Extending the Vision and Impact: Canadian and U.S. STEM Outreach Experiences

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ABSTRACT

A cross-border, cross-cultural examination of successful outreach organizations and initiatives provides valuable information for others interested in similar ventures, and can also serve to enable these organizations to learn from each other and to be motivated toward new possibilities. This paper and presentation will describe two specific, highly successful programs designed to encourage young high school women in studies and careers in science, technology, engineering and mathematics – the Women in Science and Engineering (WISE) Newfoundland and Labrador Summer Program and the Santa Clara Valley Section of the Society of Women Engineers' (SWE) GetSET program. Also included is a description of a successful post-secondary retention program, the Institute for Women and Technology (IWT) Virtual Development Center (VDC). Lastly, new ways to improve the overall effectiveness of all programs are introduced.

INTRODUCTION

Since 1990, WISE Newfoundland and Labrador has provided young women about to enter their last year of high school with first-hand science, technology, engineering, and mathematics (STEM) experience through summer-long paid positions in university research settings. The majority of the students have been from small and often isolated communities and from a largely homogeneous Caucasian population, with a small number of first nations and Asian-ancestry women participating.

Established in 1992, the GetSET Program, an initiative of California's Santa Clara Valley Section of the Society of Women Engineers, is a four-year program that reaches out to girls in high school who are from ethnically diverse groups typically under-represented in engineering and computer science. Participants, largely from urban settings, attend a one-week, hands-on summer science and math camp at local post-secondary institutes, are involved in an number of activities over an extended period, and are provided with a variety of growth opportunities including college entry information and support.

Established in 1999, the VDC is research program aimed at identifying practical and innovative ways to involve women and girls in all sectors of the technology world and in all phases of technology creation. It consists of a network of eight geographically distributed development centers (VDC Sites) that are located at Purdue University, Santa Clara University, Texas A&M, Smith College, the University of Arizona, the University of Colorado at Boulder, the University of Washington and the University of California.

With emphasis on increasing effectiveness and breadth of impact, we will present a simple process by which all three programs can support each other.

WISE STUDENT SUMMER EMPLOYMENT PROGRAM

WISE Newfoundland and Labrador is a non-profit, volunteer organization, which aims to increase the participation of women in STEM careers by increasing awareness that these professions are rewarding and exciting options for women. WISE also provides mentoring, professional development and networking opportunities to facilitate the success of women in these fields, and advocates for equitable workplaces. WISE has been active in Newfoundland and Labrador since 1988 in a number of successful initiatives that include conferences, workshops, videos, science kits, poster series, newsletter, presentations and meetings.

Our longest-running and most significant undertaking is the WISE Student Summer Employment Program [1-4]. Since 1990, the SEP has placed 460 female Grade 11 students from throughout the province in paid summer jobs in science, engineering, medicine and technology, primarily at Memorial University. With hands-on exposure to work, weekly tours and personal interactions with scientists and engineers, the eight-week Program aims to demonstrate that careers in these fields are interesting, rewarding, and accessible, as well as to build self-confidence and provide a support network for the students for the future. Current major funders are Human Resources Development Canada and Industry Canada's PromoScience.

In addition to the job experience, other activities enrich the Program: weekly tours to technology-related sites, a career choices evening, a job-sharing day, final presentation day and a published compilation of student summaries.

Two Co-Directors, members of WISE and professional scientists, oversee the running of the Program throughout the year. The Program Coordinator, a senior undergraduate student, runs the day-to-day program activities in the summer, and the Residence Coordinator facilitates students' stay in the University Residence. In recent years, the coordinators have been former WISE students.

The SEP has been subject to rigorous evaluation since its inception based upon results of pre- and post-summer questionnaires to students, longer-term follow-up surveys, data collected during a conference which brought together students from the first five years of the Program, and a Masters of Education thesis [1,2,4]. Evaluations from students over the 12 years of the Summer Program revealed that >95% felt that their job provided actual experience in a scientific or technical field and >85% were more encouraged to consider a career in a scientific or technical field. Surveys of the 1990-96 students reveal that all had gone on to post-secondary education or training, with 55% of declared majors being in the fields of science, engineering and computer technology. For 48% of students at the WISE Futures Conference, their WISE summer confirmed their choice of study or career in science, engineering, medicine or technology and another 19% had changed their post-secondary choice to one of these fields. The reality of these women's experiences, however, are reflected in more than just statistics, and the words of the WISE participants below convey very powerfully the outcomes of the SEP.

- Humanizing of science and scientists: “As much as I try not to have stereotypes, you still have this image in your head of what a professor is like ... but you realize that scientists are just people, most of whom love their jobs.”
- Contributions to research and science: “It felt really good to actually be part of the process, knowing that what you were doing would actually make a difference.”
- Discovery of the process of science, relevance to curriculum: “I was fascinated to see how it all comes together; to see where the stuff in your textbooks, what you learn in high school, to see how it actually has practical application.”
- Increase in confidence, self-esteem, and sense of responsibility: “It gave me the feeling of independence; you learn to become your own person and this is a definite bonus.”
- Discovering what they don't want to do, but still value: “Experience, whatever it is, makes you stronger, makes you better.”

SWE GetSET PROGRAM

The Society of Women Engineers Santa Clara Valley Section's outreach program GetSET (Get Science, Engineering, and Technology) encourages young underrepresented women to consider and pursue careers in engineering. In developing the program, a premium has been placed on hands-on learning exercises that will lay a foundation of technical, scientific, and engineering concepts. Through the GetSET program, young women are given the knowledge that they need to begin to invent, to contribute, and to discover ideas to improve our world.

GetSET is a follow-on program to the Higher Education Outreach Program of the Society of Women Engineers which was largely funded by a NASA grant. Starting in 1993, 20 girls were chosen as the first class of GetSET participants. With the support of our community, we added a new class of 20 eighth grade girls to the program beginning in 1995 and each year following. Currently the program has a participant base of 70 girls entering grades 9 through 12 (four years prior to college). Neither financial status nor grades are the prime consideration in the selection of the participants. All costs associated with participating in the program are paid for by the GetSET program through generous corporate and individual contributions. GetSET has been extremely effective in encouraging girls to stay in math and science classes throughout high school.

The majority of the participants go to high schools where the typical graduation rate is 40% of all students.

The primary event for GetSET is a residential, weeklong engineering experience each summer with women engineering mentors called Summer Week. The curriculum of hands-on laboratory workshops for GetSET has been developed and adapted specifically for the program. One to three learning experiences also occur during the school year to reinforce the summer program and are held as funding permits.

The Summer Week is composed of hands-on laboratory activities, a design project spanning 1 - 2 days, educational games, industrial tours, and organized social activities. Summer Week activities are centered on a core curriculum. The curriculum has been updated to include modern day computing courses along with teaching traditional use of mechanical tools. Within the four-year span of the program, participants are introduced to a wide variety of engineering disciplines and a sampling of engineering concepts. Basic concepts such as problem solving, measurement, data collection and analysis are introduced. Teamwork, creativity, development of communication skills and project planning are promoted during all four years of the program. These concepts are presented through application and development of skills in engineering and technology. Examples are building a radio kit, creating a web page, taking a bicycle apart (and putting it back to together), experiments using purchased electronic kits and programming in Java.

The GetSET program is an all-volunteer effort. A core group of volunteers does the planning for Summer Week and another core group is responsible for raising the funds required. In addition there are over 80 volunteers that support the Summer Week. The daytime workshops are led and facilitated by women engineers and scientists. An important tenet of the program is to show that women have technology based careers, and lives outside of work. Women college students, the GetSET girl planning committee and the counselors support the evening activities. Past graduates of the GetSET program are encouraged to become counselors and to volunteer for the evening activities. The location of the Summer Week program is one of the Santa Clara Valley area universities. Every effort is made to take advantage of any special facilities of the host university. The local Student SWE Section members are encouraged to volunteer to help with every aspect of the program, especially to work as a counselor. Tours and demonstrations at the local university or at local companies also utilize men and women volunteers.

The goals of the program are as follows:

- Encourage young women to enroll in math and science throughout high school.
- Expose the young women to concepts, material, and knowledge related to engineering.
- Show how engineering relates to every day life.
- Inspire enthusiasm in the process of leading engineering.
- Compile data to understand the impact of this type of program on the participants.

Outcomes:

- All participants in the program have graduated from high school.
- At high school graduation participants report they will attend college.
- Many of the participants take college courses at local colleges while in high school.
- 20-30% of participants report they will study engineering or science.
- High school graduates have been accepted to top universities in the United States such as Stanford, Harvard, MIT, Santa Clara University, University of California San Diego, San Jose State, Cal Poly San Luis Obispo and others.
- Approximately 20% of each class moves out of the area from the time they enter GetSET until graduation. Many continue to participate in Summer Week although they live out of the area.

IWT VIRTUAL DEVELOPMENT CENTER

IWT seeks to change the world for women and technology by increasing the impact of women on all aspects of technology, by increasing the positive impact of technology on the lives of the world's women, and by helping communities, industry, education and government benefit from these increases. The Virtual Development Center (VDC) is one of four major IWT programs [5].

The VDC is a research program aimed at identifying practical and innovative ways to involve women and girls in all sectors of the technology world and in all phases of technology creation. It consists of a network of eight geographically distributed development centers (VDC Sites).

At each VDC Site, the academic year begins with an Innovation Workshop designed to actively involve people from community groups in the generation of ideas for technology-based products that they need and that positively benefit their communities.

Technical and non-technical students and faculty from the academic institution also participate in the workshop to contribute their own needs, but more importantly, to hear from the community first hand. As part of the workshop, the ideas are prioritized and further defined. After the workshop, the students develop the ideas through course project work under the guidance of the local Leadership Team that includes technical and non-technical faculty and community representatives. At the end of the year, students present the results of their work at the annual VDC Conference.

The VDC fosters increased retention and enrollment in engineering and computer science by providing an enriched learning experience. Comments from students show a re-affirmation of and increased commitment to the choice of technical study. Additionally, students who are academically prepared for technical study but currently studying other fields display an increased interest in technical education. There are indications of increased appreciation for the contributions of engineers and computer scientists, as well as a better understanding of the problems communities want technology to address. Lastly, the increased diversity of participation by people otherwise excluded from technology development enhances and enriches the education process.

- "Being a part of VDC taught me to look at technology from a different (and better!) point of view."
- "I realized the importance of focusing technology to encourage women's interest in the field and it's helped me as a whole to understand the project development process."
- "I'm thrilled that I was able to join the IWT team as a freshman and plan on remaining with the team during my next three years at Purdue."
- "Getting through a technical degree program is very difficult. (I believe) freshmen involved in this VDC Conference are going to feel more confident in their programs."
- "The best part was meeting with our community collaborators. Through them we really got a grasp on what the problem is."

INCREASING EFFECTIVENESS

Typical measurements of high school outreach program results look for increases in the number of students choosing to study technical fields. The main process emphasis at this level is the enrichment of an individual student's experience. At the post-secondary level, the problem is the retention of students in technical fields which is evidenced, for example, by the percentages of women graduating in engineering of only ~19% in Canada for 1999 and ~18% in the U.S.A for 1996. [6,7]

If programs are to be more effective, the challenge is to provide more systemic ways to connect successful high school outreach programs to successful post-secondary retention programs that allow students to transition more smoothly and graduate in increasing numbers. Four questions are asked to help identify opportunities for improvement, and answers as they relate to the WISE SEP, GetSET and the VDC are offered as an example of what is possible.

- What programs must exist?

At every level of education, students who could become engineers and scientists are lost. The loss starts with middle school, increases in high school and continues through college. Effective programs that systematically identify and nurture students through STEM studies are needed at all academic institutions at all levels in order to significantly reduce this loss. In addition, a system to keep program organizers informed of related program activity is needed.

- How can former students of high school outreach programs strengthen post-secondary retention programs?

A fundamental goal of the VDC is to involve women and girls in all aspects of technology so that technology products that truly meet the expressed needs of women and girls are created. This means female participation starting with the conception of ideas through implementation and product end-of-life. High school outreach programs can condition students to **expect** female involvement. Given the recognized shortage of students ready and willing to pursue technical study, especially in computer science and engineering, this expectation can help raise the bar for post-secondary educators and administrators and reinforce the need for effective retention programs. The recent success of professional women's soccer and basketball and women's Olympic hockey, is a good example of what is possible when the rising expectations of girls are given proper attention.

- How can post-secondary retention programs reinforce the lessons learned by students who participated in high school outreach programs?

The WISE SEP opens a broader array of choices to its participants and builds their expectations of success in STEM fields. Post-secondary initiatives such as proactive recruitment of participants into first-year university programs and their continued engagement in student research assistantships have the potential to not only strengthen self-confidence, but also to enhance young women's contributions to the outcomes and environment of STEM education and research.

The GetSET program provides direct knowledge of STEM fields and tools required to succeed in them. As with the WISE SEP, post-secondary initiatives focused on recruitment and financial support are the first step. The reinforcement of academic tools and the mentorship of participants would increase the likelihood of success in STEM fields.

- How can high school outreach programs and post-secondary retention programs bring back value to families and communities so that they will continue to encourage their children to enter these programs?

Ultimately, those trained in STEM fields work to improve the lives of human beings; therefore all programs must be able to show value to our families.

The VDC places emphasis on the continuous involvement of community throughout the development process, which provides many opportunities to demonstrate the relevance of the technology to the people expressing the need.

The WISE SEP spirals its influence to the home communities of the participants through their sharing their experiences with family, peers and teachers. They convey the positive messages that women are active agents in science, engineering and technology, and that these fields impact our everyday lives.

Lastly, GetSET provides insight into engineering and science that oftentimes is not available to the families of participants. An immediate or extended family member has recommended about 25% of the current participants. Families report that self-esteem and knowledge gained through GetSET allows participants to be a role model and mentor to younger siblings and extended family members.

CONCLUSION

The GetSET and WISE Summer programs are very successful in meeting their established goals. Now is the time, however, to look beyond those and other similar programs, to the next step for the student participants. We must envision where they will go, what expectations they will bring with them, and what impact they could and will have on the future. Programs like these must connect with the many outreach and higher education programs in Canada and the U.S. in such a way as to reinforce earlier lessons and ensure women continue to progress and lead in the fields of science and engineering.

REFERENCES

1. Emerson, C., and Murrin, F. (1996). "Investing in WISE Futures Final Report." www.stemnet.nf.ca/WISE/
2. Emerson, C., and Murrin, F. (1998). ""I Know I Can Be Whatever I Choose": Outcomes of a Summer Job Experience." Women in the Workplace: Achieving Harmony, CCWEST National Conference,Vancouver. www.stemnet.nf.ca/WISE/.
3. Emerson, C., Murrin, F., Tovell, D., and Armour, M. A. (1998). "Investing in the Future: Lessons From Two Award-Winning Organizations on How to Deliver a Summer Employment/ Enrichment Program in Science and Engineering for Female High School Students." Women in the Workplace: Achieving Harmony, CCWEST National Conference, Vancouver. www.stemnet.nf.ca/WISE/
4. Sheppard, K. (2000). "An Evaluation Of The Women In Science and Engineering Summer Employment Program." New Frontiers, New Traditions - a National Conference for the Advancement of Women in Engineering, Science and Technology, CCWEST National Conference, St. John's. www.stemnet.nf.ca/WISE/.
5. Montano, G. (2001). "Women and Technology Citizenship." Increasing the Impact of Women on Technology. 12th International Conference of Women Engineers and Scientists
6. In Canada - 20.6% women full-time engineering undergraduate enrollment in 1999; 18.7% women engineering undergraduate degrees awarded in 1999. Canadian Engineering Resources Board survey for the Canadian Council of Professional Engineers. www.ccpe.ca/files/report_cerb_trends_E.pdf
7. In U.S.A. - 19.0% women full-time engineering undergraduate enrollment in 1996; 17.9% women engineering undergraduate degrees awarded in 1996. Society of Women Engineers. www.swe.org/SWE/ProgDev/stat/stathome.html