



Attracting and Retaining more **women** into engineering: successful strategies for this decade

At an early age, girls show that they have the academic ability to succeed in engineering and other math and science related professions. Yet obstacles placed before them from birth discourage them from choosing or continuing in the field. Strategies must be developed for parents, educators and employers to validate the contributions girls and women can make, to let them know there is a place for them in the engineering profession.

To succeed means making large gains in the enrolment of women in undergraduate engineering programs. The average female enrolment has increased from 10.8 per cent in 1985, 14 per cent in 1990, 18.9 per cent in 1995, to reach 20.6 per cent in 1999¹. The 2000 figures show no gain in many universities and a decrease in some.

Some think that 20 per cent is a natural ceiling for the enrolment of women in engineering programs and that nothing more can be done. This is a pessimistic view, since there have been equal (or near equal) enrolments in several other countries, for example Venezuela and in Eastern Europe, for some time. Some disciplines in Canada have succeeded in attracting an equal number of women such as chemical, industrial, and environmental engineering.

For less successful programs like electrical, mechanical, and computer engineering, this points to the continued existence of obstacles, but they are more subtle today than they were a decade ago. Overtly sexist

acts like the Lady Godiva parade and comments by some professors that women do not belong in their classes have been replaced by active recruitment programs. The remaining obstacles are linked to stereotypes, still alive and well in our society, on what are appropriate careers for women and men. In a report entitled *Gender Socialization, New Ways, New World*, Coulter describes how sexist attitudes and behaviour occur both at home and at school. Sexist attitudes are so ingrained, they have often become unnoticed. The report provides advice for parents and teachers on how these practices can be eliminated². Sadker et al have found that schools have been providing better opportunities for boys than for girls, except in single-sex schools for girls. Boys receive more attention, are more stimulated and challenged, and receive more positive feedback on their participation. Girls are often rewarded for neatness and good behaviour³.

Girls tend to under-estimate their abilities in mathematics and science, whereas

by Monique Frize, P.Eng., O.C.



boys are prone to over-estimate their performance. Girls now do better than boys in the provincial exams in mathematics, yet boys are more confident of their abilities⁴.

Building positive self-esteem and confidence in girls will make them realize that these subjects can be natural choices for them. In spite of their strong academic performance, many girls drop these subjects in high school, seeing these as male domains, not relevant to their own future. Some mothers have lower academic expectations and allow lower grades and achievement for girls. Effective ways are suggested for parents to encourage their gifted girls by bringing them to extracurricular science-based activities, providing books, assisting with school work, travelling and visiting parks and museums⁵.

Young women in high school tend to avoid courses in computers and technology⁶. This hampers their future job opportunities in most fields, as today, computers are integrated into almost any type of work. Crombie's study found that single-sex technology classes for women, with a curriculum that was attractive to them, filled-up rapidly and the results in performance and confidence of these women were as good as that of the men in the mixed class. However, women in the mixed class performed markedly less well⁷.

Out-of-school science activities can stimulate the interest of girls and young women in science, mathematics, engineering and technology provided that they have been designed to be of interest to both sexes. Many programs fail to attract girls or to retain them because of their masculine approach. A summer program with an equity policy enrolled boys and girls on a first come basis, except that if the number of boys was larger, the boys (or their families) who found a girl to enroll would be admitted with the girl. This ensured equal numbers and made boys and their families part of the solution⁸. To be successful in attracting both sexes, out-of-school activities need to place much care and effort on recruitment, marketing, content, and leadership styles, and ensure that all activities are inclusive. Since most programs are funded through a blend of public and private industry support, organizers need to make sure programs work for all.

The image of engineering as a field for men remains a problem. The concept of the engineer as a train driver has been put to rest, but other symbols remain. For example, construction equipment and mechanical drills are perceived as masculine^{9,10}, adding to the misconceptions that women have about what engineers do. Since young women are quite concerned about preserving their feminine image and helping society in their chosen

profession, it is no wonder that many avoid engineering and opt for medicine, law and nursing. To succeed, we must demystify the work of engineers, especially in fields where women are least represented, and demonstrate how engineers can help society.

When I visit schools, I tell the story of the development of the cardiac pacemaker and show how engineers can help to save lives. This always produces a great interest for the field of biomedical engineering and partly explains the doubling of enrolments of women in electrical engineering (12 to 24 per cent) at both University of Ottawa and Carleton University in a two year period. Another reason for this dramatic increase is the work of the Pathmakers, a group of volunteers (female students in science and engineering) making presentations in the Ottawa-area schools. These students are passionate, inspiring and committed to encouraging girls and young women to pursue successful careers in engineering and science. Pathmakers have reached thousands of students from grades one to twelve and have increased its contact with schools by 500 per cent since 1998.

Pathmakers spark the students' interest, through their personal stories of following a career path in these fields, and provoke excitement and wonder through interactive demonstrations and hands-on experiments, contributing to the elimination of stereotypes surrounding science and engineering careers and gender roles that limit choices to traditional careers. They convey the message to stay in school, take science, technology and mathematics courses, and explore career opportunities for future economic independence and an interesting job. They inform students about the opportunities in the job market, and encourage them to become well rounded, educated adults. Teachers gain new ideas, resources and teaching methods and this helps to enrich the science curriculum and career guidance program. Pathmakers are an inspiration and a catalyst for the success of the next generation, and gain valuable communication, interpersonal and presentation skills that will benefit their own careers. The program received one of the three Outreach Project Awards from the Canadian Engineering Memorial Foundation in 1999. It is a program that can be replicated anywhere.

Another issue is the lack of recognition by many engineering professors of the differences in learning styles and interests of women and men. Women tend to favour relational learning, which associates applications to theory. They enjoy group work and a collaborative approach when there is a critical mass of women in the group. To retain women who have chosen this path, it is important to pro-

vide networking and mentoring opportunities and create a climate that integrates and respects feminine values.

Only half of the women who obtain a degree in engineering apply to become licensed professional engineers¹¹. It is vital that the profession examines this issue and determines why this is happening. Then steps can be taken to increase the proportion of women becoming licensed as a P.Eng. It will also be important for employers to ensure that women are treated appropriately in the hiring and promotion process; that sexual harassment is eliminated; that provisions are made for young women and men to balance their family and career needs; and that feminine perspectives and approaches are recognised and valued. Then, recruiting and retaining them will no longer be an issue; women will finally feel that they belong in the profession.

Monique Frize, P.Eng., O.C., holds the NSERC/Nortel Joint Chair for Women in Science and Engineering, School of Information Technology and Engineering, University of Ottawa, and Department of Systems and Computer Engineering, Carleton University. Visit her websites at www.carleton.ca/cwse-on or www.genie.uottawa.ca/cwse-on.

References

1. Canadian Engineering Human Resources Board, Canadian Council of Professional Engineers. (2000) *Canadian Engineers for Tomorrow: Trends in Engineering Enrolment and Degrees Awarded, 1995-1999*. Ottawa.
2. Sadker D. and Sadker M. (1994) *Failing at Fairness: How America's Schools Cheat Girls*. Charles Scribner's Sons, New York.
3. Coulter, R. (1993) *Gender Socialization: New Ways, New World*. Report printed by the Ministry of Equality, British Columbia, Victoria, B.C.
4. *Globe and Mail*, article on provincial testing results. November 3, 1997.
5. Wood, S.L. *Family, Home, and the School Environment's Influence on Gifted Girls: Perceptions of Choice to Take Extracurricular Science Classes*. Master's Thesis, Faculty of Education, University of Ottawa, 1999.
6. Frize, M. (1998a) "Missed Opportunities." *Canadian Consulting Engineer*. 1:30-34.
7. Crombie, G. and Armstrong, P.I. (1999) "Effects of classroom gender composition on adolescents' computer-related attitudes and future intentions." *Journal of Educational Computing Research*, 20: 317-327.
8. Frize, M. (1998b) "Impact of a Gender-Balanced Summer Engineering and Science Program on Future Course and Career Choices." *Proceedings of WEPAN Conference*, Seattle, Washington, June 1998.
9. Sorensen, K.H. and Berg, A.J. (1987) "Genderization of Technology among Norwegian Engineering Students." *Acta Sociologica*, 30 (2): 151-171.
10. Robinson, G.J. and McIlwee, J.S. (1991) "Men, Women, and the Culture of Engineering." *The Sociological Quarterly*, 32 (3):403-421.
11. Canadian Engineering Human Resources Board, Canadian Council of Professional Engineers. (1998) *National Survey of the Canadian Engineering Profession*. Ottawa.