

## **OUTREACH PROGRAMS FOR YOUNG WOMEN IN HIGH SCHOOL**

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### **ABSTRACT**

Women make up 52% of the population and 55% (1996) of all undergraduate students in Canadian Universities, yet only 21% of students enrolled in applied science and engineering programs are women [1]. In 1991, the Women in Engineering (WIE) committee at Ryerson Polytechnic University initiated the "Discover Engineering" Summer Camp for young women in high school. The objectives of the program are to educate young women about the challenges and rewards of engineering, and to motivate them to choose engineering as a career option. Due to the overwhelming success of the camp, including a yearly 150 student enrollment (since 1997) and wait list for the following year, the camp has expanded its outreach to include in-class high school workshops during the 1999-2000 academic year on a trial basis, to raise awareness among those students who have not yet considered engineering as a potential career path, due to a lack of knowledge, interest or confidence. This paper describes the design, implementation and curriculum behind this new outreach initiative, as well as evaluates the effectiveness of the program and impact of the presentations and provides recommendations.

### **INTRODUCTION**

The engineering profession has not been as successful in attracting women as other previously male-dominated fields such as law, teaching or medicine. While the climate for women in engineering has been slowly changing over the years, lack of encouragement, peer pressure and factors such as lack of visibility of careers in engineering compared with other professions, still act as barriers preventing more women from pursuing a career in this non-traditional field. Since 1991, the Discover Engineering summer camp for young women in high school was the main outreach project of the WIE committee. In 1999, when the opportunity arose to hire a full-time WIE Coordinator, the committee decided to expand its outreach activities and extend the Discover Engineering camp curriculum to the classroom to target students who may not have ever considered attending the camp, let alone a future career path in engineering. Like the camp, the high school workshop program was developed to address the problem at a stage when high school students are exploring potential majors and careers. From November, 1999, to April, 2000, members of the WIE committee made presentations to high school students in the greater Toronto area with the goal of encouraging young women to consider futures in engineering.

### **BACKGROUND - RYERSON OUTREACH INITIATIVES**

In 1989, the participation of women in undergraduate engineering programs at Ryerson Polytechnic University was less than half the provincial average, with percentages as low as 3 to 5% in Mechanical, Aerospace and Electrical engineering [2]. The WIE committee was established that same year with an explicit goal to increase the number of women in Ryerson engineering programs. Its first initiative, the 'Discover Engineering' summer camp is unique in the Toronto area. Unlike some other science and engineering programs, it is delivered exclusively to women. Although evidence about single-sex education is somewhat conflicting, there is a general perception that girls fare better in math and science in single sex environments [1]. The camp is presented in a week-long format, which allows more time to introduce the many dimensions of engineering. The target age group is students in grades 10 to 12, and engineering faculty have primary responsibility for the development and delivery of the curriculum.

To-date, over 1000 young women were introduced to engineering through the camp experience. Recent surveys of participants who attended the program in 1994-1997 indicate that more than 500 of those young women are already working in an engineering field, or studying to enter it. Information collected from the surveys suggests that the camp experience helped them significantly to decide whether or not to study engineering, becoming a deciding factor for 360 [2]. These numbers indicate a positive contribution that the WIE committee at Ryerson has made over the years to its stated goal of attracting more women to engineering.

### **THE HIGH SCHOOL WORKSHOP PROGRAM**

The 'Discover Engineering' high school workshop program was initiated in the Fall of 1999 as an extension of the 'Discover Engineering' camp program. The goal of the new initiative is to raise awareness about careers in engineering among all high school students. This means that the program is offered to co-ed classroom environments and not just to female students. The participation of women presenters, who are faculty, staff and students, however, provides strong, positive role models for the young women in the audience. Women role models help change stereotypical perceptions of engineers, held by both male and female students.

The workshop program is also intended to tackle the visibility issue around engineering. Students may have a clearer idea of what careers such as medicine, business and teaching are about, because they are more likely to interact with professionals in these areas. Even popular television shows depict the lives of lawyers and doctors, but little is heard about engineers. It is difficult to follow a career path without information on the career itself or even a general awareness. Presenters relate the workshop material to real-life situations and examples, making engineering more attainable and comprehensive as a profession.

The workshops are promoted in greater Toronto area high schools for grade 10-13 audiences, at no cost to schools. Each workshop is approximately one and one half hours. It includes a brief introduction and discussion about the purpose of the workshop, the definition of engineering, characteristics of an engineer, engineering programs at Ryerson, and general opportunities in the field of engineering. The discussion is followed by a hands-on classroom activity, which emphasises human factors, problem-solving and teamwork. Two activity modules are currently available, Engineering Design and Engineering Challenges.

#### **Engineering Design activity**

Students are divided into teams of three or four, presented with a problem, and asked to design and test their solution. The teams are required to budget, draft a design and build a structure that will contain an egg and protect it from cracking/breaking once dropped from a 20 foot height. They are given 30 'Discover Engineering' dollars and can only purchase items from the 'Discover Engineering' store for their structure. This exercise promotes group work and problem-solving skills.

#### **Engineering Challenge activity**

The objective is to build the tallest free-standing structure possible within a specific time limit. Students are divided into groups of five and given a limited number of straws and marshmallows as building materials. Every member of the group is assigned a specific role, i.e. use of only the left hand, cannot talk, use of scissors only, use of marshmallows only, team leader, etc. This exercise promotes co-operation within the group, team-work, and problem solving skills.

In order to determine the level of awareness among students about engineering prior to the workshops, all students were asked to complete questionnaires. At the end of the workshop, the students were asked to complete evaluation forms to obtain feedback on the effectiveness of the workshop.

## PROGRAM RESULTS

### Summary of Questionnaires

664 students completed the questionnaires prior to the workshops, of which 66.4% were female and 32.2% were male. More questionnaires were completed by females because the workshops were delivered at an all-girls high school, as well as at a technology conference exclusively for girls in grade 10.

Percentage of students who were interested in becoming an engineer:

Total (Females and Males)	Females	Males
24.5%	16.2%	56.2%

Percentage of students who knew what an engineer does:

Total (Females and Males)	Females	Males
24.4%	16.2%	41.9%

Percentage of students who didn't know what an engineer did, but still wanted to become an engineer:

Total (Females and Males)	Females	Males
6%	4.6%	10.1%

Number of students who had engineers in the immediate family:

Males	Females	
32.5%	60.3%	Male engineer in family
6.1%	8.5%	Female engineer in family

Of all students who wanted to become an engineer, 13.3% had a female engineer and 38% had a male engineer in the immediate family. Although females were more likely to have an engineer in the immediate family, they were less likely to know what they did or want to become one.

### **Summary of Evaluations**

Questions	% Students (Male and Female)
Did you find the workshop interesting?	83%
Were the presenters enthusiastic and helpful?	90.3%
Did the workshop increase your knowledge of engineering?	65.6%
Do you think the workshop has influenced you to investigate engineering as a career option?	41.9%
Would you recommend this workshop to your friends?	95%

Before the workshop, only 24.5% of students wanted to become an engineer, yet after the presentation, 41.9% said they would consider investigating engineering as a career option. This demonstrates that the workshops had a positive influence on students and their future plans

Based on comments received from the workshop participants, the committee achieved its goal of creating a more positive image of engineering to high school students. A great deal of feedback was also received from teachers, although they were not given formal evaluation forms. Several teachers stated that they felt the workshops would benefit students in advanced courses more than in general courses, and the only classrooms visited were math and science classrooms. Though the program was initially developed for a Grade 10-OAC audience, we visited several Grade 9 classrooms based on the recommendations of teachers who felt that younger students should be exposed to the workshops, since students in Ontario must decide by Grade 10 which course stream to follow, i.e. sciences, arts, etc.

### **RECOMMENDATIONS**

Should the program be re-instated in the upcoming academic year, there are several recommendations to consider based on this year's experience. An important consideration is to extend the target audience to include Grade 9 classrooms in order to introduce students to careers in engineering earlier in their academic careers, before they decide what path to pursue. It would also be beneficial to ask teachers to formally evaluate the program and provide suggestions to better complement the high school curriculum.

In terms of the evaluation tools, an oversight that was made this year was asking the students to write their gender on the questionnaires but not on the evaluation forms. In the future, this should be noted on both forms in order to see whether the program triggers different responses from young women and men.

In the 1999/2000 academic year, the program was launched in November and widely advertised in December/January. Preferably, the program would have started earlier; however, funding had not been confirmed until October. It is valuable to promote this type of program early in the school year as it allows teachers and guidance counsellors more time to plan and schedule school visits. Unfortunately, several workshop requests were declined in mid-end of April, due to the university final exam period, and since the majority of the workshop presenters were students, it was impossible to extend the program into May and June.

In addition to some of the recommended changes, there were several aspects of the program that should be maintained, such as the hands-on activities and co-ed audience participation. In the future, however, it would be worthwhile to offer additional workshop activities to give teachers more choice. More on-going contact with the workshop presenters should be encouraged at the end of the presentations to promote networking and further questions. This year, students were invited to visit web-sites for Ryerson and Women in Engineering, which contains additional contact information.

## CONCLUSIONS

As demonstrated by the new high school workshop program at Ryerson, the power of role models cannot be underestimated. Young women need to see images of competent, confident and respected women in non-traditional roles in order to know that they are capable of achieving success in these areas as well [3]. It is also beneficial for young men to interact with women role models to promote a more holistic approach to appreciating a diverse engineering community.

The participation of women in engineering in Canada has increased every year since 1974 (the year first statistics were recorded), when only 2.9% of full time engineering students were women, and reached 20.7% in 1998 [4]. In the province of Ontario, there were 3,164 (or 21.4%) female engineering students in 1998, an increase of more than 50% since 1991 [2]. Ryerson alone has seen a dramatic increase in enrollments in recent years from 7.9% to 16.1% between 1992 and 1998, as shown in Figure 1. Current enrollment figures at Ryerson, while still below provincial and national averages, show signs of catching up.

### FIGURE 1: ENROLLMENT (IN %) OF FEMALE ENGINEERING STUDENTS AT RYERSON VS. ONATRIO

There are many contributing factors: an increased awareness in society at large of career opportunities for women, changing perceptions of engineering, increasing emphasis on communications and people skills, changes in the profession itself in the wake of the Montreal massacre ten years ago, and the economy, to name just a few.

National and regional recruitment efforts are certainly contributing as well. While it is still too early to evaluate the long term impact of more recent Ryerson initiatives, hundreds of young women in Ontario who decided to pursue engineering as a result of their direct and indirect exposure to the 'Discover Engineering' program are certainly beginning to affect positive change in the profession. While many 'Discover Engineering' alumni enrol at other universities to pursue engineering, the increased visibility of WIE projects at Ryerson and efforts to create a gender-positive environment at the university has had an undeniable effect on enrollments at other universities, as well as at Ryerson.

## REFERENCES

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