The Canadian House of Commons' Standing Committee on the Status of Women

Economic Security of Women in Canada.

Tuesday, May 16, 2017, 8:45-9:45 a.m. EDT

Le Comité permanent de la condition féminine de la Chambre des communes du Canada

L*a sécurité économique des femmes au Canada*

Le mardi 16 mai 2017 de 8 h 45 à 9 h 45 (HAE)

Larissa Vingilis-Jaremko, Ph.D.

Founder & President, Canadian Association for Girls In Science (CAGIS)

I am Larissa Vingilis-Jaremko, and I am the founder and president of the Canadian Association for Girls In Science (CAGIS). CAGIS is a national, volunteer-run science club for girls aged 7-16. Chapters hold monthly events for members during which we explore a variety of science, technology, engineering, and mathematics (STEM) related topics. During these events, we bring girls to the workplaces of women and men in STEM fields to get a "behind the scenes" view of STEM in action, and do plenty of fun, hands-on activities. These activities are based on inquiry, exploration, and experimentation in small group environments.

For example, in past events, we have been:

-engineers: designing, building, and testing bridges in a wind tunnel

-ecologists: sampling plant communities in forests and fields

-computer scientists: programming code to have robots execute movements to solve a problem

-orthopaedic surgeons: performing arthroscopic surgery on (rubber) knees

-mechanics: fixing cars

We additionally emphasize that STEM is everywhere and related to everything. We have even challenged our members to find topics that do not involve STEM and used these to plan additional events such as:

-the physics of figure skating

-chemistry of art conservation

These events expose girls to a wide range of STEM related topics and they build self-efficacy by having the girls build, design, and experiment themselves, rather than reading about it in a book. This hands-on learning also helps to consolidate knowledge and make associations that STEM is fun. Additionally, bringing girls to the workplaces of women and men in STEM fields helps to foster a sense of belongingness within those lab or field environments, and exposes the girls to a diverse set of role models in STEM fields.

CAGIS has received many honours for its excellence in science promotion including the Natural Sciences and Engineering Research Council of Canada (NSERC) Michael Smith Award for Science Promotion.

I founded CAGIS when I was nine years old because I noticed that girls in my class hated science. They dreaded science class and thought that they weren't smart enough or the right fit for STEM fields (despite having high grades); they all wanted to be cheerleaders and pop stars. They also associated scientists with the typical "Albert Einstein" image; an old man with crazy white hair, a lab coat, and glasses. These were very different perceptions and interests from my own. My Mom is a research scientist and my Dad was an engineer, and we regularly used STEM to explore, experiment, and help answer my endless questions. As a result, I thought that STEM was fun and I couldn't understand why my friends didn't share this perception. I also started to notice inequities in my class. For example, one day my teacher asked a volunteer to help her set up an experiment from a science kit. Naturally, I volunteered; I had the same science kit at home, and I knew the experiment perfectly. My teacher told me "no Larissa, I need a boy to do this".

I wanted to change my friends' (and my teacher's) perception of STEM and of scientists. I started by inviting women in STEM (friends of my Mom) into my classroom to talk about their careers, and to do fun, hands-on activities with us. However, I realized that my friends at other schools had the same negative and stereotypical views of the sciences, so I decided to start a science club: the Canadian Association for Girls in Science.

Since our humble beginnings, we have spread to have chapters across the country, we have reached thousands of girls, and I am proud to announce that we are currently celebrating our 25th anniversary.

I would like to say that the stereotypes I noticed during my childhood have disappeared, but sadly, they have not.

I regularly go into science classes and ask children to close their eyes and imagine a scientist. When I ask them to describe what they see, the majority still describe the old White man with crazy hair, a lab coat and glasses. He is often socially awkward and isolated. My experiences with children are consistent with research findings on children's perceptions of scientists (Finson, 2002).

These stereotypic portrayals of scientists continue to permeate the media in variety of forms, including characters on TV shows like The Big Bang Theory or the Simpsons, or children's toys, which are becoming increasingly gender divided (Sweet, 2014).

Media portrayals of scientists can influence students' interest in entering those fields. For example, female undergraduate students who read an article that refutes the stereotypes of computer scientists and states that the field is no longer dominated by male computer "geeks", express an increased interest in majoring in computer science, compared to women who read an article confirming stereotypes, or women who read no article (Cheryan, Plaut, Handron, & Hudson, 2013). Thus, media portrayals of scientists can influence interest in pursuing the sciences.

Other research has demonstrated that watching videos profiling scientists improve school children's attitudes toward the sciences (Wyss, Heulskamp, & Siebert, 2012). Additionally, visits from female scientists, reading articles about women in STEM, and teachers profiling women in STEM decrease stereotypic associations and improve attitudes toward women in science among female and male school children (Bodzin & Gehringer, 2001; Smith & Erb, 1986). Role models are important; providing children with a non-stereotyped and diverse role models in the sciences can influence perceptions of scientists and interest in pursuing STEM fields.

Additional research indicates that hands-on activities (Kanter & Schreck, 2006; Mosatche, Matloff-Nieves, Kekelis, Lawner, 2013; Stohr-Hunt, 1996), project based science (Kanter & Schreck, 2006), and cooperative learning (Gupta, 2004), and mentoring programs that connect girls to scientists (Marginson et al., 2013) improve learning and attitudes towards STEM.

To summarize, hands-on activities, project based learning, cooperative learning, and exposure to female role models in STEM fields have been shown to improve attitudes toward the sciences, increase girls' interest in STEM fields, and/or improve learning outcomes in STEM. Although I didn't know it as a child – I simply designed a club that I thought would interest other girls – these are all elements that CAGIS uses in its approach, which has been very successful.

Why is it important to remove barriers and facilitate girls' interest in STEM? Women remain under-represented in STEM occupations in Canada (Dionne-Simard, Galarneau, LaRochelle-Côté, 2016). This

under-representation affects women's economic security; according to Statistics Canada, wages are higher on average in the natural and applied sciences, fields in which women are under-represented, compared to health care, elementary and secondary education, fields in which women are overrepresented (Dionne-Simard et al., 2016). Thus, facilitating women's access to STEM fields has the potential to improve women's economic security in Canada.

It is additionally important to remove barriers and facilitate girls' interest in STEM because we live in a knowledge-based society. In order for Canada to maximize its potential, we need the best and brightest working on innovative new ideas, and continuing research and development; we cannot afford to exclude a sector of society.

I have described some of the challenges involving gender roles stereotypes among children and how they affects girls' perceptions of STEM professionals and associated career interests. I have also described a variety of evidence-based interventions that are successful at changing perceptions and facilitating STEM interest among girls and young women. Science promotion that utilizes these interventions needs to continue. However, childhood is where the problem begins, but there are several additional steps that young women must navigate before being able to enter STEM careers. Systemic barriers continue at the postsecondary level.

Following high school, youth interested in STEM careers enter college or university, depending on the field of interest. Following this, students go on to an apprenticeship, enter the workforce, or continue their education with a Master's degree or Ph.D. However, implicit stereotypes continue to affect women's opportunities. For example, in a study published in the Proceedings of the National Academy of Sciences, science professors at large research-intensive universities were given application materials from a student applying to be a lab manager. The application was randomly given either a female or a male name. The male applicant was rated as more competent and more "hireable" than the identical female applicant. The faculty additionally assigned a higher starting salary and more career mentoring to the male applicant (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012). Women are continuing to hit roadblocks before they even have the opportunity to enter STEM careers.

Of the women who continue, many will go on to earn a Ph.D. and seek a tenure-track position at a university where they can set up a lab to pursue research in their field of expertise. The Ph.D. is now typically followed by one or more postdoctoral fellowships, contract positions where the Ph.D. works in a lab continuing to do research and applying for tenure track positions. Although women disproportionately leave STEM fields at each stage of education, the highest dropout occurs at the postdoctoral level; this is the leakiest point of the pipeline (Marginson et al., 2013). This means that women are disproportionately leaving before they are able to secure a stable job in STEM.

This is in part, related to the corporatization of universities. There was a 25% decrease in the number of tenured professors in Canada over a 10 year period, between 1999 and 2009 (Findlay, 2011). Over the same time period, the number of sessional instructors increased, and it is estimated that 40-60% of undergraduate teaching in Canada is now done by sessional instructors (Findlay, 2011). Over a 15 year period, from 1990 to 2006, the ratio of students to full time faculty increased by nearly 40% (CAUT, 2012). These disappearing tenure track positions are the jobs that many Ph.D. scientists are trained for; in many areas of STEM, there is no industrial option and much of basic research – the innovative new ideas that lay the foundation for later application and development – occurs in universities. If these

university research jobs continue to disappear, we will continue to lose a generation of STEM researchers, losses that are likely continue to disproportionately affecting young women.

“Legislation can play a significant role. In France, the National Ministry of Education made it a priority to steer the career ambitions of more young women towards the STEM fields. Equality legislation was therefore enacted to encourage the diversification of girls’ professional choices. An important strategy extended legislation to top level appointments in academia or positions on decision making bodies, such as research councils. Important elements of this include procedural transparency, standardised selection procedures, widespread publishing of position advertisements, headhunting highly qualified women, and monitoring gender dis-aggregated data on selection and hiring outcomes. Norway is a good example of the success of this approach. At one Norwegian University, equality-oriented searching was conducted through committees established for the identification and recruitment of qualified women. This can be contrasted with the case of Canada, where the underrepresentation of women in STEM has not been a significant part of federal policy thinking or reports on STEM fields in recent years. Women in Canada are particularly under-represented in STEM fields and the country has experienced little improvement in recent years.” (Marginson et al., 2013 p 140)

References

Akkus, R., Gunel, M., & Hand, B. (2007). Comparing an Inquiry-based Approach known as the Science Writing Heuristic to Traditional Science Teaching Practices: Are there differences?. *International Journal of Science Education*, *29*(14), 1745-1765.

Ben-Shachar, R. (2014, September 8). Women Don't Stick with the Sciences. Here's Why. *New Republic*. Retrieved from https://newrepublic.com/article/119363/why-there-arent-more-top-female-scientists-leaky-pipeline

Bodzin, A., & Gehringer, M. (2001). Breaking science stereotypes. *Science and Children*, *38*(4), 36.

Canadian Association of University Teachers (September 2012). 2012-2013 Almanac of Post-Secondary Education in Canada.

Cheryan, S., Plaut, V. C., Handron, C., & Hudson, L. (2013). The stereotypical computer scientist: Gendered media representations as a barrier to inclusion for women. *Sex roles*, *69*(1-2), 58-71.

Dionne-Simard, D., Galarneau, D., LaRochelle-Côté , S. (2016, June 24). Women in scientific occupations in Canada. *Statistics Canada*. Retrieved from http://www.statcan.gc.ca/pub/75-006-x/2016001/article/14643-eng.htm

Findlay, S. (2011, January 17). Whatever happened to tenure? The backbone of today's university is the ill-paid, overworked lecturer. *Maclean's*. Retrieved from http://www.macleans.ca/education/uniandcollege/whatever-happened-to-tenure-2/

Finson, K. D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School science and mathematics*, *102*(7), 335-345.

Gupta, M. L. (2004). Enhancing student performance through cooperative learning in physical sciences. *Assessment & Evaluation in Higher Education*, *29*(1), 63-73.

Kanter, D. E., & Schreck, M. (2006). Learning content using complex data in project-based science: An example from high school biology in urban classrooms. *New Directions for Teaching and Learning*, *2006*(108), 77-91.

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). STEM: country comparisons: international comparisons of science, technology, engineering and mathematics (STEM) education. Final report.

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences*, 109(41), 16474-16479.

Mosatche, H. S., Matloff-Nieves, S., Kekelis, L., & Lawner, E. K. (2013). Effective STEM programs for adolescent girls: Three approaches and many lessons learned. *Afterschool matters*, *17*, 17-25.

Smith, W. S., & Erb, T. O. (1986). Effect of women science career role models on early adolescents' attitudes toward scientists and women in science. *Journal of Research in Science Teaching*, *23*(8), 667-676.

Stohr-Hunt, P. M. (1996). An analysis of frequency of hands-on experience and science achievement. *Journal of research in Science Teaching*, *33*(1), 101-109.

Sweet, E. (2014, December 9). Toys Are More Divided by Gender Now Than They Were 50 Years Ago. *The Atlantic*. Retrieved from https://www.theatlantic.com/business/archive/2014/12/toys-are-more-divided-by-gender-now-than-they-were-50-years-ago/383556/

Wyss, V. L., Heulskamp, D., & Siebert, C. J. (2012). Increasing middle school student interest in STEM careers with videos of scientists. *International journal of environmental and science education*, *7*(4), 501-522.