

2006-1071: PILOT STUDY OF A “WOMEN IN ENGINEERING SEMINAR” THAT IS RESPONSIVE TO REGIONAL ATTITUDES

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Pilot Study of a “Women in Engineering Seminar” That Is Responsive to Regional Attitudes

Abstract

The paper describes a pilot study of a one-hour seminar designed for incoming female freshmen students. The seminar includes many features of existing women in engineering seminars including external guest speakers, introductions to the female faculty members, and presentations by Career Services. Regionally conservative attitudes about family and women’s roles are also addressed in the course through selection of speakers with a variety of personal/professional life solutions as well as supporting materials from the USU ADVANCE Institutional Transformation Award. To overcome the small number of freshmen women interested in engineering, data from the Women’s Experiences in College Engineering project is shared to help the students understand their feelings are typically aligned with a larger body of female students across the country. Student reflections acquired through required essay questions and examinations are presented to help understand whether their career choices are influenced by conservative attitudes toward family and women’s roles. Preliminary retention data is presented.

Introduction

Several engineering programs offer a seminar for female students as a retention strategy. Typically there are two goals for the seminar: inform female students about the many career opportunities available with a degree in engineering, and develop an encouraging, supportive community for the students.¹⁻³ The first goal is accomplished by providing a variety of speakers who share their experiences and offer advice about the many areas and career paths available in engineering. The second goal is accomplished through small group discussions where topics such as “how to get academic help,” “homesickness,” and “what to do and where to go in town: fun things to do” are discussed.⁴ In some programs, field trips to local companies that employ engineers are also arranged.

Enrollment and graduation of female students in the College of Engineering at Utah State University (USU) is less than the national average. Data published by the National Science Foundation indicate that women accounted for 20% of total undergraduate enrollment in engineering program since 1999 with 18.6% of the bachelor’s degrees awarded in 1998 to graduates of engineering programs typical of those offered at USU.⁵ At USU over the past five years, 10% of the freshmen in the pre-engineering program have been females and 8% of students graduating with degrees in engineering have been females. As both a recruiting and retention strategy, in Fall 2005, we offered a seminar that included many of the features of the women in engineering seminars described above, including external guest speakers, introductions to the female faculty members, and presentations by Career Services.

In addition to borrowing many of the ideas from a number of existing seminars, the USU seminar was shaped by data from the Cooperative Institutional Research Program (CIRP) freshman survey.⁶ The 2004 CIRP survey was completed by 79% of the main campus freshman

class. USU freshman students differ from those of their peers at comparable institutions in a number of areas.

- 86% of the USU freshman class viewed raising a family as essential or very important compared with 78% of the freshman at peer schools.
- 35% of the USU freshman felt activities of married women were best confined to home and family compared with 23% of the respondents at peer institutions.

The CIRP results suggest there are regional attitudes about family and women's roles that present challenges to female students interested in engineering. Additional evidence to support this regional attitude about gender can be found in the work of Moore and Vannan.⁷ Their research developed measures of the relationships between gender attitudes and religiosity. Their results suggest that residents of regions with more religiously conservative populations also hold more conservative gender attitudes. As the proportion of religious conservatism in an area increases, both religiously conservative and non-conservative exhibit more conservative gender attitudes. In addition to large regions in the South, another region they identified as conservative on both counts includes Utah, Idaho and Montana.

The paper presents a description of the course and how regional gender attitudes are addressed in the course. Student reflections acquired through required essays and examinations are discussed. Although the seminar was conducted for the first time in 2005, preliminary retention data from the 13 participants has been compiled and presented in this paper. The paper concludes with a "lessons learned" section.

Course Description

The Women in Engineering Seminar was designed for incoming female freshman students. Enrollment was open to female and male freshmen and in Fall semester 2005 only female students selected the course. The seminar was one credit hour, met once a week for an hour, and was not required for any engineering major. Course goals were to:

1. provide a variety of speakers who share their knowledge and experience about the many career-options available in engineering,
2. provide information about internships from career placement and planning specialists,
3. discuss the ways in which women integrate their professional and personal lives,
4. provide information and strategies for the academic and interpersonal skills needed to succeed in engineering,
5. develop a community of learners among peers with similar academic and career goals.

After completing this course, students should have been able to:

1. discuss career options, both traditional and non-traditional, for women in engineering,
2. articulate ways in which women integrate professional and personal lives,
3. prepare a professional electronic resume to obtain a summer internship,
4. understand a typical engineering classroom environment including strategies to improve note taking, study for examinations, and participation in study groups.

Fall semester 2005, the course grade was based on attendance, participation and series of short written assignments. Attendance and participation counted 33% of the grade and written assignments constituted 67% of the grade.

Regional Attitudes and Course Content

The CIRP results and sociological research suggest there are regional attitudes about family and women's roles that present challenges to female students interested in engineering at USU. To address regional attitudes, seminar speakers with a variety of engineering degrees and professional/personal backgrounds were selected. All speakers strongly promoted the importance of obtaining an engineering degree and their excitement about engineering. Two speakers were integrating full-time professional jobs and family responsibilities, one speaker worked part-time as a means to integrate professional and personal life, one speaker had obtained a degree in engineering but was not employed outside the home while raising children, and one speaker had started a business so she could work from home while children were small and had re-entered the workforce when her children entered middle school. The point of presenting a number of solutions to professional/personal life integration was simply that, to present a number of solutions without imposing any personal values. Throughout the course, student's opinions were honored and no attempt was made on the part of the instructor to impose her own personal/professional life solution onto the students.

Another strategy to address regional gender attitudes was to bring in supporting materials that were available from the NSF-funded ADVANCE project. The USU ADVANCE Institutional Transformation Award supports academic institutional transformation to promote the increased participation and advancement of women scientists and engineers in academe.⁸ A cornerstone of the USU ADVANCE effort is to employ the Dual Agenda business model (for organizational change) to engage departments in creative dialogues to identify and implement changes which are advantageous from both effectiveness and equity perspectives.⁹ A central idea of the Dual Agenda model is that the greatest opportunity for change, to arrive at gender equity at work and home, is to understand deeply how people perceive men's and women's roles in both the work and domestic spheres. To facilitate the discussion about how the students in the class perceived work and domestic roles, one seminar session was lead by the USU ADVANCE principal investigator who presented results on her own professional/personal life research.

In order to help the students reflect on their feelings as they progressed through the first semester, and hopefully, subsequent semesters, we spent one seminar session presenting results from the Women's Experiences in College Engineering (WECE) project.¹⁰ The WECE project was the first cross-institutional, longitudinal examination of women's experiences and retention in engineering programs. Over a three year period, fifty-three institutions with undergraduate engineering programs participated in the project. Of these, 26 schools had formal Women in Engineering programs. WECE results on aspects of women's educational experiences that were critical to their retention in engineering were presented to the students. Some of the presented data included: how female students perceived their competence in areas critical to success in engineering compared with their male counterparts, discouragement with perceptions of low grades, frustration with work load and restrictive curriculum, and the importance of study groups, internships, and participation in extracurricular activities. Since the number of women

majoring in engineering at USU is small, we felt it was important to help the students understand that their joys and frustrations were often shared by many other female students at the 53 institutions involved in the WECE project.

In October 2005, Lisa McLoughlin's article on "Spotlighting: Emergent Gender Bias in Undergraduate Engineering Education," appeared.¹¹ Although her article focused on Women in Engineering programs, her concern about singling out female students with the intention to help but making them feel uncomfortable was noted. By the time the article appeared, the semester was well underway and the syllabus set. No class time was set aside to discuss concerns with spotlighting, however, a question on the final exam was posed to get some initial reactions to this concern.

Student Reflections

One way to understand whether regional gender attitudes influence career decisions is to look at comments made by the students in their essays. This qualitative analysis required the instructor to remain objective in reviewing student work which was difficult at times.

The first two invited speakers were a mechanical engineer and civil engineer. The speakers were not asked specifically to talk about both their professional and personal lives. The mechanical engineer spoke primarily about her career and the many projects she had worked on during her fifteen years of professional experience. The civil engineer spoke about her career but at the end spent about ten minutes talking directly about her young child and how she integrated her professional and personal life. Both speakers expressed considerable enthusiasm for their careers and were very encouraging to the students to complete degrees in engineering.

Following these speakers, a two page essay was assigned. The writing assignment had elements of the classic "compare and contrast" essay to encourage the students to reflect on similarities and differences in order to better understand their personal responses to the speakers. The assignment did not directly ask the students to write about the integration of professional and personal lives. At this point in the semester, limited class time had been spent on the topic.

To gauge the freshmen's interest in and opinions about professional/personal life issues, we counted how many mentioned the topic in their essay. Nine of the thirteen students mentioned something about the civil engineer and her personal life. Of the nine, two students' comments were factual with a phrase such as one of the speakers was "both a worker and a mom." Four of the students' comments indicated a favorable response to the civil engineer's personal life solution. For example, one student stated, "so the fact that it is possible to divide your time between engineering, husband, and kids to me is one of the most important things to me, since family and education are two of the most important things in my life." Another student noted, "For me though it was very much needed to hear from someone who has both a career and is still a mother and wife." Three of the students' comments indicated disapproval of the civil engineer's child care solution. All three comments were similar to this one, "I couldn't see myself leaving my kids with a nanny while I went to work all day." Since a large percentage of the students included some sort of response about professional/personal life responsibilities, it seems clear that even for eighteen-year-old freshmen, this is a topic of interest.

A second writing assignment was made following three speakers intentionally selected to address both personal and professional life responsibilities. One of the speakers worked part time with two small children at home; one of the speakers put her career on hold while staying at home with three small children; and one of the speakers had started a home-based business so she could stay at home for ten years with young children. All three speakers had degrees in engineering and had worked in industry for at least two years before starting their families. One part of the second writing assignment asked the students to comment on how these speakers had balanced career and family responsibilities. The students all provided favorable comments on how these three women integrated professional and personal lives. Two of the students explicitly stated that work and family life issues will influence their career choice. “I grew up in a house where family is considered to be the most important part of life. Consequentially this belief has influenced my career choice; or at least it will.”

One of the questions on the final, in-class examination was “where do you see yourself five years from now? What do you need to do to get there?” Only two of the thirteen students did not mention marriage or family. Both of these students talked about careers in engineering and one talked about becoming a pilot. Both mentioned seeking an internship as part of their undergraduate plans. The remaining eleven students (85%) included some statement about marriage in their five-year plan. One student mentioned marriage in a negative connotation, “I want to be figuring out exactly what I want to do with my life, I don’t want a boyfriend/husband/family telling me what to do.” The remaining ten students mentioned marriage in a neutral or positive connotation with comments such as, “I will probably be married, but most likely will not have kids yet,” “maybe by that time I’ll be married,” “I want a good job and a family, though I think the job might have to be sacrificed to save the family some strain.”

Another question on the final examination was posed to get some preliminary feelings about whether the female students felt singled out (spotlighted). The question was: “The Women in Engineering Seminar was designed for female freshmen. Do you see this class promoting gender bias by singling female students out in order to provide experiences that the male students do not have?” Since we had not discussed McLoughlin’s article in class, and the final examination was in-class, the students responded without much time to think through the issue. Here are examples of their responses.

- “I see this class as an opportunity for women who have thought about engineering to gain experience of what it can be like to be in engineering and hear real stories of women who have done what they trying to do. Males can see this all over the place and I believe they do not even realize the efforts women must put forth in order to become an engineer and still raise a family.”
- “I agree that females need more strength and encouragement from others to help them stay in engineering. On the other hand, we learned many things that would be extremely valuable for the male gender as well, such as where to go and what to do in order to receive the internship you want.”

In summary, female students interested in engineering at USU reflect the results of the CIRP survey and the regionally conservative attitudes toward gender roles. Family and women’s roles

are important to them, although there is not enough data to suggest their concerns are any greater than those of other female engineering students across the country.

Enrollment and Retention

Presently the Women in Engineering seminar is not a required freshmen engineering course. The freshmen advisors worked hard to “sell” the course to incoming female students as a valuable one hour experience. Fall semester, 2005, thirteen female freshmen signed up for the Women in Engineering seminar, representing around one third of the female freshmen in the pre-professional engineering program. Table 1 shows the breakdown of “intended majors” since students are admitted into the College of Engineering as first semester freshmen in a pre-professional program. If a student is interested in engineering but has not settled upon a specific major, she or he is enrolled in “general engineering.” There were single students interested in biological, electrical and general engineering. To help protect student identities, these students are lumped together when reporting retention results. Success in mathematics is necessary for admission to the professional program. Note that all but two of the students were enrolled in the first or second calculus course. Two of the students were enrolled in intermediate algebra.

Table 1: Retention Data For the Students Enrolled in the Women in Engineering Seminar

Fall 2005			Spring 2006				
Intended Major	Initial Number	Enrolled in Calculus	Still Enrolled in Intended Major	Taking All Major Courses	Enrolled in Follow-on Math	Declared New Major	Left USU
CE	4	2	4	3	3	0	0
ME	6	6	4	4	4	1	1
EE, BE, GE	3	3	3	1	2	0	0
Totals	13	11	11	8	9	1	1

It was possible to collect data on the same 13 students and the courses in which they were enrolled in spring semester 2006. One student left the university at the end of fall semester and one student had processed the necessary paperwork to change majors. Both of these students were in the Mechanical Engineering pre-professional program in the fall, as noted in Table 1. Eleven students began spring semester 2006 in the College of Engineering’s pre-professional program. University enrollment data indicates we retained 11 of 13 female students in the pre-professional program.

An examination of the courses in which the remaining 11 students enrolled provides a better idea of ongoing interest in engineering. Four of the original six students interested in mechanical engineering and three of the original four students interested in civil engineering were still taking all of the course work toward their intended majors. Two of the three students interested in biological, electrical and general engineering had not formally changed majors but were taking a

few courses not required for an engineering degree, indicating they were exploring other options. Two were enrolled in the follow-on math course suggesting they are keeping an engineering option open. In summary, it appears 8 of 13 of the students are still clearly interested in engineering and an additional 2 of 13 are exploring other options but keeping the engineering option open. Taking specific coursework into consideration indicates we retained 9 of the 13 female students in the pre-professional program.

Lessons Learned

The seminar students were asked to provide feedback on how they would change the course. Many of their suggestions will be used to improve the seminar which will be offered again in fall semester, 2006. Below are some of the important lessons learned, obtained from both student feedback and instructor reflection.

- Provide clear information to the seminar speakers about the backgrounds of the freshmen students. Several speakers' presentations were at a highly technical level that made it difficult for the freshmen to follow.
- Invite junior- and senior-level female students into the class to talk about their experiences in addition to graduated engineers and faculty members.
- Include at least one more "hands on" session. We spent one session talking about engineering design and building paper towers from index cards. The students wanted more sessions like this one.
- Include at least one more community-building session where we spent time talking about classes and freshmen survival strategies.
- Move the presentation about the WECE study to later in the semester after the students have more university experiences. McLoughlin's points will be included as well so the students can discuss their feelings about being spotlighted and share any discomfort they may feel about this.

Conclusions

Enrollment and graduation of female students in the College of Engineering at USU is less than the national average. To address this issue, we developed a pilot test of a "Women in Engineering Seminar" that included many of the components of the seminars offered across the country including external guest speakers, introductions to the female faculty members, and presentations by Career Services. Regional attitudes about family and women's roles present challenges to female students interested in engineering at USU. To address these attitudes, seminar speakers with a variety of engineering degrees and personal/professional life integration solutions were selected. Supporting materials addressing ways to integrate work and family responsibilities that were available from the NSF-funded USU ADVANCE program were also incorporated into the course.

Information gathered from student essays suggest the USU students think about integrating career with a family. 85% of the students mentioned marriage in their "five year plan." Whether female students at USU think about career and family integration more than other female students is difficult to gauge. Also, it is too early to tell whether a seminar emphasizing personal/professional life integration will make a difference in retention. Student feedback from

the first course was sufficiently favorable to offer the Women in Engineering Seminar again during fall semester 2006. Student suggestions for ways to improve the course will be included in the 2006 offering.

Finally, as we continue to grapple with why women leave engineering programs across the country, further investigation into the relationship between students' views on personal/professional life integration and persistence in engineering seems important. A recent article supports this last statement.¹² A retention study of students at Rowan University by Hartman and Hartman looked at “stayers” and “leavers” in an institution which provides many “female-friendly” features. One conclusion of the study was that female leavers at Rowan perceive more problems in the conflict between career and family than female stayers do.

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