

# A COLLEGE COURSE FOR WOMEN STUDYING ENGINEERING TAUGHT BY PROFESSIONAL WOMEN<sup>†</sup>

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**Abstract**— *The development and impact of a college-level management seminar course for women studying engineering taught by successful women professionals is discussed. The CONNECTIONS Career Seminar Course is offered to Northeastern University students through the efforts of the Northeastern CONNECTIONS Program, an NSF grant-funded program established to strengthen and enhance academic and career-related pathways for women studying engineering, mathematics and technology. The Career Management Seminar addresses the communication, ethical decision-making, leadership, management, and team-building skills required for today's engineer. The seminar also provides a unique forum for women studying engineering and technology to learn from and network with professional women from the engineering industry. The seminar course is one credit hour in nature and interactive through the use of case studies, in-class discussions and reflective homework assignments. Background information, contributors from Industry, the Northeastern University CONNECTIONS Program, associated career management topics, and course evaluations are discussed.*

*Index Terms* ¾ Career management, CONNECTIONS, Curriculum, Women in Engineering, Industry Relations

## INTRODUCTION

### *The importance of Non-Technical Skills*

*“At some point early in their careers, successful performance on the part of the young engineer depends on their management knowledge and skill. Failure in this area can mean lost or upset clients, unprofitable projects, missed deadlines, disgruntled fellow workers, and, in the worst case, termination of the young engineer” [1].*

Over the past few years, current professionals and newly hired college graduates have witnessed a change in the engineering workplace. Not only is it expected that engineering graduates have a sound technical background, but it is also now equally important that they are able to communicate effectively, work in teams, demonstrate leadership, and understand how to resolve ethical dilemmas.

In addition to the engineering field, engineering departments are also viewing non-technical skills as a required element to the engineering curriculum. The incentive to incorporate management and business skills into the engineering major derives not only from feedback from alumni and employers, but also from Accreditation board for Engineering Technology (ABET 2000).. The released 2001-2002 criteria for institutions seeking accreditation for their engineering programs lists the following six skills and abilities (over half of the eleven identified) as non-technical in nature:

- An ability to function on multi-disciplinary teams
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues [2]

### *Preparation of Undergraduate Women for Professional Careers*

According to the Department of Labor Statistics for 2002, approximately 10% of the engineering workforce is comprised of women. Given this statistic, engineering colleges have another aspect to address - retention rates of women and minority undergraduates. Research has suggested that women transfer out of engineering primarily due to a “fear of losing interest, lack of self-confidence, poor advising, and not being accepted in their department” [3]. Feelings of “psychological alienation or depression played a critical role in their decisions to leave [science, mathematics, and engineering] disciplines, and that despite good academic performances, they experience diminished self-esteem, self-confidence and career ambitions” [4]. A women professional engineer describes the type of preparation that undergraduate women in engineering can benefit from:

*“Although there are a significant number of women engineers in the profession and continuing to enter the profession - you are still primarily in the minority. Women*

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*entering the profession should be aware of this and know in advance that they will not have the women support network/camaraderie that they have been accustomed to in High School and College. Women need to have confidence in themselves and their abilities as an engineer to be able to stand out as an individual.” – WOMAN PROFESSIONAL, 2002*

Studies at Northeastern University also revealed similar trends among its undergraduate women in the College of Engineering. During the Fall of 1999, 354 entering engineering students were asked to complete a survey on their academic experiences and confidence levels. A total of 201 pre and post surveys that documented student academic performance as well as perceived confidence levels at the beginning and end of the first year were received. This survey was then presented again during the students’ sophomore year. Preliminary results from these surveys reveal a decline in female confidence relative to their male peers after freshman year, despite the same or slightly higher grades. [5 & 6]

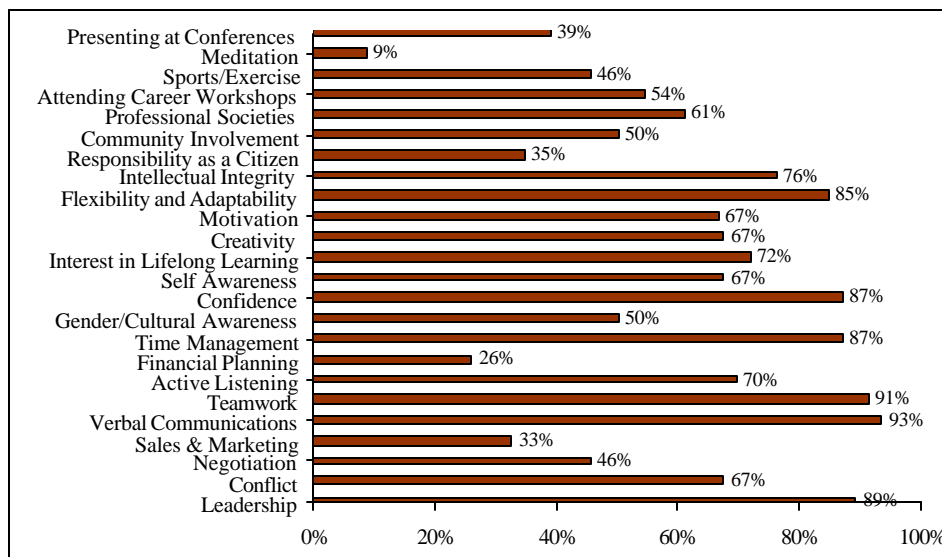


FIGURE 1:  
SKILLS AND ABILITIES NECESSARY FOR SUCCESS (2002)

While the issues surrounding confidence are complicated and confidence itself is dependent on a number of variables the results suggest that undergraduate women’s programs designed to build self-confidence would be beneficial to the students.

So the question then becomes, what has enabled current women engineering graduates, undergraduates and professionals to persevere and advance in their careers? In an effort to address this question, over 50 women engineering professionals and undergraduates were asked to complete an online survey regarding skills essential to their

success. Figure 1 below reflects the outcomes of the survey responses.

Those traits receiving survey responses of over 65% were the following, in rank of response frequency:

1. Verbal Communications
2. Teamwork
3. Leadership
4. Confidence
5. Time Management
6. Flexibility and Adaptability
7. Intellectual Integrity
8. Interest in Lifelong Learning
9. Active Listening
10. Self-Awareness
11. Creativity
12. Motivation

The objective of this paper is to present a Career Management Seminar Course offered to Northeastern University (NU) College of Engineering women.

## PROGRAM & SEMINAR COURSE DEVELOPMENT

In an effort to address the criteria set forth by industry, the goals established by the ABET 2001-2002 Criteria for Accrediting Engineering Programs, and the skills identified by women as key elements to their success, a unique learning environment for undergraduate women in engineering was created in the Fall of 2000. Through the CONNECTIONS Program at Northeastern, an National Science Foundation grant-funded

program for women in engineering, mathematics and technology, a career seminar course was developed to address the communication, ethical decision-making, leadership, and team-building skills required for today’s engineer. CONNECTIONS was established in 1999 to strengthen and enhance academic and career-related pathways for college women and pre-college girls studying engineering, mathematics, science and technology. The CONNECTIONS Program focuses on the transition points between middle school and high school, high school and college, and college and career, and hosts numerous events addressing professional topics in the engineering and technical realm. During the 2000 – 2001 academic year , ninety-seven different college women participated in

CONNECTIONS activities. Many of these programs provide students with the opportunity for longitudinal involvement.

One of the programs offered by Connections is the Career Management Seminar. Not only can professionals bring significant industrial knowledge to the classroom through their own experiences as engineers and managers, but they can also represent to the undergraduate women what one can achieve after graduation. Whether the course serves to inspire, re-energize or better prepare undergraduate women for a future career in engineering, it is a win-win situation for all involved.

### ***Seminar Course Development***

With input from a focus group of upper class college women in engineering, science, technology and mathematics and suggestions from local professionals, the CONNECTIONS Career Seminar course (GE 1005) was developed as a weekly one-hour session for women currently studying engineering. The one-hour time frame matched student schedules best, as engineering classes and associated labs fill most days with little flexibility. The seminar course addresses issues currently faced in the workplace and is designed to appeal to upperclass women preparing for or just returning from their cooperative education experiences or those seniors facing graduation and a full-time career.

Each seminar was led by a different professional and ranged in topics from Ethical Decision Making to Teamwork. Instructors had either volunteered or were invited by the CONNECTIONS Program to participate – all had substantial industrial experience, some being company Presidents and others being successful Project Managers. Industries that participated in the initial Fall 2000 seminar course were the Hewlett-Packard, Agilent Technologies, Genzyme Biosurgery, and Judith Nitsch Engineering. Additional companies, such as Massachusetts Port Authority, Parsons Brinkerhoff Infrastructure, Raytheon, and Choate, Hall & Stewart joined in the following year.

Grading consisted primarily of attendance, homework assignments, readings from a supplied course manual, and class participation, with class participation assuming 50% of the total grade to encourage a dialogue between students and the professionals teaching each section. Grading, seminar topic objectives, and assignments were all discussed on the first day of the seminar course and listed in detail on the seminar course syllabus. Although taught by individual professionals, the last class was attended by all presenters so that students could ask questions pertaining to each topic covered. A course instructor facilitated and organized the professional presentations and attended all class meetings to provide continuity. Course preparation included meetings

with professional speakers to review course objectives and instructional objectives for each topic.

Topics included the following:

- Professional Ethics and Decision-Making
- Communication and Personality Styles
- Managing Your Manager
- Marketing and Sales Techniques
- The Transition to Work after Graduation
- Leadership
- Teamwork and it's Role in the Current Workforce
- Balancing a Professional Career with a Personal Life
- Time & Self Management

## **SEMINAR COURSE EVALUATION**

The course was insightful, relevant and interesting to the students who participated in the CONNECTIONS Career Seminar Course. In addition, the seminar course enhanced the student's studies and experiences in engineering. In short, they viewed the course as beneficial to their future careers.

### ***Students Overall***

Using evaluations created and interpreted by Cambell-Kibler (2001) the following trends were noted from the students who had participated in the course in the Fall 2000 through Winter 2002:

- All students would recommend this course to other students. As one student put it, "It's a nice change from the regular classes we have to take, and we learned a lot practical information." [7]
- As seen in Table 1, overall, students rated the course as "one of the best" and felt both the course instructor and topic leaders were effective. Students rated the amount they learned as "an exceptional amount," felt the course packet, readings, and class activities were "extremely useful," and strongly agreed that they were "treated with respect" in class. [6 & 7]

Additionally, students were asked during the last class to provide a sentence or so describing their experience with the course. The following are excerpts from this last assignment:

- "GE 1005 has given me very helpful insight to the workplace. In this class, we talked about experiences that happen almost everyday in the workplace, ex: teamwork, communication, ethics, etc. "Managing Your Manager" has given a new dimension to the workplace. I believe this class has made me a more informed employee." *Senior, Environmental Geology*

TABLE I:  
USEFULNESS AND EFFECTIVENESS OF SEMINAR COURSE COMPONENTS [6 & 7]

<u>Course Components</u>	<u>Rating</u>	<u>SCALE USED</u>
Overall rating of course	1.2	1 = One of the best to 5 = One of the worst
Overall effectiveness of instructor	1.3	1 = Always effective to 5 = Almost never effective
Overall effectiveness of topic leaders	1.5	1 = Always effective to 5 = Almost never effective
Amount learnt by student	1.8	1 = An exceptional amount to 5 = Almost nothing
Usefulness of course packet and readings	1.9	1 = Extremely useful to 5 = Almost useless
Usefulness of in class activities	1.4	1 = Extremely useful to 5 = Almost useless
Student treated with respect in class	1.0	1 = Strongly agree to 5 = Strongly disagree

▪ “Meeting the professionals has given me inspiration to achieve in the field of engineering. They have shown me where I could be one day.” *Sophomore, Civil & Environmental Engineering*

▪ “It was a fun experience, with a lot of real-life applications, which makes it even more interesting. Thank

you for the opportunity to take such an interesting, non-traditional class.” *Junior, Civil & Environmental Engineering*

▪ “We learned how to become phenomenal women by phenomenal women. I really enjoyed the class as it helped me tremendously as a person to realize what kind of business ethics I have. This class helped me get a new job – a permanent one.” *Senior, Chemical Engineering*

Other, non-quantitative responses from individual students regarding the seminar course are listed below (Connections 2002):

- "I have learned that I need to be responsible for my own career."
- "The class made me feel comfortable to speak up and ask questions to people in higher positions when I am surrounded by semi-strangers."
- "I have learned more about how engineering works in practice, how companies work and what I will be doing in one."
- "It was the one class I looked forward to coming to."
- "I am always so busy and stressed out, a lot of tips were shared on how to change that. I also learned a lot on ways to work better with others."

When asked about their expectations for the class, all students mentioned expecting to learn more about the "real" working world, including learning more about the "professional ethics and relationships I will face", "how to present myself", "how to handle difficult bosses" and

"becoming a professional." One described expecting to get advice from those "who have excelled in the field and have a lot of experience" and other individuals added that they expected to learn about teamwork, to interact with numerous disciplines, or that they would generally learn about real-life situations, "as opposed to the regular material we learn in all of our other classes" [6].

It is important to note that the most recent seminar course, offered in the Winter 2002, witnessed the enrollment of four male undergraduates. This change in class environment had

an initial impact on the group dynamics, where the men dominated the discussions and asked the majority of questions. By the third class, all students (men and women) showed equal initiative in expressing thoughts and asking questions. It is also relevant to note one comment made on a male student's evaluation of the course:

*"Women have a leading role in the industry and I need to let some of my sexist views go."* Senior, Computer Engineering

#### ***Professionals Overall***

Overall, the experience of leading a seminar on career-related topics for undergraduates in engineering has been very positive one. Many of the professionals who participated in the seminar course found the class discussions and student interaction beneficial personally and within the context of their own work environment:

- "Coming back to my own school to teach a career related topic is both energizing and informative. It is always interesting to hear career concerns and questions from the viewpoint of the student; some are the same that I had, while others make me realize how engineering has and is changing for the better. They often also make me think about how I can make the office environment more "user-friendly" for all employees." *Civil Engineering Manager, 2001*

▪ “I believe the Career Connections course provides a vital piece in helping retain and prepare young women for life after college. I believe that communications, teamwork, organization, networking, etc. -- the soft-skills -- are the keys to success in today's environment. Understanding this and developing these more fully in college is a great advantage for women in engineering. I also believe that helping young women understand the incredible breadth of opportunities out there for those with technical degrees. All aspects of life are impacted by technology in today's world, and a technical background opens many doors in almost any field of interest.” *Computer Technology Manager, 2001*

▪ “For me, participating in the Connections Course has been a great experience. As a female civil engineering student at NU, I remember that there were only a handful of other females in my classes and there were no female professors. As a result, I constantly struggled with whether or not I belonged and was always looking for reassurances that it was ok for me to not only want to study engineering but to excel at my studies. The Connections course allows these female students to meet and talk to female professionals who have been where they are now and have figured out a way to make it work. It creates a unique outreach program and provides the reassurance that many of these students may also be searching for. I love the opportunity to talk to students and share my experiences and I look forward to continuing to participate in the future.” *Professional Engineer and Attorney, 2001*

## DISCUSSION

The need to address and strengthen professional skills for undergraduate engineering majors is apparent. Industry and academia both view such skills as beneficial to career success after graduation. In addition to professional skills, undergraduate engineering programs also need to provide women with confidence building activities. The CONNECTIONS Career Seminar Course was developed to support the transition from college to career for women in engineering by incorporating in-depth discussions on team work, leadership, management and communications with professional insight from successful women in industry. Students participating in the seminar course have reported a positive experience with the course and an enhanced knowledge those skills, which will aid in their success as engineers. Professionals have also voiced strong encouragement for such a program and, for those who participated, a continued commitment to mentoring college women. Further developments of this course, such as institutionalization, expanded versions, and the impact of such a course on the perceptions of women as successful engineers (found in both women and men) are currently being explored.

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## REFERENCES

- [1] Bergeron, Edmund H., A Perspective on the Need to Give an Introduction to Engineering Management to all Engineering Students, *Leadership and Management in Engineering*, 1(1), 26-29, 2001.
- [2] Accreditation Board for Engineering and Technology (ABET), *Criteria for Accrediting Engineering Programs: Effective for Evaluations during the 2000-2001 Accreditation Cycle*, November 2001.
- [3] Brainard, Suzanne G. et al., “WEPAN Pilot Climate Survey: Exploring the Environment for Undergraduate Engineering Students,” Engineering Information Foundation, New York, N.Y., 2001.
- [4] Seymour, Elaine and Nancy M. Hewitt, *Talking About Leaving: Why Undergraduates Leave the Sciences*, Westview Press, Boulder, CO, 1997.
- [5] Campbell, Patricia B., Earl Hadley, Lesley K. Perlman, “Women in Science, Engineering, and Math (SEM): Making Connections Between Curriculum, Career, and Personal Development”, Interim Evaluation Report for the CONNECTIONS Program, 2001.
- [6] CONNECTIONS, *CONNECTIONS: Women in Science, Engineering, and Math (SEM): Making Connections Between Curriculum, Career, and Personal Development*, Year 3 Annual Report, 2001.
- [7] Campbell, Patricia B. and Leslie Hoey, *Connection's Northeastern GE1005 Course: Evaluation Summary*, Campbell-Kibler Associates, Inc., Groton, MA., 2001.