Canada's STEM Skills Crisis: Can P-TECH Education Bridge the Gap?

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Technology, disruptive innovation, and a rapidly evolving global marketplace have dramatically adjusted the skillset sought by employers in the 21st-century economy. While the solutions for a sluggish North American labour market are varied, one possible approach is to better equip students with the technical skills demanded by higher wage industries. An area that shows promise is education for Science, Technology, Engineering and Math (STEM) related professions. In the United States and Canada, the demand for STEM jobs is growing at a faster rate than overall employment; simultaneously, the skills demanded by STEM employers are evolving much faster than education systems can adapt.[1] Together these phenomena give rise to a skills gap, defined simply as the gap between the skills employers need and the skills workers possess. In order for both the public and private sectors to effectively innovate, deliver value, grow businesses, and create prosperity, there must be adequate pools of skilled talent from which to draw. By improving education outcomes for segments of the population that have traditionally faced systemic barriers to STEM occupations, such as indigenous peoples and women, Canada can grow the talent pool and reduce the skills gap by mobilizing these sources of untapped potential.

Closing Canada's Skills Gap

To ensure Canada is on track for sustained economic growth, the country requires an agile workforce that can meet changing market demand. By 2019, there will be approximately 182, 000 unfilled jobs in the information and communications technology sector because of the growing skills gap.[2] Skill shortages in the province of Ontario alone are estimated to cost the economy up to $24.3 billion in forgone GDP and $3.7 billion in potential annual tax revenue.[3] Despite the apparent skills gap, there continues to be misalignment between post-secondary education and employer needs. Canada's economic future is dependent on the ability of government and industry actors to work in tandem to build a skilled workforce. A report by IBM's Institute for Business Value found that Canadian executives cite lack of collaboration between industry and academia, as well as inadequate investment from the private sector as the greatest contributor to Canada's skills gap.[4] The report also found that nearly half of Canadian executives believe the private sector

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should bear significant responsibility for upskilling the workforce. Notably, executives see secondary education institutions as a primary vehicle in equipping students with necessary skills. Canada is facing a looming skills crisis that requires action. Private sector collaboration at the secondary school level may help to address the skills gap by equipping students with skillsets that deliver stronger education and career outcomes.

'New Collar' Jobs

Addressing the skills gap requires a shift in how society views traditional labour market employment. IBM CEO Ginni Rometty uses the term 'new collar' to describe the growing number of jobs that do not fall under the traditional white- or blue-collar categories, and may not require a traditional four-year degree. Employers hiring for new collar jobs are seeking candidates with relevant skillsets.[5] With so many industries being reshaped by technology, there is a rising crop of jobs that demand technical training in areas such as data science, cloud computing, and cybersecurity. For example, approximately 15% of IBM's new hires in the U.S. have less than a college degree.[6] This skills-oriented hiring model can address the widening skills gap, while also reducing the cost and time barriers to education that prevent individuals from pursuing the training needed for higher paying tech professions.

Why P-TECH?

To address the skills gap and related educational barriers, IBM partnered with the City University of New York, and the New York City Department of Education to launch the Pathways in Technology Early College High Schools (P-TECH) program. P-TECH is a public-funded, six-year (grade 9-14), education program that integrates high school, college, and workplace learning. Students are admitted to the program on a lottery basis, with no consideration given to their academic history prior to selection. Throughout the program, students are paired with business mentors and they participate in employer visits, workshops, and skills-based paid internships. P-TECH students graduate with a high school diploma and a no-cost associate's degree in technology-related disciplines such as computer science and engineering. Upon completion, students should have the necessary skills to obtain high demand information technology jobs. By providing tangible career-related experience, P-TECH connects the dots between skills learned in the classroom, and how they can be applied in the workforce.

The first P-TECH school opened in 2011 in Brooklyn, New York and, by the end of 2017, the program will have expanded to over 80 schools in the U.S. with over 400 business partners. At P-TECH Brooklyn, students often complete the program in five years or less. Out of the 50 students who have graduated from the Brooklyn school, 35 percent have completed the program and received their high school diploma and college associates degree at least one or two years ahead of schedule. P-TECH graduates are significantly surpassing the national average, where only 20% of U.S. high school graduates go on to complete a two-year community college degree in three years or less.[7] Many P-TECH Brooklyn graduates come from low-income households and are the first in their family to graduate with a post-secondary degree. Gabriel Rosa, a 19-year-old student from Brooklyn, graduated in just four years and is now working in a new collar role at IBM as a Front-End Developer.[8] According to Gabriel, "P-TECH itself was an experiment" that gave him the skills necessary to deal with problems, "both in [his] personal and

professional life."[9] P-TECH graduates like Gabriel can either take jobs with the schools business partners, mostly in new collar positions ranging from digital design to data analytics or go on to pursue their bachelor's degrees.

> According to Rashid F. Davis, P-TECH's Founding Principal: P-TECH is redefining possibilities for underserved youth and creating a new generation of young leaders. [P-TECH's] extraordinary graduates show that homegrown American STEM talent can be produced, pointing the way to what is possible."[10]

In 2014, the P-TECH founding partners unveiled a digital playbook, complete with tools and case studies and an approach for expanding the program nationwide and beyond. The first international expansion of P-TECH was to Australia in 2016, which now has 14 pilot schools. The Australian government, education, and industry partners are collaborating to deliver a P-TECH education model suitable for local needs.[11] Like their U.S. counterparts, Australian P-TECH students are pursuing their high school and associate's degrees, while developing the workforce skills that can be applied in an increasingly global and digitized economy. Given P-TECH's track-record in the U.S. and pilot expansion into Australia; bringing P-TECH to Canada could help to minimize the skills gap and improve labour market outcomes for young Canadians, especially those facing systemic barriers to STEM professions. As Canada and Australia have similar education systems, P-TECH Australia may offer a strong proof-case for what the program could offer Canada.

The P-TECH Potential

Improving Education Outcomes for Canada's Indigenous Youth

Although not a one-size-fits-all solution, the P-TECH model may offer an innovative approach to improving education and socioeconomic outcomes for Canada's indigenous youth. Strong education remains an evidence-based pillar to counteracting the effects of poverty. However, capital budgets for on-reserve schools are underfunded by $169 million annually.[12] As a result, science labs are often outdated, computer access is unavailable, and the overall quality of educational infrastructure is poor. Coupled with other factors, Canada's on-reserve schools are failing to deliver acceptable education outcomes for indigenous students. An overwhelming number of Canada's indigenous population is neither completing high school nor pursuing post-secondary education. The rate of incomplete secondary studies for on-reserve indigenous youth is 58 percent.[13] The rates are considerably lower for off-reserve indigenous youth and Métis youth, (30 percent and 20 percent respectively) but stand in stark comparison to the incompletion rate of 10 percent for non-indigenous Canadian youth. Given the strong link between poverty, high school education completion rates, and employment levels, improving both off- and on-reserve educational outcomes will be crucial to allowing Canada's indigenous youth to reach their full potential. Additionally, the demands of the modern job market often require more than just a high school diploma. Existing programs to provide post-secondary financial aid to indigenous youth are also underfunded, further hindering access to higher education. By offering a publically funded high-school and associate's degree program, as well as investment in educational infrastructure, paid-internships and access to high-skilled, high-paid employment after completion, P-TECH has the potential to improve outcomes for Canada's indigenous youth.

A major challenge to incorporating P-TECH into Canada's remote indigenous communities is the lack of large employers and IT job opportunities in these areas. Proactive investment by employers near indigenous reserves could further strengthen the case for expanding P-TECH into Canada. As P-TECH Australia demonstrates, with effective cross-collaboration from government, industry, and educational institutions, the model can be adjusted for local circumstances.

STEAM Academy

The Six Nations Polytechnic (SNP) STEAM (Science, Technology, Engineering, Arts, and Mathematics) Academy on the Six Nations Reserve in Brantford, Ontario showcases the impact of the P-TECH in action. SNP STEAM Academy is a grade 9-14 technology school where students, "create their own pathways to high-skilled jobs" graduating with both an Ontario Secondary School Diploma and a two-year Ontario College Technician Diploma, free of cost.[14] As a corporate sponsor, IBM has hosted workshops for STEAM students to promote design thinking and coding skills. While the academy is open to non-Six Nations, all students are expected to follow the values of Ga'nigohi:yo:/Kanikoriio (Respect and the Good Mind). The Academy is dedicated to fostering the next generation of innovators through excellence in "STEAM" education, with a strong focus on revitalizing indigenous language and knowledge systems. STEAM Academy encompasses how an education system can preserve and celebrate Canada's rich indigenous cultural heritage, while equipping its students with the skills to thrive in a 21st-century economy.

Encouraging Girls to Pursue STEM

The impact of expanding P-TECH in Canada has far-reaching potential, including encouraging more girls to pursue STEM careers. According to a report by TD Economics, women still represent less than one-quarter of employment in STEM occupations.[15] A report by IBM titled "Empowering Women's Success in Technology" estimates there will be approximately 1.4 million computing-related jobs by 2020 in the U.S. alone, and only 3 percent will be filled by women.[16] Although the problems that contribute to gender disparity in STEM are complex, increasing the pipeline of talented, young women entering the field can improve representation, and challenge stereotypes that hinder women's progress. A report by the American Association of University Women titled "Why So Few?" explores how stereotypes in education affect female students' pursuit of post-secondary STEM education and related professional careers. Specifically, perceptions and unconscious beliefs about gender in mathematics and science were found to measurably harm girls' test scores and influence their confidence in pursuing STEM careers.[17] Fortunately, the research also indicates that actively countering these stereotypes in the classroom can increase girls' confidence and their likelihood to pursue careers and post-secondary education in STEM fields. By cultivating environments that foster persistence in STEM, and providing tangible mentoring and career opportunities, P-TECH can undercut the negative stereotypes that deter girls from pursuing technology-driven careers.

Problems with P-TECH: Growing Pains

Before the first P-TECH school in Brooklyn had even graduated its first class, the P-TECH model had already expanded to 60 schools across the U.S. Critics argue that the program's rapid expansion is not justified by results, nor have educators had enough time to ensure the education model's sustainability. A National Public Radio report titled, "Turmoil Behind the Scenes at a Nationally Lauded High School," discusses the risk of having high school age students enroll in college courses before they are ready. The article cites that 21 percent of P-TECH Brooklyn students had earned D's and F's in their college courses in the fall of 2014.[18] Partners at the Brooklyn school responded to the problem by implementing early-warning systems that intervene when students show signs of struggling. By fall of 2015, the number of D's and F's dropped to 14 percent. In response to critiques surrounding student performance, Stan Litow, President of the IBM International Foundation, argued that, "education often resists innovation," whereas, the philosophy behind P-TECH's expansion is to, "modify along the way," rather than wait to begin to replicate.[19]

If P-TECH were to expand into Canada, the approach should consider the lessons learned from the U.S. experience. For example, Canadian actors may choose to observe and collect greater performance measures from pilots before rolling-out the program nation-wide. However, the approach must also take into consideration the unique barriers to P-TECH's success in Canada. For P-TECH to succeed in Canada's indigenous communities, the model will need vigorous buy-in from industry partners willing to serve remote communities. Nonetheless, continuing with the status quo is simply unacceptable. Early results from the P-TECH inspired SNP STEAM academy in Brantford demonstrate that the model is already delivering positive outcomes for Indigenous youth. Given the on-reserve education crises in Canada, policymakers must consider adopting a proactive and iterative approach towards expanding P-Tech in Canada.

Can P-TECH Bridge the Gap?

Rapid technological change has outpaced the rate of curriculum and program development by educational institutions, contributing to Canada's growing skills gap. Solutions to this complex problem are varied, but as governments are challenged to do more with less, spending should be focused on robust, evidenced-based programs that demonstrate socioeconomic improvements. Broader and earlier introduction of STEM education can strengthen the Canadian economy by reducing job vacancies in high paying fields and supplying growing sectors with a diverse talent pool equipped with 21st-century skillsets. The strong correlation between investing in education, employment opportunities, and poverty alleviation, offers an incentive for the government to support expanding P-TECH into Canada, particularly for indigenous youth. P-TECH can also encourage more girls to pursue STEM-related careers, which is particularly valuable to Canada, as retaining more women in STEM has been shown to foster innovation, creativity, and competitiveness in the sector. The early success of P-TECH in the United States, and now in Australia, shows promise for reducing Canada's skills gap, while simultaneously delivering better labour market outcomes for future generations. However, in order for P-TECH to realize its full potential in Canada, the program must be tailored and adapted to address local needs.

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