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Searching for the Peach Blossom Shangri-La: Student Engagement of Men and Women SMET Majors

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The famous poet from China's Jin Dynasty, Tao Yuanming, wrote about the "Peach Blossom Shangri-La,"¹ a utopian setting where people can pursue their dreams, protected from the harsh realities of the outside world. The story is about a fisherman who follows a stream and comes upon miles of dazzling blossoming peach trees lining both banks. Eventually he arrives at the source of the stream which suddenly opens up to reveal a beautiful, idyllic land where people live together happily and peacefully. The ancestors of the villagers came to this place to avoid the chaos of war during ancient times. The fisherman returns to his home but is unable to retrace his steps to show others this place.

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¹A more detailed version of the Peach Blossom Shangri-La story can be found at <http://www.blackmask.com/books77c/peach.htm>.

Over the past two decades, women have made impressive inroads into many fields, including such traditionally male-dominated professions as law and medicine. However, their advancement has flagged in technical fields such as science, mathematics, engineering, and technology (SMET) (Thorn, 2001). For example, in 1996 women received about 55% of all bachelors' degrees, but accounted for only about 18% of bachelors' degrees in engineering fields, 34% in mathematics and computer sciences, 37% in physical sciences, and 50% in biological/agricultural sciences (National Science Foundation, 1998).

Despite efforts by colleges and high school counselors to encourage more women to pursue SMET majors, these fields continue to show some of the largest gender disparities (Huang, Taddese, & Walter, 2000), even as demand increases for people trained in these areas. Increasing the number of women in SMET fields is not only a matter of gender equity. It would also add much-needed diversity in perspectives, creativity, and leadership to these fields (Baum, 2000).

Contrary to prevailing thought, women who pursue engineering and other SMET fields are just as well prepared and committed to the field as their male counterparts (Huang et al., 2000). Although women are less likely than men to enter science and engineering fields, those who persist are likely to do well (Huang et al., 2000). Women have a tendency to overcompensate for being in a male-dominated field, a phenomenon referred to as the "Madame Curie effect," meaning that women believe they must become more qualified and develop exceptional ability to compete with men in male-dominated science (Rosser, 1997). Previous research has reported that women who choose SMET majors are more likely to have high mathematics and science self-concepts, positive attitudes toward math, plans for advanced education, and a strong background in science and math in high school (Davis et al., 1996; Ethington, 1988; Maple & Stage, 1991; Nauta, Epperson, & Wagonner, 1999; Sax, 1994).

Seymour and Hewitt (1997) suggest that disciplinary cultures and the nature of precollege and collegiate educational experiences combine to hinder women's persistence in SMET fields. Indeed, the academic culture and "chilly classroom climate" said to characterize many SMET programs may be the greatest obstacles women must overcome to succeed (Eisenhart et al., 1996; Hall & Sandler, 1984; Hollenshead et al., 1996; Tonso, 1998; Whitt et al., 1999). In part, this is because these fields have long been associated with masculine images that feature competitiveness and a studied objectivity that tends to suppress the legitimacy of subjective and connected ways of knowing (Easley, 1986). Those women who appear to function effectively in such settings often establish a dual identity so that they can adapt their behavior when necessary to meet SMET cultural demands but also remain authentic to their own personality in other settings (Newton, 1986).

The cultural values played out in SMET fields also conflict with the preferred learning styles of many women (Oakes, 1990). For example, unlike male students who employ "separate knowing" approaches, female students are more likely to engage in "connected knowing" (Belenky et al., 1986), which emphasizes learning through relating with others and values subjective experiences; these latter behaviors are discouraged in SMET fields (McIlwee & Robinson, 1992; Seymour & Hewitt, 1997). In addition, aspects of traditional science pedagogy, such as a competitive classroom ethos and large lecture classes are not congenial with women's preferred learning styles and discourage their participation in class activities (Astin, 1993; Fassinger, 1995; Nulty & Barrett, 1996; Rosser, 1991). Thus, it is not surprising that women in SMET classes report less positive experiences in the classroom than their male colleagues (Astin, 1993; Fassinger, 1995; Nulty & Barrett, 1996; Rosser, 1991). At the same time, when SMET courses use gender-sensitive pedagogy that downplays the masculine culture of competition and encourages collaboration through group projects and negotiated learning, women tend to perform well and are reasonably well-satisfied (Colbeck, Cabrera, & Terenzini, 2001; Scantlebury, 1998; Stage et al., 1987).

The masculine image of SMET fields also influences the early socialization of women students and is thought to diminish the interest of and academic achievement of young women in science and math courses in high school (Kelly, 1987). This results in a negative amplification cycle (Weick, 1979), in which fewer women enter the SMET pipeline, producing gender disparity which, in turn, reinforces the mythology about who belongs in science and engineering (Eisenhart & Finkel, 1998; Maher & Tetreault, 2001). That few female role models are available tends to further erode women's confidence that they can do well in SMET fields. Thus, tenuous self-confidence likely discourages young women from entering SMET fields, despite having academic abilities that are on a par with their male counterparts (Seymour & Hewitt, 1997). In fact, many women who leave SMET fields before earning degrees have higher grades than men who persist (Cunningham & Helms, 1998; Drew, 1996; Seymour & Hewitt, 1997).

The gender disparities and difficulties faced by women in SMET fields have not gone unnoticed. As with other fields, many SMET programs, especially engineering, are revising their curricula and pedagogical practices to increase students' engagement in activities that are known to contribute to student learning, satisfaction, and educational attainment (Eisenhart et al., 1996). One of the best-known set of such activities is the "Seven Principles of Good Practice in Undergraduate Education" (Chickering & Gamson, 1987): student-faculty contact, cooperation among students, active learning, prompt feedback, time on task, high expectations, and respect for diverse talents and ways of learning. The theory that undergirds these and other effective educational practices suggests that students who

engage more in such activities will be more likely to succeed and persist in college, as well as realize greater gains in areas of critical thinking, problem solving, and effective communication (Astin, 1993; Education Commission of the States, 1995; Pascarella & Terenzini, 1991).

The findings from evaluations of some of these efforts suggest that modified pedagogical approaches are having desired effects. For example, Cabrera and associates (2002) found that the self-evaluated gains by students in engineering classes in group, problem-solving, and design skills were more the result of pedagogical practices than students' pre-college characteristics. They suggested that men and women students majoring in engineering would benefit equally if effective educational practices were used. If effective educational practices are "process indicators" that signal student success and development (Ewell & Jones, 1996), to what extent are women SMET students engaged in educationally effective activities and how do they perceive their campus environment compared to their male counterparts? Is a Peach Blossom Shangri-La attainable for women majoring in science, mathematics, engineering, or technology? It stands to reason that the more SMET programs use effective educational practices, the more realistic such a goal becomes.

PURPOSE OF THE STUDY

This study examines the extent to which women majoring in SMET fields engage in effective educational practices. Specifically, we looked at two groups of women and their male counterparts who attended four-year colleges and universities: (a) first-year students near the end of their first year of study, and (b) seniors who were about to graduate. Four questions guided the study:

1. How does the engagement of female SMET majors in effective educational practices compare with those of male SMET majors? That is, do women and men SMET students differ in terms of academic effort, interactions with teachers and peers, and participation in active and collaborative learning opportunities?

2. Do female and male SMET majors differ in the degree to which they report making gains in selected desired outcomes of college? For example, do women and men benefit equally in areas such as acquiring work-related knowledge and skills and in analyzing quantitative problems?

3. Do female and male SMET majors differ in their perceptions of their college environments? In particular, do female and male SMET majors differ in how supportive they find their campuses, and are they equally satisfied with their collegiate experience?

4. Do the patterns of engagement for female and male SMET majors hold for their counterparts in other majors? To put the experiences of fe-

male and male SMET majors in perspective, we need to know whether observed differences are due to processes specific to SMET fields, or whether an overarching gender effect operates in college including SMET fields.

Answers to these questions will aid our understanding of the experiences of female SMET majors and, perhaps, point to interventions that could attract and retain more women in SMET fields in the future.

METHODS

Data Source

We obtained the information reported in this paper from 106,460 randomly sampled first-year and senior students from the 2001 and 2002 administrations of the National Survey of Student Engagement (NSSE). As mentioned earlier, extensive research indicates that good educational practices in the classroom and interactions with faculty and peers are directly related to desired student outcomes (Astin, 1993; Chickering & Reisser, 1993; Kuh, Schuh, et al., 1991; Pascarella & Terenzini, 1991), and the NSSE focused on precisely these practices (Kuh, 2001, 2003).

More specifically, the NSSE survey tapped student experiences in several dimensions: (a) involvement in different types of in-class and out-of-class activities, (b) amount of reading and writing, (3) participation in educational programs such as study abroad, internships, and senior capstone courses, (4) perceptions of the campus environment including the quality of students' relationships with peers and faculty members, and (5) student satisfaction with academic advising and their overall collegiate experience. In addition, students estimated their educational, personal, and social growth in selected areas since starting college, and provided background information such as their sex, age, race/ethnicity, enrollment status, living arrangements, and major field. The psychometric properties of the survey are acceptable, and the instrument produces relatively stable results from one year to the next (Kuh, 2001; Kuh, Hayek, et al., 2001).

We investigated whether women and men differed on student engagement, self-reported gains in desired outcomes of college, perceptions of the supportiveness of their institution, and student satisfaction with their collegiate experience. The engagement measures included academic effort, active and collaborative learning, student-faculty interaction, diversity experiences, challenge of exams, time spent relaxing and socializing, and amount of reading and writing done. The self-reported gains from college included three dimensions: (a) personal and social development, (b) quantitative, analytical, and work-related skills, and (c) general education. The appendix describes each measure and provides reliabilities when applicable.

TABLE I
NUMBERS AND PERCENTAGES OF WOMEN AND MEN IN SMET AND NON-SMET MAJORS BY CLASS

	<i>First-Year Students</i>				<i>Seniors</i>			
	<i>Women</i>		<i>Men</i>		<i>Women</i>		<i>Men</i>	
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>
SMET majors	5535	46%	6492	54%	5647	44%	7107	56%
Biological/life sciences	3231	72%	1256	28%	2718	67%	1327	33%
Computer and information sciences	614	25%	1798	75%	977	32%	2047	68%
Engineering	748	22%	2613	78%	793	23%	2687	77%
Mathematics	395	60%	260	40%	503	60%	342	40%
Physical sciences	547	49%	565	51%	656	48%	704	52%
Non-SMET majors	26987	73%	10164	27%	31838	72%	12683	28%
Total	32522	66%	16656	34%	37485	65%	19790	35%

SMET majors were defined as those students who indicated that their declared or intended primary major was in one of the following fields: biological/life sciences, computer and information technology, engineering, mathematics, or physical sciences. The sample consisted of 12,027 first-year students from 518 institutions and 12,754 seniors from 513 institutions. (See Table 1.) Among the first-year SMET students, 5,535 (46%) were women and 6,492 (54%) were men. Among senior SMET majors, 5,647 (44%) were women and 7,107 (56%) were men. (See Table 1.) While the percentages of women in the SMET sample are somewhat higher than expected, this is likely due to two reasons. One is the overrepresentation of women among NSSE respondents, as is the case with most college student surveys (National Survey of Student Engagement, 2002); the other is the large percentage of women students in biological/life science majors. (See Table 1.)

Analytic Strategy

We employed ordinary least squares (OLS) regressions, taking into account the influence of potentially confounding background characteristics that other studies suggest could affect student engagement and satisfaction (Astin, 1993; Pascarella & Terenzini, 1991). We controlled for student and institutional characteristics, including enrollment status, place of residence (on or off campus), race/ethnicity, age, parental educational attainment, transfer status, Greek affiliation, sector, Carnegie classification, and total undergraduate enrollment. Since the focus of the study was women SMET students' behaviors and perceptions, the appropriate unit of analysis is the student level.

We used y -standardized coefficients (the unstandardized regression coefficient divided by the pooled standard deviation) to estimate effect sizes (Greenwald, Hedges, & Laine, 1996; Light & Pillemer, 1982; Pascarella, Flowers, & Whitt, 2001). As suggested by some researchers, we considered an effect size of less than .10 to be substantively trivial, meaning the difference was too small to warrant interpretation and discussion (Alexander & Pallas, 1985; Rosenthal & Rosnow, 1991). Women were coded as "1" and men were coded as "0" on the gender variable.

RESULTS

Women vs. Men in SMET majors

Table 2 reports regression coefficients that contrast women's scores with those of men in SMET fields (Columns 1 and 3). Compared with their male counterparts, first-year women majors reported more favorable scores on academic effort (.16) and reading (.20). In addition, both first-year and senior women SMET majors had slightly higher cumulative grades than men; however, first-year women reported that their exams were more chal-

TABLE 2
Y-STANDARDIZED OLS REGRESSION COEFFICIENTS
COMPARING WOMEN AND MEN IN SMET AND NON-SMET MAJORS^a

<i>Measure</i>	<i>First-Year Students</i>			<i>Seniors</i>	
	<i>SMET</i>	<i>Non-SMET</i>	<i>SMET</i>	<i>SMET</i>	<i>Non-SMET</i>
Engagement					
Academic effort	0.16***	0.13***	0.13***	0.23***	0.12***
Active and collaborative learning	-0.02	0.01	-0.01	0.08***	0.02
Student-faculty interaction	0.06	-0.08***	0.08***	0.08***	0.02
Diversity experiences	0.08***	0.03	0.08***	0.20***	0.20***
Challenging exams	0.15***	0.11***	0.23***	-0.26***	-0.30***
Relaxing and socializing	-0.28***	-0.27***	-0.26***	0.17***	0.14***
Reading	0.20***	0.14***	0.17***	0.17***	0.14***
Writing	0.02	-0.01	-0.02	-0.02	0.01
Self-Reported Gains					
Personal and social development	0.15***	0.08***	0.12***	0.11***	0.07***
Quantitative, analytical, and practical skills	-0.10***	-0.01	-0.13***	0.07***	0.06***
General education	0.08***	-0.04	0.05	0.06***	0.06***
Supportive Campus Environment					
Satisfaction	0.06	0.04***	0.09***	0.04***	0.09***
	0.05	0.07***	0.06	0.09***	0.09***

* p < .05, ** p < .01, *** p < .001 (two-tailed)

^aR² values ranged from .02 to .06 for models with first-year students, and .02 to .10 for those with seniors.

lenging (.15) and that they spent substantially less time relaxing and socializing (-.28). Women SMET majors also reported greater gains in personal and social development (.15).

Despite expending more academic effort, women SMET students gained slightly less than men in the areas of quantitative, analytical, and practical skills (-.10). Women and men in SMET majors were comparable in terms of their overall satisfaction and perceived the campus climate to be equally supportive. Column 3 of Table 2 shows that these patterns also held for senior SMET students.

Because the literature suggests that women prefer collaborative learning approaches, supplementary analyses revealed some potentially worrisome findings. Although the overall active and collaborative learning score for women and men SMET majors did not differ, we probed further by examining results for individual items that contributed to this measure (not shown in tabular form). We found that women SMET students in both classes were less engaged in several active and collaborative learning activities, such as asking questions in class, contributing to class discussions, making class presentations, working with other students during and outside of class, and tutoring other students. Moreover, senior SMET women students less frequently worked on projects with other students during class compared to their male counterparts.

Overall, women SMET students did not substantially differ from men in terms of interaction with faculty members. Supplementary analyses (not shown in tabular form) indicated that women students tended to talk more frequently about career plans and to discuss grades and assignments with their instructors more than their male counterparts. However, they less frequently discussed ideas from readings or class with faculty members outside the classroom.²

Women vs. Men in Non-SMET Majors

To determine if the observed gender differences of SMET majors were more a function of SMET disciplines or gender, we also examined the experiences of women and men in non-SMET majors (Columns 2 and 4 of Table 2). Juxtaposing the differences between women and men in SMET fields with the differences between women and men in non-SMET fields in each class reveals very similar patterns. In sum, women in general tended to be more engaged than men as both first-year students and seniors. Choosing a SMET major did little to alter the differences between the genders; observed gaps between women and men in SMET fields were comparable to gender gaps across all fields.

² All patterns reported for SMET majors were similar even when biological/life science majors were excluded.

TABLE 3
Y-STANDARDIZED OLS REGRESSION COEFFICIENTS
COMPARING WOMEN AND MEN IN SPECIFIC SMET MAJORS^a

Measure	First-Year Students					Seniors				
	Bio/life Sciences	Computer & Info Sciences	Engineering	Math	Physical Sciences	Bio/life Sciences	Computer & Info Sciences	Engineering	Math	Physical Sciences
Engagement										
Academic effort	0.11**	0.04	0.23***	0.25**	0.04	0.12***	0.16***	0.17***	0.24**	0.16**
Active and collaborative learning	-0.05	-0.10*	0.09*	0.04	-0.05	-0.09**	0.07	0.06	0.22**	0.06
Student-faculty interaction	-0.09**	0.01	0.05	-0.06	-0.09	-0.12***	0.01	0.14**	0.00	0.07
Diversity experiences	0.06	-0.07	0.18***	-0.10	0.06	-0.02	0.08*	0.12**	0.04	0.12*
Challenging exams	0.10**	0.09	0.13**	0.16	0.05	0.20***	0.17***	0.19***	0.21**	0.23***
Relaxing and socializing	-0.30***	-0.24***	-0.18***	-0.37***	-0.28***	-0.32***	-0.23***	-0.24***	-0.31***	-0.19**
Reading	0.14***	0.18***	0.19***	0.17*	0.02	0.18***	0.06	0.14**	0.15*	0.13*
Writing	-0.12***	-0.04	0.02	0.17*	-0.05	0.00	0.08*	-0.01	0.06	-0.02
Self-Reported Gains										
Personal and social development	0.06	0.11*	0.16***	0.13	0.02	-0.02	0.13**	0.06	0.15*	0.16**
Quantitative, analytical, and practical skills	0.00	0.03	0.10*	0.05	-0.07	-0.08*	0.06	0.10*	0.11	0.02
General education	-0.04	0.08	0.05	0.11	-0.03	-0.06	0.08*	0.00	0.01	0.12*

Supportive Campus Environment	0.04	-0.02	0.15***	0.06	-0.08	-0.04	0.07	0.18***	0.11	0.13*
Satisfaction	0.01	-0.02	0.15***	0.11	-0.03	-0.02	-0.01	0.14***	0.13	0.08

Note: * p < .05

** p < .01

*** p < .001 (two-tailed).

^aR² values ranged from .01 to .09 for models with first-year students, and .01 to .10 for those with seniors.

Women vs. Men in Different SMET Majors

Specific fields of study that comprise the SMET-related majors may affect men and women differently. To examine this possibility, we conducted separate regression analyses for each SMET field (biological/life sciences, computer and information technology, engineering, mathematics, physical sciences) in Table 3. Though students in different majors varied somewhat in terms of their engagement patterns, gains, and perceptions, women generally fared at least as well as men in each SMET major. Engineering showed the greatest differences between the experiences of women and men; notably, women were significantly more satisfied than men.

Limitations

This study has several limitations. First, pre-college data about students (e.g., ability, math and science preparation) were generally not available. That said, the engagement patterns reported here held even when total SAT-equivalent scores were controlled. Second, the NSSE survey does not routinely collect information from sophomores or juniors, who begin taking a substantial number of major-specific courses. Possibly some important patterns of engagement emerge during this time. Third, it is not possible to determine whether women and men SMET students take the same courses outside of their major. Examining student transcripts may help explain certain findings, such as why women report a greater degree of academic effort and challenging exams. Fourth, although the study employs some institutional controls, the national sample data may mask effects of particular institutional or classroom milieus on student behavior.

Another limitation is related to the validity of self-reported gains. As Pascarella (2001) and others point out, gain scores may be confounded by students' entering characteristics. For example, compared with their counterparts in other fields, it is possible that women who select SMET majors may start college with different levels of proficiency and knowledge in certain areas that affect the results in unknown ways. At the same time, Pike (1999) provides some evidence to suggest that gain scores are not significantly related to such characteristics as the entering ability of students as measured by aptitude scores. Although the concerns about self-reported data are legitimate and warrant some caution in interpreting, the gains measures are only one of several sets of dependent variables used in this study.

Finally, as is the case with all analyses involving survey data, it is possible that we omitted one or more gender-linked variables that could account more for our findings than gendered experiences in SMET fields. However, this study controlled for a myriad of student and school characteristics that might otherwise confound the modestly different experiences that women

and men reported in SMET fields. The addition of these controls did little to alter the effects of gender.

We also considered several measures on the survey that contributed to student *disengagement* and also exhibited gendered responses: time spent (a) caring for dependents and (b) socializing and relaxing. We found that men spent less time caring for dependents and more time socializing and relaxing; if anything, inclusion of these variables as controls tended to strengthen gender differences.

DISCUSSION

The results of this study suggest that female SMET majors are at least as engaged in effective educational practices as their male counterparts. These patterns generally held across the various individual major fields that comprised SMET. Particularly noteworthy is the finding that female SMET majors were at least as or more satisfied with their collegiate experience; they also viewed their campus environment more favorably than did their male counterparts. This pattern of findings contradicts the notion that SMET cultures are putatively inhospitable to women. Thus, to the extent that student engagement is related to academic success, our findings dovetail with prior research suggesting that women tend to thrive in college once they survive initial entry into technical fields (Huang et al., 2000; Spade & Reese, 1991). In other words, if the climate for women SMET majors remains "chilly," women today are finding ways to deal with it, including putting forth more academic effort.

At the same time, other findings from this study point to some puzzles. Assuming that women are equally able and prepared in high school to succeed in SMET fields, why do women put forth more effort but also report their exams to be more challenging than do men? Perhaps different course-taking patterns account for why female SMET majors reported more challenging exams. Or perhaps women put forth more effort than men because they expect their exams to be very challenging, a psychological response by women SMET majors who underestimate their abilities and preparation (Ott, 1978; Spade & Reese, 1991). Similarly, even though they put forth more effort (more time reading and studying, less time relaxing and socializing), women SMET students reported lower gains in quantitative, analytical, and work-related skills. Taken together, these findings are consistent with evidence that women underestimate their collegiate educational accomplishments to a greater extent than men do (Beyer, 1999; Beyer & Bowden, 1997), especially in traditionally masculine subjects (Beyer, 1998, 2002). If this is the case, then our findings may *understate* true gender differences on engagement in SMET fields.

While the bulk of our results points toward favorable findings for women in SMET fields, there is still reason to reflect. While women SMET majors engage as much as men in the more formal and public forms of effective educational practices, they have less access to the equally valuable informal exchanges with their male counterparts and faculty members. For example, women SMET majors less frequently worked collaboratively during class on projects, collaborated less with peers outside the classroom, and less often discussed ideas from class with faculty members outside of class. All this suggests that women may be excluded from what may still be a male-dominated network in SMET programs.

Such a pattern of behavior is consistent with findings from studies on social tokenism (Kanter, 1977; Sax, 1996; Yoder, Adams, & Prince, 1983; Wharton & Baron, 1987) suggesting that women are excluded—intentionally or not—from discussions related to office gossip, strategies for advancement, and assessments of performance.³ These informal discussions tend to occur away from the workplace itself, such as in recreational venues. So, despite the fact that women appeared to collaborate on projects with colleagues and interact with their instructors as often as men in our study, women SMET majors may still be disadvantaged because of limited access to informal learning opportunities.

Another debilitating aspect of social tokenism is that the tokens (women SMET majors) often try to make themselves less visible, because their very presence can make them uncomfortably salient. For example, women may fear being targeted for reprisal by powerful peers, especially if their performance in any way leads to male counterparts losing face in a public fashion (Kanter, 1977). Our data, however, do not suggest that women SMET majors adopt a subdued posture with respect to asking questions and contributing to class discussions. At the same time, student engagement items measure the frequency of behavior, not its intensity or depth. For example, we cannot distinguish between those students who “sometimes” contribute to class discussions with well-crafted arguments and those who respond with simple “Yes” or “No” answers. Thus, we might interpret these findings differently with information about intensity and depth of engagement (Feldman, 1972).

This brings us to a conundrum identified by Roselyn Mickelson (1989): Why do women in college work as hard as they do to earn high grades and persist to graduation in large numbers when they face post-college employment that will net them only 76 cents for every dollar that men earn? (U.S. Census Bureau, 2002) In addition to income considerations, female SMET

³ We recognize that the percentage of women in biological/life science majors exceeds maximum thresholds that some scholars have proposed for tokenistic processes to operate (Kanter, 1977).

majors are further burdened the prospect of juggling the demands of work and home life. Indeed, women engineering majors predict that they will perform the bulk of household labor and childcare, even though they recognize that these roles will likely hinder their career advancement (Hawks & Spade, 1998). Still, they persist and succeed, bringing to mind the "Madame Curie effect" (Rosser, 1997), going to great lengths to overcompensate for perceived deficits and obstacles. To help us better understand this and related phenomena, future studies of the experiences of college students should take into account possible gender differences and focus on the underlying motivations and expectations of both men and women majoring in SMET fields.

IMPLICATIONS

Our findings have several implications for making SMET major courses and programs more female-friendly. First, pedagogical approaches in SMET programs should take into account the preferred learning styles and campus climate issues that appear to disadvantage and discourage women students. Previous studies show that traditional pedagogical techniques favor White male students (Kahle, 1990; McShannon & Derlin, 2000; Tobin & Gallagher, 1987). An approach that incorporates more collaborative learning initiatives would be beneficial for women students. Moreover, other research (Cabrera et al., 2002; Colbeck et al., 2001) indicates that men and women benefit equally when these and other effective educational practices are used more consistently throughout the curriculum.

Second, special programs, counseling services, and curricular innovations may be needed in the short term to bolster the self-concepts of women students in SMET fields of study. There is plenty of evidence from this study and others to show that women students can successfully respond to and survive demanding academic programs. At the same time, other features of historically male-dominated disciplinary cultures and the larger society continue to pose formidable obstacles. Programs and services should be designed to debunk the commonly perceived myth that "science and math are not for girls," instead providing examples of the valuable contributions that women make to these fields. Special extracurricular activities for women, such as bringing in distinguished women engineers to lecture on campus, can provide role models and positive images of women in engineering and other SMET fields (Stage et al., 1987).

Finally, additional efforts are needed to reculture SMET learning environments that have been traditionally dominated by White males to also embrace people from other historically underrepresented groups. Nothing short of full participation by all members of an increasingly diverse population is needed to generate the creativity essential to prepare a well-trained

workforce and guarantee the long-term economic and social progress of a democratic society (Baum, 2000; Shirley, 2000).

CONCLUSION

In general, women students majoring in science, mathematics, engineering, and technology-related fields appear to be engaged in effective educational practices equally with men. These findings are in sharp contrast to earlier studies that point to substantial gender differences in performance in SMET-related subjects at the high school level, and SMET-related activities in the workplace (American Association of University Women, 1992; Rosser, 1989; Leder & Fennema, 1990; Marini & Brinton, 1984; Orenstein, 2000). That said, this study and others hint that social tokenism processes may operate to varying degrees in SMET fields in college.

Taken together with the results of other studies (Huang et al., 2000; Rosser, 1997), it appears that the college environment has fewer dampening gender-related effects on satisfaction and desired outcomes in college than in either the high school or post-college SMET work settings. To the extent this is true, higher education may be moving toward a kind of "Peach Blossom Shangri-La" for women SMET majors, making gender equality a reality on college campuses where women can blossom and thrive.

APPENDIX

SURVEY ITEMS CONTRIBUTING TO MEASURES OF STUDENT ENGAGEMENT, GAINS, AND SATISFACTION

Academic Effort (Cronbach's $\alpha=.76$)

- Number of hours per week spent preparing for class (studying, reading, writing, rehearsing, and other activities related to your academic program).
- The frequency of having worked harder than you thought you could to meet an instructor's standards or expectations during the current school year.
- During the current school year, the extent to which coursework emphasized analyzing the basic elements of an idea, experience, or theory.
- During the current school year, the extent to which coursework emphasized synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships.
- During the current school year, the extent to which coursework emphasized making judgments about the value of information, arguments, or methods.
- During the current school year, the extent to which coursework emphasized applying theories or concepts to practical problems or in new situations.
- The extent to which the institution emphasizes spending significant amounts of time studying and on academic work.

Active and Collaborative Learning (Cronbach's $\alpha=.64$)

- The frequency of having asked questions in class or contributed to class discussions during the current school year.
- The frequency of having made a class presentation during the current school year.
- The frequency of having worked with other students on projects during class during the current school year.
- The frequency of having worked with classmates outside of class to prepare class assignments during the current school year.
- The frequency of having tutored or taught other students (paid or voluntary) during the current school year.
- The frequency of having discussed ideas from your readings or classes with others outside of class (students, family members, coworkers, etc.) during the current school year.
- The frequency of having participated in a community-based project as part of a regular course.

Student-Faculty Interaction (Cronbach's $\alpha=.73$)

- The frequency of having discussed grades or assignments with an instructor during the current school year.
- The frequency of having talked about career plans with a faculty member or advisor during the current school year.
- The frequency of having discussed ideas from your readings or classes with faculty members outside of class during the current school year.
- The frequency of having worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.) during the current school year.
- The frequency of having received prompt feedback from faculty on your academic performance (written or oral) during the current school year.
- Have worked or planned to work on a research project with a faculty member outside of course or program requirements before you graduate from your institution.

Diversity Experiences (Cronbach's $\alpha=.65$)

- The frequency of having had serious conversations with students of a race or ethnicity different from your own during the current school year.
- The frequency of having had serious conversations with students who differ from you in terms of their religious beliefs, political opinions, or personal values during the current school year.
- The extent to which the institution emphasizes encouraging contact among students from different economic, social, and racial or ethnic backgrounds.

Supportive Campus Environment (Cronbach's $\alpha=.79$)

- The extent to which the institution emphasizes providing the support you need to help you succeed academically.
- The extent to which the institution emphasizes helping you cope with your nonacademic responsibilities (work, family, etc.).

- The extent to which the institution emphasizes providing the support you need to thrive socially.
- Quality of relationships with other students at your institution.
- Quality of relationships with faculty members at your institution.
- Quality of relationships with administrative personnel and offices at your institution

Challenging Exams (Single item)

- The extent to which your examinations during the current school year have challenged you to do the best.

Relaxing and Socializing (Single item)

- Number of hours per week spending on relaxing and socializing (watching TV, partying, exercising, playing computer and other games, etc.).

Reading (Cronbach's $\alpha=.24$)

- Number of assigned textbooks, books, or book-length packs of course readings during the current school year.
- Number of books read on your own (not assigned) for personal enjoyment or academic enrichment during the current school year.

Writing (Cronbach's $\alpha=.50$)

- Number of written papers or reports of 20 pages or more during the current school year.
- Number of written papers or reports between 5 and 19 pages during the current school year.
- Number of written papers or reports of fewer than 5 pages during the current school year.

Gains in Personal and Social Development (Cronbach's $\alpha=.82$)

- The extent to which your college experience contributed to developing a personal code of values and ethics.
- The extent to which your college experience contributed to understanding people of other racial and ethnic backgrounds.
- The extent to which your college experience contributed to understanding yourself.
- The extent to which your college experience contributed to learning effectively on your own.
- The extent to which your college experience contributed to working effectively with others.
- The extent to which your college experience contributed to voting in local, state, or national elections.
- The extent to which your college experience contributed to improving the welfare of your community.

Gains in Quantitative, Analytical, and Work-Related Skills (Cronbach's alpha=.72)

- The extent to which your college experience contributed to analyzing quantitative problems.
- The extent to which your college experience contributed to acquiring job or work-related knowledge and skills.
- The extent to which your college experience contributed to using computing and information technology.
- The extent to which your college experience contributed to working effectively with others.

Gains in General Education (Cronbach's alpha=.80)

- The extent to which your college experience contributed to writing clearly and effectively.
- The extent to which your college experience contributed to speaking clearly and effectively.
- The extent to which your college experience contributed to acquiring broad general education.
- The extent to which your college experience contributed to thinking critically and analytically.

Satisfaction (Cronbach's alpha=.79)

- How would you evaluate your entire educational experience at this institution?
- If you could start over again, would you go to the same institution you are now attending?

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