

**The NSERC/Industry Chairs for Women in Science and Engineering:
A National Program in Canadian Universities**

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ABSTRACT

With the establishment of five senior academic positions in science and engineering faculties across Canada aimed at promoting the participation of women, NSERC (the Natural Sciences and Engineering Research Council of Canada) and its industry partners made a significant commitment to

this objective. This NSERC Chairs program is unique in Canada, and possibly in the world. The program began in July 1997. This paper presents a summary of the challenges, results, and lessons learned from the program's first four years.

Keywords: participation, research, university

PROGRAM DESCRIPTION

In 1996, NSERC (the Natural Sciences and Engineering Research Council of Canada) announced the creation of five new Chairs for Women in Science and Engineering (CWSE), one for each of the BC, Prairie, Ontario, Québec, and Atlantic regions of Canada. Each Chair is jointly sponsored by NSERC, an industry partner, and the host university. The Chairholders are senior academics in a field of science and engineering, who commit to spending approximately 50% of their time on Chair work.

The NSERC program of five Chairs followed the tenure, 1989 - 1997, of a single national chair for engineering only, the Northern Telecom/NSERC Chair on Women in Engineering at the University of New Brunswick, held by Monique Frize. Based on the success of this Chair and the continuing need for promotion, a report to NSERC [1] recommended the establishment of five Chairs.

The objectives set out by NSERC for the Chairs are:

1. Develop, implement and communicate strategies to:
encourage women students in elementary and secondary schools to consider careers in science and engineering;
increase enrollment of women in undergraduate and graduate programs in science and engineering in all Canadian universities;
increase the retention rate of women in science and engineering positions;
sensitize university science and engineering departments on how to improve and promote the integration of women students and professionals amongst their ranks.
2. Provide accomplished, successful and recognized women role models in science and engineering research in Canadian universities.
3. Improve the level and quality of participation of women in science and engineering as students and as professionals.
4. Develop, implement and communicate strategies to eliminate roadblocks to women wishing to pursue careers in science and engineering, as well as methods to evaluate progress.
5. Develop and implement a communication and networking plan to ensure a regional and national impact on opportunities for women in science and engineering.

The program launched in July 1997, with Chairs at the University of British Columbia supported by IBM, the University of Calgary supported by Petro-

Canada, University of Ottawa and Carleton University jointly supported by Nortel, the Université Laval supported by Alcan, and Memorial University of Newfoundland supported by Petro-Canada.

UNIQUE FEATURES OF THE CWSE PROGRAM

Active promotion in Canada of women in science, engineering, and technology has been underway for more than a decade. The accumulated information from the disciplines of sociology, education, psychology and women's studies on the participation of women in science and engineering is substantial. At the same time, the persistently low participation rates indicate the need for new or different approaches. Each of the NSERC Chairholders is an active scientist/engineer, fully committed to research and teaching in her respective discipline, with the viewpoint of a scientist/engineer as well as working experience in the institutions which educate and develop scientists and engineers. At the same time, the objectives of the Chair lead the Chairholder to consider the social, cultural and educational aspects of women's participation in science and engineering. The Chairholders work in a meta-disciplinary environment. Hence the Chairs present a unique opportunity for fresh analysis of the concepts and processes which lead individuals to successful participation in science and engineering.

The advantages derived from the Chairs' unique positions and perspectives are balanced by the challenges specific to the role. Engineers and scientists like to solve problems, to progress through research and results to satisfactory solutions in a planned manner. They may not have the same patience or appreciation as their sociologist counterparts for the context of the problem posed and for all the connections to factors outside the scope of their desired solution. Finding the patience has been one of the challenges. On the scientific/engineering side of their careers, Chairholders felt they experienced some form of isolation and marginalisation as a result of Chair activities, a phenomenon well known among people who work on behalf of the status of women. Maintaining that mainstream respect and recognition is a time and energy-consuming challenge. A third and inevitable challenge is that of maintaining momentum in scientific research and teaching while fulfilling the leadership and promotion expectations of the Chair, managing a high volume of public and individual communications, continuously multi-tasking.

NATIONAL NETWORK

The five Chairs work closely together to ensure the effective sharing of strategies, experiences and information, and to develop a solid national network. This co-operation was initiated immediately upon the announcement of the Chair awards. The Chairs adopted the strategy that they would meet together approximately twice per year and that they would rotate the meeting location such that all regions would be visited at least once during the five year term. A 'Chair of Chairs' concept was also initiated where one of the Chairs was responsible for a one year term to (1) co-ordinate and host a meeting, (2) arrange teleconferences and broadcast email messages, (3) co-ordinate a national newsletter, and (4) serve as a member of the board of the Canadian Coalition of Women in Engineering, Science, and Technology (CCWEST) and CCPE (Canadian Council of Professional Engineers).

The framework that has been adopted during the meetings allows the Chairs also interact with interested groups in the University community. Typically the Chairs meet with women faculty in science and engineering, researchers working in the area of gender and science, and also with the Chair's Advisory Council, if applicable. This format has been shown to be effective in communicating a national vision for the Chairs while showcasing to the local community the work of their regional Chair.

The Chairs have levered their network to communicate a strong national voice. For example, there have been a number of meetings with leaders in the science and engineering community, including the National Committee of Deans of Science, the National Committee of Deans of Engineering and Applied Science, the Secretary of State for Science and Technology, and the President of NSERC. The Chairs have collectively responded to a number of media reports on women in science and engineering issues so that factual information is communicated to stakeholders and the public at large. Finally, the Chairs have taken active participation in a number of national and international organizations (e.g. ICWES, APEC, UNESCO).

The Chairs have also been involved with the development of several national initiatives including (1) a national newsletter which is published yearly and is disseminated through the Chairs' web pages, (2) the creation of a bibliographic database containing reference material on gender and science and engineering, accessible through some of the Chairs' web pages, and (3) the development of a

National Action Plan for the Chairs so a common vision can be effectively communicated.

Two national conferences (Vancouver in 1998, St. John's in 2000) and an international conference (Ottawa in 2002) on women in science and engineering will have taken place within the five-year term. Although the conferences are hosted by individual Chairs, they became truly national events due in large part to the efforts of all the Chairs to identify contributions and encourage participation from the respective regions.

DIVERSE APPROACHES

The regional programs of the individual chairs are different in content, audience, and scope. The results of these activities are reported elsewhere [2-6]. The present paper concentrates on information gained from the shared experiences.

Four of the Chairs have a highly qualified permanent staff person who coordinates programs and acts as assistant to the Chair. For the fifth, the Chair is assisted by a sequence of work term students.

Within the regions, the Chairholders act as spokespersons and information resources about women in science and engineering. Each has given many invited talks, frequently spoken for radio, TV, and print media, assisted in school events, and served on committees and Boards in the science education and promotion fields. All of the Chairs established communication networks through their regional universities and science promotion organizations, and all work cooperatively with community organizations such as WISE (Women in Science and Engineering).

The Chairs have collaborated with university colleagues in sociology, education, history, psychology, and women's studies in research, teaching, and promotion projects. These collaborations have resulted in numerous publications, new curricula, and graduate students whose programs are enriched by multidisciplinary supervision.

School recruitment activities such as Pathmakers in which university and professional women visit classrooms together [3], and special events which bring girls together for a day of hands-on Information Technology (IT) and talks from keynote speakers drawn from the IT sector [4], are effective in generating awareness and enthusiasm among students for the highlighted careers. An email mentoring system which links girls with women science and

engineering students as well practicing engineers and scientists fosters that enthusiasm [4]. The positive effects of these programs continue to be offset by persistent gender differences in interest and perceived ability in physics, engineering and computer science which manifest in grade 8 and gradually increase until grade 12 [7]. In mathematics, there are only slight gender differences, or reversed trends, in interest and perceived ability at all grade levels.

A persistent and familiar theme is that young women are attracted to the life sciences, where the applications and human dimensions are clear early on in their studies. They are unfamiliar with careers in the physical sciences and engineering, and their high school experience with these subjects does little to persuade them to follow this route. For high school students, interest in a subject is strongly dependent on its connection with their daily lives, the variety of methods of teaching, and the teachers themselves. This is the motivation for the program OPUS (Outils Pédagogiques Utiles en Science), a web-based resource for teachers [8]. OPUS follows the high school Physics curriculum, linking it with the students' experience and providing basic information, activities, and ideas for hands-on projects.

Most science and engineering career paths go through university. Pedagogy and curriculum features at this level, not required by excellence in science or skill level of the student, continue to have significant influence on the participation ratios. Specific initiatives such as Physics review sessions prior to the mid-term and final exams help the students who participate. Program change will assist many more. However universities, being of long tradition, externally funded, and internally evaluated, are among the most traditional institutions in our society [9]. The most important changes must take place in our own front yard.

In computer science courses, one important factor contributing to the low participation and high attrition rate of female students is their lack of programming experience, compared to male students, prior to entering university. A programming activity called Virtual Family was developed as a computer activity that could engage teenage girls with no programming experience in an enjoyable 1 – 2 hour experience involving programming in Java [10]. This activity incorporates some of the components of electronic games that research has shown to appeal to girls, namely story line, characters and relationships. Another approach is a new university course that introduces fundamental computer science concepts

through applications in biology, psychology and fine arts.

At the end of the university experience, continued participation and satisfaction is still challenged for women who work in minority situations or in very traditional institutions (such as universities). A practical guide aimed at supporting career success summarizes much of the practical information distilled by the Chairs for professional and academic women and their mentors [11].

INSIGHTS

For all the Chairs, and throughout all the information considered, fundamental and pervasive themes emerged. Two challenges persist: work-life balance for career women, and achieving fair respect and recognition for women's scientific or engineering work. A wide range of effective actions are applications of one strategy: appropriate mentoring for young women to make them aware of the issues and give them the self-confidence to succeed.

The impact of the Chairs is much greater than five times that of a single Chair. Not only is the effectiveness of each Chair strengthened by sharing of information and by mutual support, but also five people across the country with a consistent message give it legitimacy and make it more likely that organizations will hear it more than once.

NEXT PHASE

The first 5-year term of the Chairs program ends in summer 2002. NSERC has again demonstrated its commitment to the overall objectives by announcing that its support will continue at the same level over the next 5 years. In keeping with NSERC policies for research chairs, host universities may apply for renewal of support for incumbent chairs. Where a Chair is not renewed, NSERC will continue the regional representation of the CWSE program by holding an open competition among universities in that region.

Some of the current Chairs decided not to continue for another term. Each of the individuals holding Chairs is a serious scientist and has committed the substantial portion of her career to making a contribution, and a reputation, as a scientist. Promoting women in science and engineering is a different career path. While the synergy between the scientific activities and the promotion activities is significant, so too are the tensions. For all of the Chairs, the decision whether to renew was a carefully

considered one. The differences between those who wished to renew and those who did not were not large.

For the continuing and the incoming Chairs, the first term provides a substantial platform on which to build. There is a database, including time series, on participation rates, and reliable data sources have been identified. The Chairs have compiled a common knowledge base of research on factors that influence participation, and produced Canadian benchmarks for some key international research trends. Across the considerable variety of the Chair programs, there is useful practical experience and information on program impact. Finally and possibly most important, there is a much greater awareness in universities across Canada than there was 10 years ago [12, 13] of the importance of increasing the participation of women in science and engineering, as well as optimism that progress is being made.

The work of the Chairs is now at a turning point. The challenge of raising the participation of women to current levels has been met through energetic recruitment and promotion programs. However, any further gains will need much deeper changes to the environment, the curriculum, and pedagogy, as well as changes to broad public perceptions, so that some of the women who are now choosing more liberal professions (medicine, dentistry, law, pharmacy, business) will begin to see engineering and sciences as a fields that benefit society and ones where their feminine perspectives are valued. This is the most difficult part of the work.

Efforts over the next five years will focus on achieving these deeper and broader changes. Universities will continue to be the critical area of activity, and engineering and computer science the benchmark disciplines. Positive changes in attitudes can be achieved by demonstrating the effectiveness of new teaching methods, and giving people experience with them. In some cases, it may be necessary to tackle traditions more directly. It may be another decade before a critical mass of women is achieved in engineering and all of the sciences. The work will depend on the activation of an extended network of the Chairs, the support of Deans and other administrators, and the participation of professors who will champion new tools and approaches that better fit a diversity of students.

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