

2006-2340: BUILDING THE ENGINEER IN ME: DESIGNING A SEMINAR FOR FIRST-YEAR FEMALE ENGINEERING STUDENTS

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Building the Engineer in Me: Designing A Seminar for First-Year Female Engineering Students

Abstract

Designing an initiative whose goals are to recruit, retain, and support female engineering students provides many opportunities to experiment with different combinations of academic, social, and service models. We present the design process by which one component of the initiative, a seminar aimed introducing first-year female engineering students to the engineering profession, was developed in this paper. The seminar, entitled *Building the Engineer in Me*, is intended as a cornerstone in the initiative, and, by conscious design, contains innovative and unique features. The initiative, a project involving students, faculty, and administration of the University of Virginia's School of Engineering and Applied Science (SEAS), will be directed by the Center for Diversity in Engineering (CDE). It is scheduled for launch in AY 2006-7.

Keywords: Recruitment, retention, support, female engineering students

Introduction

The percentage of undergraduate female engineering students enrolled at the University of Virginia's School of Engineering and Applied Science (SEAS) has remained static at or around 25% since 1994, regardless of strong recruitment and retention efforts primarily led by the Center for Diversity in Engineering (CDE), formerly known as the Office of Minority Programs. SEAS also has the lowest percentage of female undergraduate students among the various schools and programs at the University. Figure 1 in Appendix A is a graphical representation of the enrollment figures for female undergraduate students from the schools and programs at UVa from 1994 to 2005, providing an efficient means of portraying these trends.¹ The undergraduate enrollment percentages are mirrored in the female graduate engineering student population at the University as well as at many other American universities.^{2,3} Figure 2 in Appendix A is the graduate counterpart to Figure 1.

To combat these trends, CDE proposed the creation of the Women's Initiative in 2004 to SEAS leadership. The Women's Initiative, modeled after various Women in Engineering (WIE) and Women in Science and Engineering (WISE) at peer institutions (see ^{4,5,6,7}, for example) would be the vehicle for co-ordinating and implementing recruitment, retention, and support activities for both undergraduate and graduate female engineering students. Establishing the Initiative would give greater visibility to these activities, and the additional CDE staff would be dedicated resources. Organizing current and planned activities and outreach projects also provides the opportunity to capture, quantify, and assess project performance in a systematic manner. The ability to evaluate project performance quantitatively is extremely critical to establishing the success of the Initiative.

One popular component of WIE and WISE programs is a seminar offering educational support and networking opportunities with other students, faculty, and industry representatives; see ^{8,9,10,11}, for example. We decided to develop a similar offering as the first component of the Initiative

due to the reported success of these seminars. As well, a seminar serves simultaneously as a recruitment, retention, and support activity, affording us the opportunity to measure effectiveness in terms of all of the Initiative’s primary goals. The purpose of this paper is to present details of the development process.

Designing the Seminar

The first steps in a structured educational design activity are to conduct a needs analysis at the institution and a survey of existing programs at other institutions. The institutional needs analysis was conducted using students, faculty, and school administration as the subject matter experts (SME). The structure and performance of existing programs were reviewed through a survey of the literature and web-based program information. From the information provided by the needs analysis and surveys, we formulated the seminar’s pedagogic goals of providing an active learning situation that facilitates the development of an awareness of what it means to be a female who is learning to become a practicing engineer and an awareness of the various personal, educational, and professional challenges and opportunities she may encounter.

Conducting an informal morphological analysis¹² using the components and features found in our survey which we thought would appropriately support the seminar’s pedagogic goal is one method for reviewing the range of possible implementations. A truncated sample of the resulting morphological box is given in Table 1, below. This analysis also helped us to meet the mandate that the seminar provide a learning experience that did not replicate services offered by other University programs, such as the SEAS Center for Engineering Career Development and UVA’s Women’s Center. Providing a unique educational opportunity, we believe, will facilitate acceptance of and participation in the seminar.

Table 1. Truncated Sample of the Morphological Box Used in the Seminar’s Design Process

Parameters	Duration	Class Size	Student Enrollment	Instructional Venues	Instructional Methods	Desired KSA Outcomes
Values	J-term (intersession)	small [<15]	non-restricted	classroom	lecture	increased leadership skills
	one semester	medium [15 - 25]	restricted	research lab	experiential / active	increased academic confidence
	two semesters	large [> 25]		academic lab [e.g., CAD]	discussion	increased knowledge of profession
	orientation activity			library		info for selecting "good fit" major

KSA – Knowledge, Skills, and Abilities

The results of the needs analysis and surveys also led us to decide to design a version of the seminar for undergraduate students and one for graduate students, since each level of study has its unique opportunities and challenges. The planned development of a “sister” seminar for graduate students is another innovative feature of the Initiative, since we have found that the primary audience for initiatives for women in engineering is undergraduate students. We anticipate good synergy from the pairing of the seminars.

The undergraduate seminar will be the focus of the following discussion, since it is scheduled for implementation first.

Seminar Structure, Features, and Evaluation

The academic goals of the undergraduate seminar are to provide first-year (freshmen) female engineering students the information that can help them consolidate the gains made during the fall semester in making the transition from high school to university and complete the transition successfully; to provide tools and information that can empower female engineering students to achieve academic and professional success; and to provide an introduction to the practice of engineering and engineering research at the University. We also hope to encourage increased enrollment of female students in graduate engineering programs through early exposure to research and the resulting contacts with possible faculty and graduate student mentors and role models.

The seminar’s time is structured as follows:

- Welcome and presentation of specific seminar objectives
- Presentation by instructor, students, or other speakers
- Reminders / discussion on upcoming assignments
- Open discussion time as time allows

Students have three assignments to complete during the semester. One assignment that we see as an innovative feature is that each student will have the chance to lead a class session, thus participating in seminar administration. This feature will be accomplished by limiting class size to 14, the number of possible classroom meetings. Giving students this opportunity provides them with the chance to practice leadership, management, and communication skills. Prior to leading a session, a student will meet with the seminar instructor to plan the session, thus insuring that each student will have some one-on-one time with the instructor during the semester.

Each student will also keep a journal tracking personal and academic progress and issues. A minimum entry of three paragraphs (each paragraph having a minimum of three sentences) per week is required. This information will help guide the development of a student’s professional development plan. Journals are a common feature of these types of courses; see ¹³ for example.

Finally, students will develop and present their plans for professional growth, discussing the academic and personal strategies and scenarios that will best prepare them for success as a practicing engineer.

Seminar topics are planned to include the following:

- Orientation / Discussion of Course Topics / Kick-off
- What's This on the Stacks PCs? An Overview of Engineering Software Tools
- What to Expect as a 2nd, 3rd, and 4th year Student – Panel Discussion with SEAS Students
- My Life in Engineering – Panel Discussion with SEAS Faculty and Graduate Students
- My Life in Engineering – Panel Discussion with Industry Representatives
- Research Opportunities for Undergraduates
- Field Trips to Engineering Facilities

Seminar plans are scheduled to be completed by the end of AY 2005 – 6. We would like to have information about the seminar available for summer orientation sessions. We plan to disseminate information about the seminar primarily through memos to faculty advisors and a multi-media presentation available through the CDE web site. As with the institutional needs assessment, input from undergraduate students will heavily figure in developing the presentation from story board to final assembly.

We plan to evaluate the seminar's success in meeting Initiative goals of recruitment, retention, and support of female engineering students through the analysis of data gathered through pre- and post-seminar surveys, and through annual follow-up surveys. Proposed survey items for the pre- and post-seminar surveys are presented in Appendix B. These surveys will be approved by the University's Institutional Review Board. We plan to gather data to support both quantitative and qualitative evaluation of short-term and long-term success of the Initiative's goals to recruit, retain, and support female engineering students at UVa.

Acknowledgments

We would like to thank our SMEs for graciously sharing their experiences and opinions with us, and the reviewers for their comments and suggestions.

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Appendix A

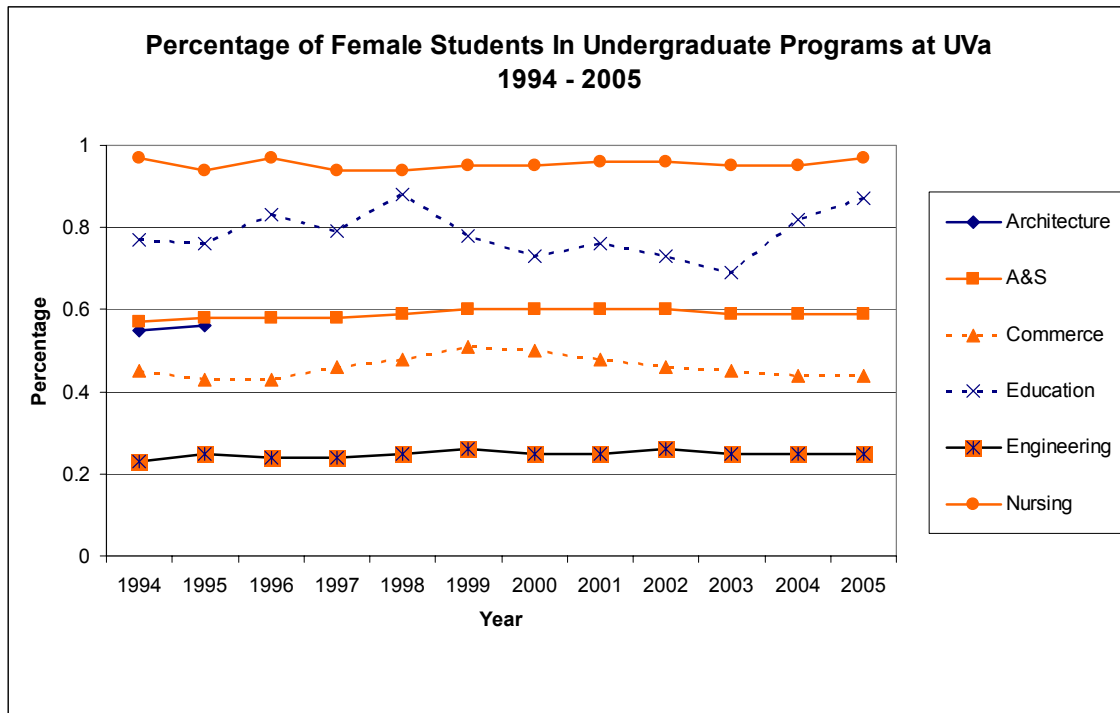


Figure 1. Percentage of Female Students in Undergraduate Programs at the University of Virginia, 1994 - 2005

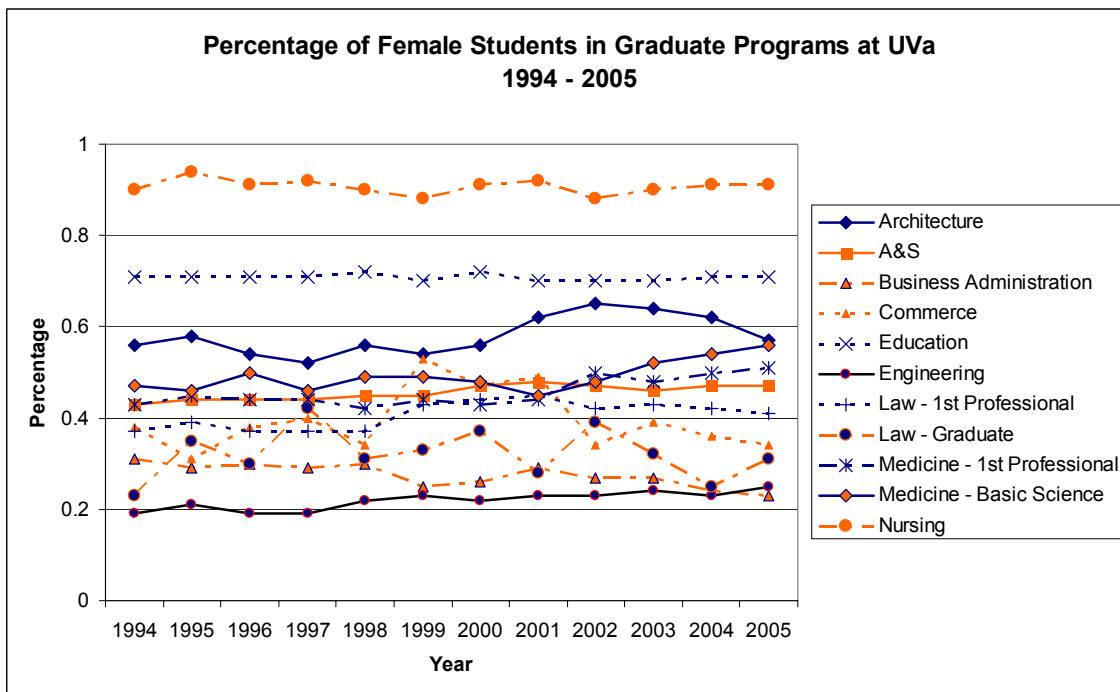


Figure 2. Percentage of Female Students in Graduate Programs at the University of Virginia, 1994 - 2005

Appendix B

Sample Proposed Pre- and Post-Seminar Skills Self-Assessment Questions

How would you rate your knowledge, skills, and abilities (KSAs) in the following areas on a scale of 1 (non-existent) to 5 (excellent)?

Leadership skills	1	2	3	4	5
Verbal communication / presentation skills	1	2	3	4	5
Written communication / presentation skills	1	2	3	4	5
What an engineer really does	1	2	3	4	5
What's involved in performing engineering research	1	2	3	4	5
The major I want to declare	1	2	3	4	5
My comfort level in meeting academic demands	1	2	3	4	5
Time management skills	1	2	3	4	5
Familiarity with engineering software	1	2	3	4	5

Sample Proposed Pre-Seminar Evaluation Questions

Please rate your expectations for this seminar in the following areas on a scale of 1 (non-existent / none) to 5 (high).

Forming relationships with other students	1	2	3	4	5
Forming relationships with faculty	1	2	3	4	5
Networking with industry representatives	1	2	3	4	5
Getting more comfortable with my studies	1	2	3	4	5
Learning about SEAS	1	2	3	4	5
Learning about research opportunities	1	2	3	4	5
Learning about professional opportunities	1	2	3	4	5

We also propose to elicit how well these expectations were met in the post-seminar survey, as well as ask students to estimate how much of any increases in their KSAs were due to participation in seminar activities.

Sample Proposed Post-Seminar / Annual Evaluation Questions

Please tell us how much you (dis)agree with the following statements on a scale of 1 (strongly disagree) to 5 (strongly agree).

This seminar helped prepare me for academic success	1	2	3	4	5
This seminar helped prepare me for professional success	1	2	3	4	5
This seminar is one reason why I chose UVa	1	2	3	4	5

If you're thinking about or planning to transfer to the College or another university:

Attending this seminar had no influence on my remaining in engineering	1	2	3	4	5
Attending this seminar had no influence on my remaining at UVa	1	2	3	4	5