicating the underrepresentation of women in STEM disciplines. Chubin, May, and Babco (2005) noted that, while their representation is improving in some STEM majors, women and minorities are still underrepresented in engineering majors. A study by the American Council on Education (Anderson & Kim, 2006) indicated increasing six-year persistence/graduation for African-American and Hispanic STEM majors,