

THE ENGINEERING PROFESSION'S POSITION

- Science, technology, engineering, and mathematics (STEM) education plays a central role in promoting Canada's economic development and capacity to compete globally as well as increasing Canada's prosperity and productivity.
- The role and nature of post-secondary education is evolving rapidly. Evidence-based research is needed to guide this change.
- Canada, unlike many countries, currently has little capacity and few federal funding mechanisms to support such research.
- Canada must support STEM education research in the higher education sector if we are to continue to graduate world-class engineers.

The challenge(s)

In recent years, STEM education research has been gaining traction and has become increasingly valued globally. This growth is supported by substantial research funding. For example, the United States provides US\$7 billion annually in federal funding to STEM education, which includes US\$105 million through their National Science Foundation for research to improve undergraduate STEM education.

Australia has also provided substantial federal funding towards strengthening STEM education and digital literacy programs. The National Innovation and Science Agenda's Inspiring all Australians in digital literacy and STEM provides a variety of STEM education initiatives that work to increase the participation of youth in STEM education programs while strengthening their digital literacy skills. The total funding for this initiative is \$11.2 million. The Department of Education and Training's 2016-2017 initiatives towards STEM education and digital literacy total \$64.6 million.¹

To remain internationally competitive and better support Canada's aspirations, STEM programs in Canada are seeking to improve their curriculum and program delivery. This is certainly the case for engineering education, a key driver of Canadian competitiveness.

Currently, there is little or no dedicated research funding for this important emerging research area. Without funding to support graduate students and to carry out the studies, it is impossible for professors to focus on the area without risking their future in academia. This lack of core funding hinders the ability to study the effectiveness of current pedagogy, the complex interactions between academia and industry in Canada, the success of Canadian graduates, and the impact of program redevelopment.

Despite these funding challenges, several Canadian universities have established, or are developing, graduate programs and graduate courses in engineering education

(e.g. University of Toronto, University of Manitoba, and Queen's University). The majority of these Canadian researchers rely on a patchwork of foundation contracts, donors, and industry to support research, and much research is done without any funding whatsoever. It is simply not possible to build substantive engineering education research programs without a consistent and sustainable funding source.

Some schools have created internal funds for educational initiatives; however, these funds are typically small, and they provide little opportunity to learn how to properly conduct or sustain educational research. Small internal grants also tend to confine knowledge locally and thus limit how widely this knowledge is shared. Most critically, this lack of dedicated funding programs implies that engineering education research is simply not valued or needed, when in fact the exact opposite is the case if Canada is to strengthen its world-class engineering faculties so as to sustain its global leadership in engineering and a strong economy.

How Engineers Canada has contributed

Engineers Canada recognizes the evolving nature of engineering education and is actively engaged in supporting STEM education and careers in many ways. One of Engineers Canada's many roles is to accredit undergraduate engineering programs. The Canadian Engineering Accreditation Board holds institutions to some of the highest standards in the world, which help graduate some of the best-educated and most well-trained engineering students. Accredited programs satisfy the academic requirements for licensure as a professional engineer with the provincial and territorial engineering regulators, which ensures Canada's engineering education system remains amongst the best in the world.

Engineers Canada also supports the Canadian Federation of Engineering Students (CFES), a national, bilingual organization that represents approximately 85,000 engineering students across Canada. The CFES aims to provide opportunities in support of an all-encompassing education for engineering students in Canada to become unparalleled professionals in their field.

Recommendations to the federal government

A significant gap exists in Canada's research funding ecosystem. This research funding gap is, in part, a result of a lack of coordination between the research granting councils. To reduce the gap, the federal government needs to increase the level of coordination between granting agencies for funding to support research on post-secondary STEM education. Social Sciences and Humanities Research Council (SSHRC) funding does exist for research on STEM education at the primary and secondary school levels, but primarily for researchers in social science and humanities. Natural Sciences and Engineering Research Council (NSERC) does not have adjudication committees addressing disciplinary educational research, making it challenging for engineering faculty to obtain funding to study education in their own fields (e.g. for engineering professors to study the way to improve engineering education in their own classroom). Further, graduate students pursuing STEM education research within engineering or physical science faculties are also limited in terms of the opportunities for scholarship funding and career pathways: their research is not eligible for NSERC scholarships while their fields of study do not align with SSHRC. Thus, the research funding gap falls between NSERC and SSHRC's mandates, and could be addressed through better coordination between these research granting councils.

The proposed investment in STEM education research will do much to help Canada develop better trained and prepared scientists and engineers. The funding will help Canadian academics discover more effective ways to teach and infuse into curricula complementary skills such as technical communication, leadership, teamwork, and entrepreneurship skills that can multiply the success of students after they graduate and expand their many positive contributions to society.

This research investment will also help attract and domestically develop academics specializing in STEM education. Globally, over 30 universities now offer graduate research programs in STEM education, and a number of prominent departments and schools of engineering education exist in the US. In Canada,

universities have started to recognize this need with programs emerging at a few universities and others indicating interest. Regrettably, this growth is being stifled by the lack of research funding. Creating targeted funding to support research on post-secondary STEM education is needed if Canada is to continue educating world-class engineers.

We therefore recommend the federal government:

- Ensure better coordination between research granting councils, specifically between Social Sciences and Humanities Research Council (SSHRC) and Natural Sciences and Engineering Research Council (NSERC), to support research funding on post-secondary STEM education.
- Ensure graduate students pursuing STEM education research within engineering or physical science are provided with opportunities to receive scholarship funding and career pathways.
- Support targeted funding to strengthen research in post-secondary STEM education.

How Engineers Canada will contribute

With its network of expert volunteers, Engineers Canada will:

- Provide advice and facilitate the development of legislation on funding priorities.
- Participate in future research studies on interaction with industry and career performance in engineering.
- Bring in international perspective through its work with the International Engineering Alliance.
- Highlight international organizations' work on advancing STEM education, such as the work conducted from the UK Royal Academy of Engineering and the Australian Academy of Technology and Engineering, to advance Canadian STEM education research needs.
- Participate in formal government forums, national roundtables, and appear before House of Commons standing committees to advance STEM education research.
- Work collaboratively with provincial and territorial regulators to ensure appropriate needs in STEM education are being met.

¹ Australian Government (2017). "Department of Education and Training: Inspiring All Australians in digital literacy and STEM." Retrieved from: <https://www.education.gov.au/inspiring-all-australians-digital-literacy-and-stem>.