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Table of Contents

If you're viewing this document online, you can click any of the topics below to link directly to that section.

Women and Minorities in the Science, Mathematics and Engineering Pipeline. ERIC Digest.....	1
FACTORS AFFECTING INTEREST IN THE SCIENCES.....	2
CHALLENGES IN RETAINING STUDENTS.....	3
INNOVATIONS IN RETAINING UNDERREPRESENTED STUDENTS.....	4
CONCLUSION.....	4
REFERENCES.....	5



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Over the next 10 years, the United States will need to train and educate an additional 1.9 million workers in the sciences (NSB, 2002). Recent enrollment trends indicate that increased involvement of underrepresented groups is essential in meeting this demand. Currently, all along the educational pipeline, students are being lost in the fields of science, mathematics and engineering (SME). Moreover, the participation and persistence rates of women and minorities in these fields are dramatically lower than those of the general student population. In 1998, women who received 56 percent of BAs overall comprised 37% of the SME bachelor degrees conferred, and underrepresented minorities, including African-Americans, Latinos, and Native Americans, received just 12% of the total SME degrees awarded (NSB, 2002).

Community colleges have been called upon to help bolster underrepresented student participation in these fields (Feuers, 1990; NSF, 1996). Two-year colleges enroll nearly half of all undergraduate students. Women slightly outnumber men at these campuses, and over fifty percent of ethnic minorities in higher education attend a community college. As many of these underrepresented students have their first exposure to higher education SME at these institutions, community colleges possess a special responsibility and influence in moving participants through the pipeline. This digest discusses SME interest barriers and strategies for retaining women and minorities in SME, examining how community colleges are working to promote increased representation and success of women and minorities in SME.

FACTORS AFFECTING INTEREST IN THE SCIENCES

Student interest in SME fields continues to decrease. A recent national study examining trends in undergraduate education reveals a steady decline in student interest in the physical sciences and mathematics over the last thirty years (Astin, Parrott, Korn, Sax, 1997). Of those students who enter showing an interest in SME, certain academic factors are found in common. These include: earning high SAT math scores and high school GPAs and having previously taken courses in science and mathematics (Seymour, 1992). In addition, students in SME at community colleges also tend to be enrolled full-time, have higher academic aspirations than their peers, and have a greater interest in transferring to four-year institutions (Feuers, 1990).

After accounting for these factors, however, minorities and women still appear to have a lower level of interest in the sciences (NSB, 2002). Research indicates that attitudinal factors contribute to the discrepancy. African-Americans, Native Americans, and Latinos possess strong cultural values of group and community membership that may be at odds with the perceived levels of individualism and competition associated with the sciences (NSF, 1996). They also report a lack of interaction with current participants in SME fields, which is a barrier to increased interest. For women, perceptions of

competition and difficulty with majoring in the sciences are paired with low self-ratings of ability in analytical fields that have traditionally been male-dominated. Cases of math anxiety and instructors' lowered expectations have also been shown to hinder women from participating (Seymour and Hewitt, 1997).

To reverse these perceptions and increase female and minority participation, educators point to the need to strengthen the educational pipeline, especially at the pre-college and community college level where interest in mathematics and science develops. To this end, community colleges have partnered with elementary and secondary schools. The Mathematics, Engineering, Science, and Achievement (MESA) program, which partners Glendale Community College with local high school classes, is an example of such an approach (Mendoza, 1991). Evaluations of similar programs at Broward Community College and Delgado Community College reveal high levels of persistence in these programs as well as increased women and minority student interest in science and technology (Green, Blasik, Hartshorn, Shatten-Jones, 2000).

CHALLENGES IN RETAINING STUDENTS

In addition to the challenges of recruiting students as SME majors, there are also retention issues. These three fields report the lowest retention rates among all academic disciplines. Approximately 50% of students entering college with an intention to major in SME change majors within the first two years (Center for Institutional Data Exchange and Analysis, 2000).

One reason for this loss of students is that many incoming freshmen lack basic science and mathematics literacy needed for persistence. A study conducted at twenty-three community colleges in California found that 31% of students fail to complete SME courses, while another 19% complete courses but with a grade of D or F (Feuers, 1990). Not only is the course completion rate particularly low in SME fields, but the percentage of students requiring remedial work is also increasing, approximately one-third of students at two-year colleges enroll in remedial mathematics courses (NSB, 2002). These courses are essential for responding to students' lack of readiness for college level SME course work. Especially in urban community colleges that serve a large minority population from low performing high schools, intensive programs in remedial education are important for increasing minority student retention in SME (Feuers, 1990).

While deficiencies in students' academic preparation lead to attrition, research suggests that students' negative perceptions of SME subject material and career options also play an important role. In a survey of college students who left SME, the most frequently cited factors contributing to decisions to change majors included: the belief that non-SME majors offer greater intrinsic interest, a loss of interest in SME, and a rejection of the SME career-associated lifestyle (Seymour, 1992).

Farrell (2002) explains that SME fields have failed to highlight the social value and

relevance of the subject material. In particular, the disconnection between subject material and life applicability has been shown to affect the retention of women in engineering. For many female students, the technical nature of engineering does not suggest life skills of creative thinking and communication. Seymour (1992) explains that the image of scientific careers also does not appeal to female students' orientation toward helping others and having a family.

INNOVATIONS IN RETAINING UNDERREPRESENTED STUDENTS

Community colleges have employed several approaches to increase retention of women and minorities in SME. First, efforts have been taken to address the perceived lack of relevance of coursework. The National Science Board (2002) recommends restructuring undergraduate SME curriculum to include more investigative learning, technology, laboratory experience, and collaborative work. Programs that have provided students an opportunity to engage in hands-on, real life projects have been successful in increasing female enrollment and retention (Farrell, 2002). Changing the curriculum to promote more collaborative group work has also helped students develop peer networks. Such social support systems are of particular benefit to underrepresented students in fields that have previously been perceived as intimidating or unwelcoming (Farrell, 2002).

Mentoring programs that help socialize students to SME fields are another form of support for women and minorities. The presence and guidance of peer or faculty mentors have been shown to positively affect retention (NSF, 1996). For women in the sciences, mentors help provide a support network that increases students' self-confidence and feeling of worth to the field (Goodman Research Group, 2002).

Lastly, two-year colleges are seeking not only to increase retention, but also to increase transfer of underrepresented students. Currently, over 35% of ethnic minorities graduating with a bachelor's degree in science and engineering began their college careers at community colleges (NSF, 1996). To increase these numbers, partnerships between two- and four- year colleges have been established. Programs like the Community College Summer Research Program at Occidental College have successfully transferred groups of students who have later gone on to pursue SME study (Halleck, 1990).

CONCLUSION

Increased participation of women and minorities is essential in meeting the projected need for SME workers, and in furthering the nation's production of technology and scientific research. The community college, with its diverse student population, is an integral player in advancing underrepresented student involvement in the sciences. At these institutions, steps need to continue to be taken to reduce social and educational

barriers and encourage students to pursue and persist in SME.

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