INTRODUCTION TO ENGINEERING: DEVELOPING A COURSE THAT IS SENSITIVE TO THE NEEDS OF ENTERING WOMEN STUDENTS

Larry Korta

Milwaukee School of Engineering, Milwaukee, Wisconsin

Introduction

In 1991, Milwaukee School of Engineering received preliminary National Science Foundation funding to develop IDEAS, a three-year program to improve the retention of women engineering students. IDEAS was an acronym for Interaction-Discovery-Experience-Assimilation-Stretching. First-year funding included both the development and implementation of the interaction phase (a welcoming retreat-like activity for first-year women engineers, run by women faculty and staff and returning female students) and the development of Discovery.

While some details of the Discovery segment have been published elsewhere (1992 FIE)[3], this paper will discuss the singular importance of first-year students' exposures to successful practicing engineers, and to share some of the specific comments and general impressions we received from the first class of "Discoverers" at a recent "class reunion."

Development of the Discovery Program

In the original proposal, all five segments of the IDEAS program were to be for women only. As planning for the Discovery course unfolded, however, strong opposition to the single gender "Introduction to Engineering" course was expressed by current female students, and, to a lesser extent, by faculty, staff, and alumnae. From a successful woman graduate we heard a comment like, "our world of practicing engineering is not 'feminine,' why should your introduction to engineering be different?" From women engineering students we heard comments like, "I never needed special help in predominantly male classes before, I don't intend to start now," and "I didn't come here to attend all female classes."

Some faculty and staff took a slightly different position, arguing that "an introductory course such as that proposed must, above all, realistically portray what engineering is all about...and engineering is definitely not for women only." On the other hand, some also made the observation, "Our male students may have an even greater need to witness successful female engineers than do our female students."

Comments such as the above convinced the course designers that the Discovery course should be coeducational. On the other hand, it was felt that maintaining the current male/female student ratio (approximately 2 in 30) would not provide the important "critical mass" for the women engineering students. We decided, therefore, to establish (with the Registrar's Office) a minimum requirement of 30% female in the course. This was to provide the support benefits often described in the literature as "clustering." In the experimental section that we conducted, we attempted to have approximately 50% female students.

Course Objective: Realistic Vision of Engineering

Recall that we earlier cited several concerns regarding the planned Discovery course that related to the subject of "realism." As the planning for this new introductory Engineering course proceeded, "vision" became one of our drivers. We were committed to developing a course that would provide our new students with a clear vision of what was **beyond graduation**; we wanted to have our students see an exciting, challenging, attractive, yet realistic picture of themselves as practicing engineers. We became committed to enabling our entering students, male and female alike, to see what engineers do, to see how engineers behave, to see the environments in which engineers practice. This brought us to a critical dimension of the Discovery program: meaningful exposure to practicing engineers in business and industry. Our belief was that by establishing a clearer vision of what it will some day be like to be an engineer, students would be better able to fight their way through what often seems like the "mine field" of engineering education.

What Engineers Do...The Industry Connection

We identified three strengths of Milwaukee School of Engineering upon which we could build our first-year students' "realistic vision of engineering": experienced faculty, client-driven senior design program, and a long tradition of strong industry connections.

Through the eyes of the faculty...

The "typical" MSOE faculty member has over seven years of industrial experience. We wanted our first-year students to hear about either past industrial assignments of our senior faculty, or to hear about their current consultancies. Invited faculty were most willing to spend about twenty minutes with a class of first-year students telling them, and in most cases **showing them**, about some of their favorite accomplishments...and interesting failures! Faculty were invited from each of the academic programs at the school...we sought out female faculty members to be involved in this part of the program wherever possible. Our instructions to the faculty: paint a realistic picture of engineering practice...help the students connect to the various courses they will be studying over the next four years. A collateral benefit of this activity was that students were exposed to a much broader array of

institutional talent at a time when some of them are not at all sure which field of engineering is right for them.

Through the eyes of seniors...

Our senior design program is heavily oriented towards "live" industry projects. We decided, therefore, to use senior design teams to provide the first-year students another view of what engineering is really about. We did this in two different ways. When we arranged for our first-year students to attend a Sensors Expo in Chicago, we invited an Electrical Engineering senior design team and their faculty advisor to accompany the class. On the bus ride to Chicago, we asked the team to describe their project and to indicate what kinds of information they were seeking at the Expo. They then engaged the first-year students as their "technical aides." We also asked the faculty advisor to give a brief overview of some of the more important technologies they were to see at the Expo. On the trip back, we asked each first-year student to briefly summarize what he/she had learned about sensors. (They also had a team interview assignment related to identifying the various functions in organizations which use engineering talent.)

Later in the course we invited a team of Industrial Engineering seniors to brief the students on their Senior Design project. After the briefing, the seniors then involved the first-year students in generating ideas for one facet of their project. With over two dozen projects and project teams to choose from, we selected a team comprising two females working with an industrial client whose contact individual was also female. Although we didn't feel that gender should be the sole factor in the selection of a Design Team, we thought it would be helpful in again providing contemporary role models for the female members of the class. What was most important was that the first-year students saw real engineering practice with a "live," open-ended problem...and they saw two bright young "almost-engineers" intensely excited about what they were doing. (The project happened to involve the design of equipment for a severely handicapped individual...projects that, in the experience of the authors, almost always capture the imagination of the students.)

Through the eyes of practicing engineers...

Over the course of the first year (as detailed in the Frontiers in Education paper, the traditional one-term introduction to Engineering course was changed to extend over the entire three quarters) this class was able to visit several companies in the Milwaukee area. AC Rochester (supplier of catalytic converters for GM vehicles), Kimberly-Clark (major paper products manufacturer), MasterLock (leader in the manufacture of combination locks and related devices), and Allen-Bradley (Rockwell automation systems and components). In all cases, these were not "field trips," but rather engineering-oriented visits behind the scenes of both the production areas and the engineering laboratories, offices, and support facilities. Guides for the visits were typically recent engineering graduates, while the visits were typically hosted by senior

engineering management. In these facilities, many of the senior managers and key technical personnel involved with the visit were female.

We again asked that the students be presented a realistic picture of what engineers do. We were concerned that the visits might become glossy recruiting opportunities; fortunately, this was not at all the case. Company personnel were quite frank in answering questions like "what do you most like and dislike about your job?" (Much to our dismay, one of our students reported after one of the visits that engineering was the career for him because he understood that you never worked more than forty hours a week and never took work home!...we **think** the host was being facetious!) We were quite pleased that all companies involved were every bit as anxious as we were to present successful female engineers to our class.

In addition to the visits to four large industrial operations, we also wanted to provide exposure to the world of engineer-entrepreneur. To this end, we invited two successful local entrepreneurs to a joint presentation to the class. We deliberately selected one of the two participants to be female and asked that they tell the class about their career paths and about opportunities for entrepreneurs. During the lively discussion that followed, specific questions regarding the challenges of women in engineering were raised. This session generated exceptional interest on the part of both the female and male members of the class.

Assessment

Our primary objective in the entire IDEAS program, and certainly in the Discovery component of that program, was to enhance the retention of women engineering students. Unfortunately, measurement of Discovery effectiveness was confounded by the effects of other retention initiatives, most notably our faculty-staff and peer Mentor program. We are, of course, pleased that these and other programs are collectively having a positive impact on retention.

Of the women students that completed the year-long "Introduction to Engineering-IDEAS" course, only one is no longer in school. She decided to transfer from engineering to business at another institution. The others are now moving into their senior year, and all are quite active in various aspects of student life, including the Peer Mentor program to which we referred. This, of course, is an extremely small sample, and we would hesitate to draw any conclusions from these numbers alone.

As reported in FIE 92, we offered six recommendations which are repeated here:

1. Give students an early exposure to practicing engineers, including women and minorities, and their work environment, to enable students to visualize themselves as successful engineers.

2. Focus on specific technologies in the freshman year to allow coordination of a research/writing/presentation project with a facility tour and an opportunity to meet engineers who are working on some aspect of the technology.

3. Involve entering students in senior design activities, perhaps as evaluators of senior design presentations, to allow students to become familiar with expectations for a successful project early in their academic careers.

4. Incorporate videotaping and peer evaluation of presentations throughout the curriculum in order to improve a student's presentation skills.

5. Develop a program to help students understand group dynamics and to function effectively on a team to develop skills that the student will need as an engineer.

6. Develop a series of presentations and small group meetings between entering students and senior faculty, where faculty discuss their projects and career experiences, to inform the beginning student about the differences in engineering specialties and functions.

We recently had a reunion of those students who completed the course. Their "favorite things"?...company visits (see #2, above) and interaction with MSOE faculty (#6). When asked about which activities provided the greatest benefit in subsequent coursework, they cited the videotaped presentations and the various team activities. They also reminded us that, at the time of the IDEAS course, neither of the latter two activities was particularly well-received! Perhaps the most significant response was to the question, "If you had to do it all over again, would you elect to take the IDEAS course?"...every student in attendance, including all of the women students, replied in the affirmative.

Conclusions

We are convinced that the decision to design a **coed** introduction to Engineering to enhance retention of women students was the correct move. Concerns which were addressed:

lack of realistic understanding of what engineers really do,

little appreciation for the environments in which engineers work,

limited appreciation for the amount of social as well as technical interaction required of successful engineers,

limited access to engineering role models,

are all concerns that we feel are not entirely gender specific. Those actions we took to especially enhance learning for our first-year women engineering students seem to be every bit as effective with our first-year men students...and, we might add, for our faculty and staff as well. While DISCOVERY as conducted in the trial has not continued, most of the elements of that program have been, or shortly will be, incorporated into our college-wide Introduction to Engineering course, with an expected continued positive influence on retention and on learning.

Acknowledgements

We must acknowledge not only the support of the National Science Foundation, but the contributions of time and talent made by AC Rochester, Kimberly-Clark, Allen-Bradley, and MasterLock. They all said their involvement was an investment in a better future...we most heartily concur.

Figure 1: Freshmen Women, Numbers and %

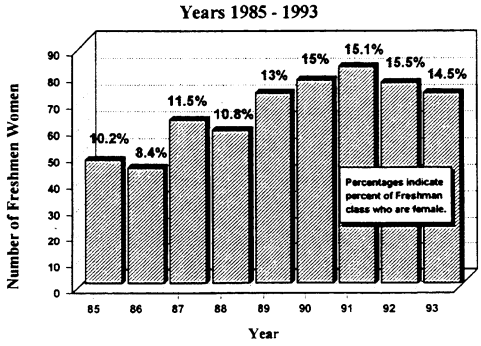
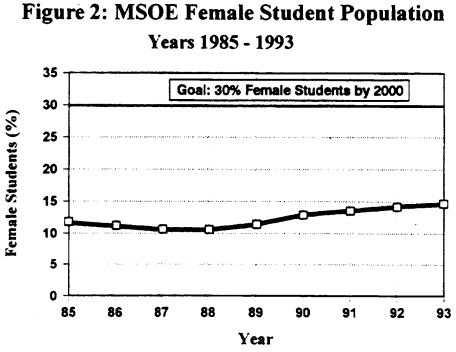


Figure 2: MSOE Female Student Population



References

1. Agogino, A., Sheppard, S., and Oladipupo, A., "Making Connections to Engineering During the First Two Years" (Synthesis Coalition), Frontiers in Education, 1992.

2. David, D., and McCoullum, H., "A Program for Retention of First Year Minority Students in Engineering and Science," Frontiers in Education, 1992.

3. Diggelman, D. and Korta, L., "Introduction to Engineering: Developing a Coed Course that is Sensitive to the Needs of Women," Frontiers in Education, 1992.

4. DiTomaso, N., Farris, G., and Cordero, R., "Degrees and Diversity at Work," IEEE Spectrum, April, 1994.