

UNDERGRADUATE WOMEN IN SCIENCE AND ENGINEERING: PROVIDING ACADEMIC SUPPORT

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Although male and female students of science and engineering start their college careers with comparable academic credentials (Owen, 1993), women abandon these majors in greater proportions than men (Astin & Astin, 1993). The undergraduate science and engineering classroom has been identified as one of the specific locations where barriers to women students' participation and persistence might exist (e.g. Seymour & Hewitt, 1994).

In this paper, we present factors that have been found to influence the learning experiences of undergraduate women in science and engineering. After summarizing research findings, we suggest actions that individual faculty members can take to improve the academic environment. While these suggestions are made with women students in mind, their implementation can result in a more positive learning climate for all students. We will look at the critical areas of classroom climate, self-confidence, and interaction with faculty and peers.

Classroom Climate

RESEARCH FINDINGS: Most faculty members are very supportive of women's presence in their courses. However, some faculty unconsciously support an atmosphere that is overly competitive and unfriendly to women (Belenky, Clinchy, Goldenberger, & Tarule, 1986). Male and female faculty members tend to interact more with men and respond more positively to men's classroom contributions than to women's (Barba & Cardinale, 1991; Klawe & Leveson, 1995; Sternglanz & Lyberger-Ficek, 1977). Compared to women, men typically participate in greater numbers in class discussions (Crawford & MacLeod, 1990; Huntington, 1986; Krupnick, 1985; Sternglanz & Lyberger-Ficek, 1977), interrupt more often, and are more assertive (Brooks, 1982; Sandler, 1987). Women, on the other hand, are often more hesitant than men when answering questions or sharing opinions. Below we describe specific teaching behaviors that can positively influence the classroom climate for students.

SUGGESTIONS: Allow more time after asking a question before calling for an answer, and intervene when students are interrupted. Learn students'

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names and use them. Encourage non-participating students to join in discussions by actively soliciting their opinions. Request that frequently participating students sometimes refrain from responding in order to provide an opportunity for others to contribute. Provide frequent encouragement by lauding both correct answers and genuine efforts. Never belittle a student's response, and take advantage of incorrect answers to clear up misunderstandings. Provide prompt feedback by handing assignments and exams back quickly. Assign groups of students to work through short problems during class so they can evaluate their grasp of the concepts being covered. Then, ask questions of the groups, rather than of individuals. Assign grades using a fixed criterion rather than a curve to encourage student cooperation. Be aware of the way in which your own behavior is affecting students. Comments, humor, and behavior that might be interpreted as sexist or flirtatious should clearly be avoided.

Self-Confidence

RESEARCH FINDINGS: Lack of self-confidence can affect the capacity of women to perform to the best of their abilities. Women express a lack of confidence in their math (Sax, 1994), spatial-mechanical (Lenney, 1981), and creative abilities (Lenney, 1981), particularly when compared to men. In addition, women's confidence levels decrease during their college careers, a decrease that is unrelated to actual decreases in their ability or achievements (Arnold, cited in Widnall, 1988). Women also tend to attribute success to external factors and to attribute failure to personal lack of ability, while the reverse is true for men (Felder, Felder, Mauney, Hamrin, & Dietz, 1995). Women are often concerned about the perception of engineering and some science disciplines as male professions, a concern that is exacerbated by primarily male portrayals of engineers and scientists (Brush, 1991). Many women students lack confidence in their future ability to balance an engineering or science career with family responsibilities (Morgan, 1992). Faculty can play an important role in increasing the self-confidence of women students.

SUGGESTIONS: Recognize individual academic accomplishments. For example, send congratulatory notes to students who receive academic awards or do well on exams. Let students know you care about them by greeting them outside the classroom and inquiring about their academic progress and future plans. Encourage students to tutor others and to hold leadership positions in extracurricular activities as ways of increasing their confidence. Highlight the achievements of women in your discipline. For example, discuss women's historical contributions during class

presentations and invite women scientists and engineers, particularly alumnae, to participate as guest speakers in classes or student society meetings.

Interactions with Faculty

RESEARCH FINDINGS: The unapproachability of science and engineering faculty members and a lack of adequate advising are often cited as concerns of women students (Seymour, 1992a; Seymour, 1992b). There appears to be a correlation between informal contact with faculty and both student confidence (Sax, 1994) and student persistence (Pascarella, 1980; Pascarella & Terenzini, 1979). It is particularly important that the nature of the interaction between faculty and student be positive (Seymour & Hewitt, 1994). Ways to encourage positive student-faculty interactions are presented below.

SUGGESTIONS: Throughout the semester, encourage students to attend office hours. Treat all questions seriously. Listen and watch for messages that show low self-confidence, such as self-deprecating behavior and speech. For example, some students might preface an answer with a comment such as, "This is probably all wrong, but..." Offer special encouragement to these students. Engage women in informal discussions of career plans, and encourage women to consider graduate study. Recruit women as research and teaching assistants. Inform women of enrichment opportunities, such as internships, workshops, and professional conferences. Attend faculty-student events and meetings of your department's student society to keep informed of student issues.

Interactions with Peers

RESEARCH FINDINGS: Many undergraduate women in science and engineering feel isolated (Baum, 1990) and perceive that they are resented by male students (Morgan, 1992). Women are frequently interrupted in learning groups, and their contributions are often ignored by men (Pearl et al., 1990). Women who are confident in science and engineering classrooms often elicit negative responses from their male peers (Seymour & Hewitt, 1994). Many women hide their academic abilities to avoid alienation and ensure social success (Noble, 1987). Faculty can take positive action to counter negative peer interactions.

SUGGESTIONS: Praise women's individual academic accomplishments to counter negative reactions from peers. Attempt to create a cooperative instead of a competitive learning environment by encouraging students to work in

groups. When creating cooperative learning groups, attempt to place more than one woman in a group. Monitor cooperative learning groups for gender-related conflicts. Challenge sexist attitudes and comments. Make it clear to students that unpleasant behavior in the classroom will not be tolerated.

Conclusion

Faculty members can make a difference in the college experience of undergraduate women in science and engineering. By paying attention to issues of classroom climate, student self-confidence, and student interactions with both faculty and other students, we can positively impact student persistence and future career success.

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