Retention of Diverse Undergraduate Engineering Students

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Engineering and its product, technology, have had a profound impact on society; one has only to compare the life of the average citizen of 1900 with that of the average citizen of 2000 to realize that virtually all of the differences are the result of engineering. Moreover, the impact in the 21st century will be felt in every aspect of our lives, from our personal health to
our collective governance. Engineers must no longer limit their sense of responsibility to the products and infrastructure we design, but must include the larger effects they have.

(William Wulf, President, National Academy of Engineering, April 25, 2000)
The engineering profession needs the substantial participation of women if we are to make our full contribution to the solution of the technical problems facing our society. (Sheila Widnall, Institute Professor, MIT, April 26, 2000)
ABET CRITERIA

- Ability to function on multidisciplinary teams
- Understanding of professional and ethical responsibilities
- Ability to communicate effectively
"We'll be examining the distinction between 'savoring' a sonnet and 'accessing' it."
ABET CRITERIA

- Broad educational basis to understand information and engineering solutions in a global and societal context
- Recognition of the need and ability to engage in life-long learning
- Knowledge of contemporary issues
Criterion 3. Program Outcomes and Assessment

Engineering programs must demonstrate that their graduates have:
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) An ability to function on multi-disciplinary teams
(e) An ability to identify, formulate, and solve engineering problems
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) A recognition of the need for, and an ability to engage in lifelong learning

(j) A knowledge of contemporary issues

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
U.S. Engineering Workforce

- Currently, 80% white, non-Hispanic
- 90% male
- Gender composition similar to Europe
- Overwhelmingly middle-aged
Female Friendly Pedagogical Techniques—Observations

- Expand the kinds of observations beyond those traditionally carried out in scientific and engineering research. Women students may see new data that could make a valuable contribution to scientific experiments.

- Increase the numbers of observations and remain longer in the observational stage of the scientific method. This would provide more hands-on experience with various types of equipment.
Incorporate and validate personal experiences women are likely to have had as part of the class discussion or the laboratory exercise.

Undertake fewer experiments and problems likely to have applications of direct benefit to the military and propose more experiments to explore problems of social concern.
Consider problems that have not been considered worthy of investigation because of the field with which the problem has been traditionally associated.

- Formulate hypotheses focusing on gender as a crucial part of the question asked.
- Undertake the investigation of problems of more holistic, global scope, rather than the more reduced and limited scale problems traditionally considered.
Female Friendly Pedagogical Techniques—Methods

- Use a combination of qualitative and quantitative methods in data gathering.
- Use methods from a variety of fields or interdisciplinary approaches to problem solving.
- Include females as experimental subjects in experimental designs.
• Use more interactive methods, thereby shortening the distance between the observer and the object being studied.
• Decrease laboratory exercises in introductory courses in which students must kill animals or render treatment that may be perceived as particularly harsh.
“How about that! We’ve been invited to meet some biology majors.”
Female Friendly Pedagogical Techniques—Theories and Conclusions Drawn from Data

- Use precise, gender neutral language in describing data and presenting theories and results
- Be open to critiques of results and theories drawn from observations differing from those drawn by the traditional observer from the same observations
Encourage uncovering of other biases such as those of race, class, sexual orientation, and religious affiliation that may permeate theories and results drawn from observations.

Encourage development of theories and hypotheses that are relational, interdependent, and multicausal rather than hierarchical, reductionistic, and dualistic.
LIFE CYCLE OF A RICH AND FAMOUS SCIENTIST
Female Friendly Pedagogical Techniques—Practice

- Use less competitive models in the practice of science and technology
- Discuss the role of scientist or engineer as only one facet to be integrated into life
- Increase efforts in teaching and communicating with non-scientific/technical people to break down barriers
- Discuss the practical uses of science and engineering in their social contexts