Education + Skills RESEARCH INITIATIVE

MOWAT RESEARCH #183 | FEBRUARY 2019

Untapped Pool or Leaky Pipeline?

Female Involvement in the ICT Sector

BY BRAD SEWARD, KHUONG TRUONG & DEEPTI KAPADIA

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Acknowledgements

This report was produced under the Research Initiative, Education + Skills (RIES), and is funded by Employment and Social Development Canada (ESDC) and the Ontario Ministry of Training, Colleges and Universities (MTCU). The opinions, findings, conclusions and recommendations expressed are those of the authors and do not necessarily reflect the views of the funding partners.

The authors would like to thank the contributions of Mueller, Truong, and Smoke (2018) for offering an empirical foundation to analyzing the ICT industry which this report builds upon. The authors would also like to thank the efforts put into the piece by Reuven Shlozberg, and Andrew Parkin for their helpful contributions, as well as Elaine Stam for her design work on this report.

The views and opinions expressed in this report are those of the authors and do not necessarily reflect the official position of any other organization or agency. All content and any remaining errors are solely the responsibility of the authors.

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Education + Skills RESEARCH INITIATIVE

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The Research Initiative on Education and Skills is an innovative collaborative policy research initiative led by the Mowat Centre and the Higher Education Quality Council of Ontario. Its purpose is to access, analyze and mobilize data relating to the education, skills and labour market outcomes of Canadians, and to disseminate the findings to inform policy development.

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©2019 ISBN 978-1-77259-077-7

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1 INTRODUCTION

Innovations to digital technologies have altered the Canadian economy. New types of industries and occupations are emerging, and new skills-demands are being added to existing occupations. In many cases, these higher skills are a gateway to higher-paying jobs in this new digital economy.

As a result, workers must constantly update their technical skills to keep up with these technological advances.[1] This is true of both existing workers and new entrants into the workplace; "a focus on skills training and upgrading is critical as we enter a world of work which promises to be more tumultuous and uncertain than ever before."[2]

Information and communication technology (ICT) skills are situated at the heart of this trend. They are crucial to success in the digital economy, both as parts of a growing list of ICT occupations and as increasingly requisite skills in many other occupations within the economy. Indeed, ICT positions are among the fastest growing in Canada, and the Information Communication and Technology Council projects that Canada will need approximately 182,000 highly skilled ICT workers by 2019.[3]

For jurisdictions seeking to capitalize on the economic growth potential of the digital economy, ICT skills and occupations are therefore key pieces of the puzzle. On the one hand, this means that policymakers need to ensure that education, training, and re-training systems are able to meet at least a significant portion of the increasing demand for ICT skills – with migration and immigration filling up the rest. But insofar as ICT skills and occupations are becoming an important key to prosperity and success in the digital economy, policymakers must also ensure that these gains are spread inclusively across the economy.

Skills related to Information and Communications Technology occupations:[4]

- **ICT specialist skills** (e.g. Java programming, phone application creator, etc.)
- **ICT generic skills** (general-purpose technologies skills in daily life and at the workplace e.g. using the internet, using office software)
- **ICT complementary skills** (necessary skills to solve given problems in the technology-rich environment e.g. using ICT skills to organize information or to coordinate with coworkers)

In this respect, the fact that ICT fields typically fail to attract and retain many women is an important policy problem. Even though there are more women employed in ICT occupations than ever before (with an annual growth rate of approximately 13 per cent), the ICT workforce remains predominantly male. Prior estimates claim that the proportion of men is three times the number of women in these occupations.[4]

1 OECD. (2016). Skills for a Digital World. OECD Digital Economy Papers, No. 250. OECD Publishing, Paris.
2 Johal, S. and A. Yalnizian A. (2018). Race to the Top: Developing an Inclusive Growth Agenda for Canada. Toronto: The Mowat Centre. https://mowatcentre.ca/race-to-the-top/.
3 Information and Communications Technology Council (ICTC). 2016a. Digital Economy Annual Review 2016. Ottawa, Canada.
4 OECD. (2016). Skills for a Digital World. OECD Digital Economy Papers, No. 250. OECD Publishing, Paris."

This means that women are an untapped pool of talent that could help supply the growing demand for ICT skills and workers. But this also means that, insofar as ICT skills and occupations are important drivers of economic prosperity, the fruits of that prosperity currently fall disproportionately to men.

Some authors have suggested rectifying ICT labour shortages by recruiting more skilled immigrants.[5] However, it is more efficient to utilize skills already available but underutilized in the workforce - such as recent immigrants not working in the occupations they are trained for, or populations currently underrepresented in the ICT field – before looking outwards for recruitment. Policymakers should therefore first ensure that Canada's internal workforce is properly mobilized; encouraging higher participation from women in the ICT workforce is central to this undertaking.

Importantly, tailoring policy solutions in an effective evidence-based manner requires a clear understanding of the scope of the problem, solutions attempted to date and the obstacles to their success. This is the task we undertake in the present report.

We begin by mapping out the gender gap in the ICT field in Canada, applying advanced statistical analysis to a largely untapped large-scale assessment from the OECD and Statistics Canada.[6] We then discuss the key reasons for this gap, looking at both demand-side (employers) and supply-side (the educational pipeline) issues. We proceed to discuss policy initiatives that have attempted to encourage participation in the ICT field and why they have been less than successful in encouraging more female participation in the field. We conclude with a number of recommendations for policymakers undertaking the challenge of narrowing the ICT gender gap.[7]

Research Background

The research presented here by the Mowat Centre, in partnership with the Higher Education Quality Council of Ontario (HEQCO), utilizes the 2012 wave of Statistics Canada's Programme for International Assessment of Adults Competencies (PIAAC). The purpose of this survey is to study skill development, and the direct effects of these skills on labour market dynamics. The research presented in this report builds upon the methodology outlined in an upcoming piece by Mueller, Truong, and Smoke (2018).

PIAAC and its accompanying Longitudinal and International Survey of Adults (LISA) are a rich source of policy-relevant data that has been challenging for researchers and policymakers to access due to the technical know-how required and the data's privacy restrictions. The first of what will be a number of demographic profiles of outcomes, this report utilizes the Research Initiative, for Education and Skills (RIES), an innovative new data infrastructure being launched by the Mowat Centre and HEQCO to mobilize this data and inform policymaking.

5 Tech Toronto. (2016). How Technology Is Changing Toronto Employment.

6 We thank the contributions of Mueller, Truong, and Smoke (2018) for offering a methodological foundation to analyzing the ICT industry which this report builds upon.

7 A thorough investigation of the effect income has on men's and women's participation in ICT careers has already been provided by Mueller, Truong, and Smoke (2018). Our analysis therefore does not focus on this factor.

Women in ICT

APTITUDES

Minimal Difference in Aptitudes

WOMEN 302.40

MEN 306.75

Average scores in standardized testing on skills (PSTRE). Depending on definition of ICT used, men's average scores range from 305.12 to 310.55, and women's average scores range from 301.32 to 302.40.

EMPLOYMENT

Big Gap in Employment

21% WOMEN

79% MEN

Private sector:

WOMEN 18%

MEN 82%

Public sector:

WOMEN 34%

MEN 66%

Ratio of women to men employed overall, depending on definition of ICT used can be from 21-22% to 78-79%

Marginal difference in tasks required on the job

SKILLS

Differences in use of technical applications at work:

Excel and spreadsheet software:

WOMEN 55%

MEN 56%

Advanced coding:

WOMEN 27%

MEN 29%

2 EVIDENCE FROM THE PIAAC DATA

The Analytical Challenge

Mapping out the ICT gender gap in Canada is a more challenging undertaking than many would expect. There is both a definitional challenge and a data challenge, both of which this report overcomes.

One challenge is that there is no consensus on what occupations fall under the ICT category. We analyze three leading classifications: a 15-category list of the core ICT occupations defined by Information and Communications Technology Council (ICTC) in 2016, a 25-category measure of ICT occupations updated by the ICTC in 2017, and a broader group of 67 ICT occupations outlined in Mueller, Truong, and Smoke (***2018)***.[8] The findings in this report have been verified across all three classifications.

Additionally, some of the most useful data for mapping out the ICT gender gap in Canada – *Programme for International Assessment of Adult Competencies* (PIAAC) data, particularly problem solving in technology-rich environment (PSTRE) scores – has been challenging for researchers and especially policymakers to access, due to the technical expertise and privacy protections such access entails. The innovative Research Initiative on Education and Skills (RIES) model has enabled us to access and mobilize this rich store of data to help address the ICT gender gap policy challenge.

Drawing on this data, we assess:

» What is the representation of women working in ICT occupations, and does this representation differ depending on the classification of ICT?

» Does this representation differ by full-time and part-time employment?

» Does this representation differ between the private and public sectors?

» Are differences in ICT participation driven by differences in general technology skills between men and women?

» Are there differences in the division of labour for men and women in ICT occupations?

8 This list is created using the Occupational Information Network (O*NET), the Standard Occupational Classification (SOC), and the 2011 National Occupational Classification. The O*NET-SOC database is available online at www.onetonline.org.

Findings and Analysis

Our analysis of the PIAAC data presents several notable findings:

1. Women are underrepresented in the ICT field, regardless of how the field is defined

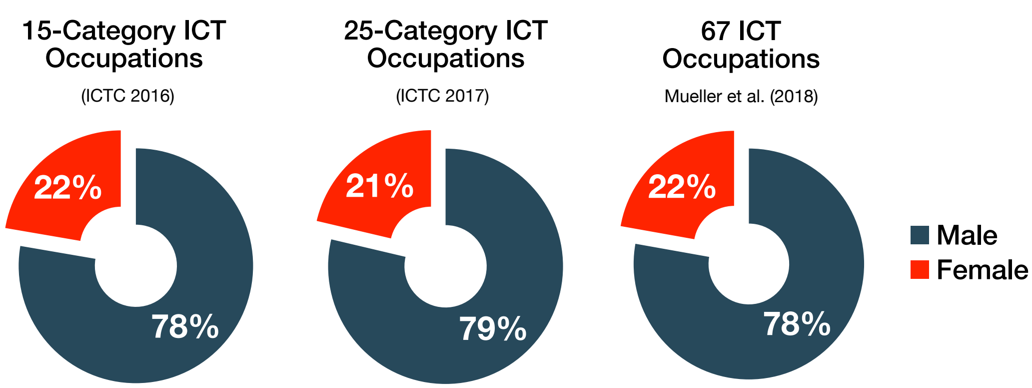
While the notion that women are underrepresented in the ICT field is widely held, it is important to test it against the data. This is not merely a matter of research integrity. Given that three classifications of what constitutes the ICT field exist, it is important to ensure that the assertion that there is a gender gap in ICT occupations in Canada does not depend on how one defines this set of occupations.

Our analysis shows that across all three definitions of ICT occupations, women are less likely than men to hold employment in ICT occupations (See Figure 1).[9] In fact, this finding holds even when women have similar ICT skills to their male counterparts – that is, when our analysis controls for educational factors, residential locations, job characteristics, working arrangement (full-time and part-time employment) and basic ICT scores.[10]

Our analysis shows that across all three definitions of ICT occupations, women are less likely than men to hold employment in ICT occupations

FIGURE 1

Representation of women across different definition of ICT occupations



9 In subsequent analyses, we will discuss the gender inequality in ICT occupations using the ICTC's 25 core digital economy occupations.
10 Regression analyses accounting for the effects of control variables are available upon request.

2. The gender gap is driven less by technically-trained women foregoing ICT careers and more by women opting out of the training that leads to ICT occupations

Many ICT occupations require a high degree of specialized and technical skills and training. These skills are acquired through field of study choices—educational pursuits that provide the prerequisites needed to pursue careers in ICT. It is therefore unsurprising then that in the general population, receiving training in the science, technology, engineering, or mathematics (STEM) fields of study increases the likelihood of acquiring employment in an ICT occupation by as much as 15 per cent.[11]

But, to what extent are gender differences in ICT participation driven by the field of study choices of men and women? Our results from the PIAAC indicate that ICT participation is dependent upon the fields of study pursued by women; when women and men both hold degrees in STEM disciplines, they have similar likelihoods of being employed in ICT occupations.

> *To what extent are gender differences in ICT participation driven by the field of study choices of men and women?*

Given this finding, one might wonder whether the ICT gender gap is simply the result of women having a lower degree of basic ICT skills than men.[12] Skills deficiencies could have a perpetuating effect on ICT careers, as both the ability to pursue requisite fields of study and the ability to transition into ICT occupations depend upon the competency of candidates. We find that this is decidedly not the case (see Figure 2).[13] Women do not score significantly differently than men in their basic ICT skills.[14] It would therefore appear that differences in ICT competencies are not the driving force behind participation in ICT related careers.

Instead, these results suggest that there is perhaps a pipeline issue. In other words, the ICT gender gap appears to be less a matter of STEM-trained women not choosing ICT occupations, and more a matter of many young women choosing not to pursue the fields of study that lead to ICT occupations. This means that policymakers seeking to encourage women's participation in ICT occupations should target educational choices more than post-graduation career choices.

11 Regression tables are available upon request

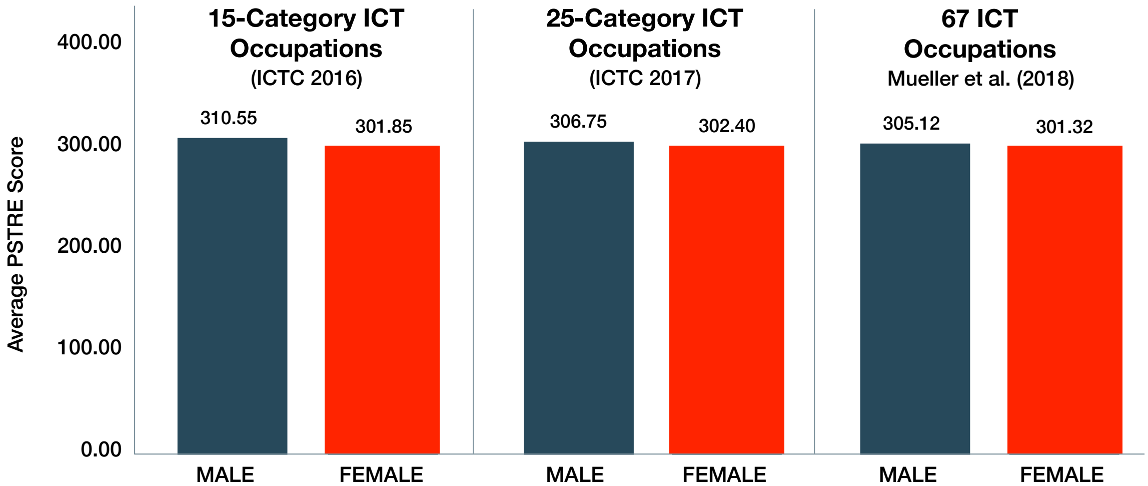
12 Kindsiko, E., & Türk, K. (2016). Detecting Major Misconceptions about Employment in ICT: A Study of the Myths about ICT Work among Females. World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 11(1), 107-114.

13 The assessment of ICT competencies is captured through the PIAAC's computer-based testing of adult problem solving in technology-rich environments (PSTRE). PSTRE is defined by the OECD as "using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks. The first PIAAC problem-solving survey focuses on the abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, and accessing and making use of information through computers and computer networks." See OECD. (2012). Literacy, Numeracy and Problem Solving in Technology-Rich Environments: Frameworks for the OECD Survey of Adult Skills. Paris: OECD Publishing.

14 Even though the test scores used in the analysis capture only ICT generic and complimentary skills, these skillsets are foundational skills to build advanced ICT skills. Thus, it is hard to imagine that persons with specialist ICT skills would not perform equally well on these "general-purpose" technology and problem-solving skills tests.

FIGURE 2

A comparison of PSTRE scores by gender

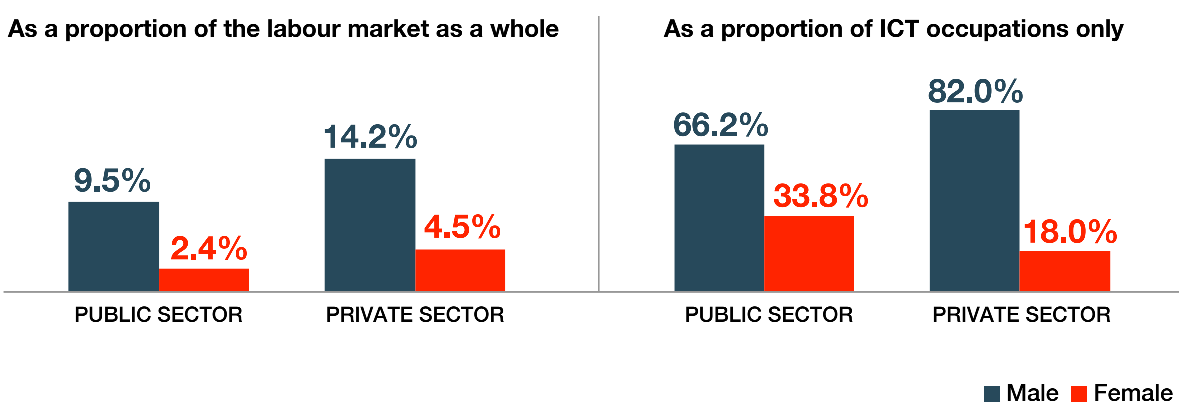


3. The ICT gender gap is larger in the private sector than in the public sector

On a superficial level, it appears as if women in ICT occupations in the private sector are faring better than those in the public sector. Women in ICT occupations make up 4.5 per cent of the overall Canadian private sector workforce, but only 2.4 per cent of the overall workforce in Canada's public sector (see Figure 3).

FIGURE 3

Public and private sector men and women working in ICT occupations



This finding, however, is misleading, since there are a lot more ICT-related jobs in the private sector than in the public sector. When only ICT occupations in each sector are taken into account, the picture is nearly reversed: women make up about a third of the public sector ICT workforce but only 18 per cent of the private sector ICT workforce (see Figure 3).

Thus, policymakers seeking to improve women's participation in ICT occupations could consider what the public sector may be doing differently than the private sector that may account for this finding. One possibility that cannot be further examined within the scope of this report is that a greater emphasis on diversity hiring within the public sector may account for at least part of this difference.

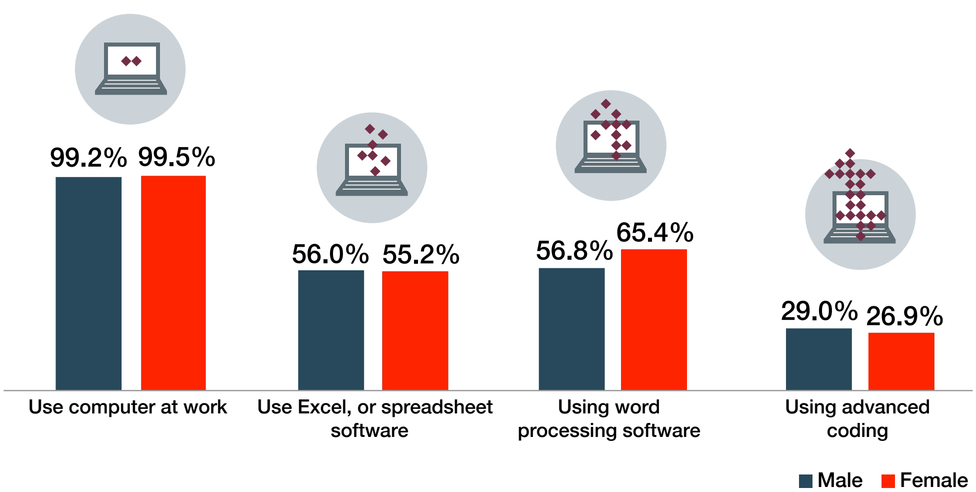
4. Divisions of labour within the ICT field are non-gendered. Women are performing the same tasks as men in the field.

A gendered division of labour—women and men being assigned different tasks and roles—is often noted in the wider literature as a deterrent to women's participation in a given sector. When this happens, the incentive for men and women to acquire skills related to tasks perceived as "belonging" to the other gender is reduced. Indeed, ICT tasks are often perceived as "male" tasks, which may create a disincentive to young women thinking of pursuing fields of study that lead to ICT careers.

Fortunately, the data contains measures for several of the tasks performed in the workplace. Our analysis of these measures indicates that there is little or no difference between men and women when it comes to being required to use different ICT skills in their work. Assessing several different measures of self-reported ICT applications used daily at work, we find that this holds for basic processing software such as Word and Excel as well as for advanced programming and other computer-related responsibilities (Figure 5).[15]

FIGURE 5

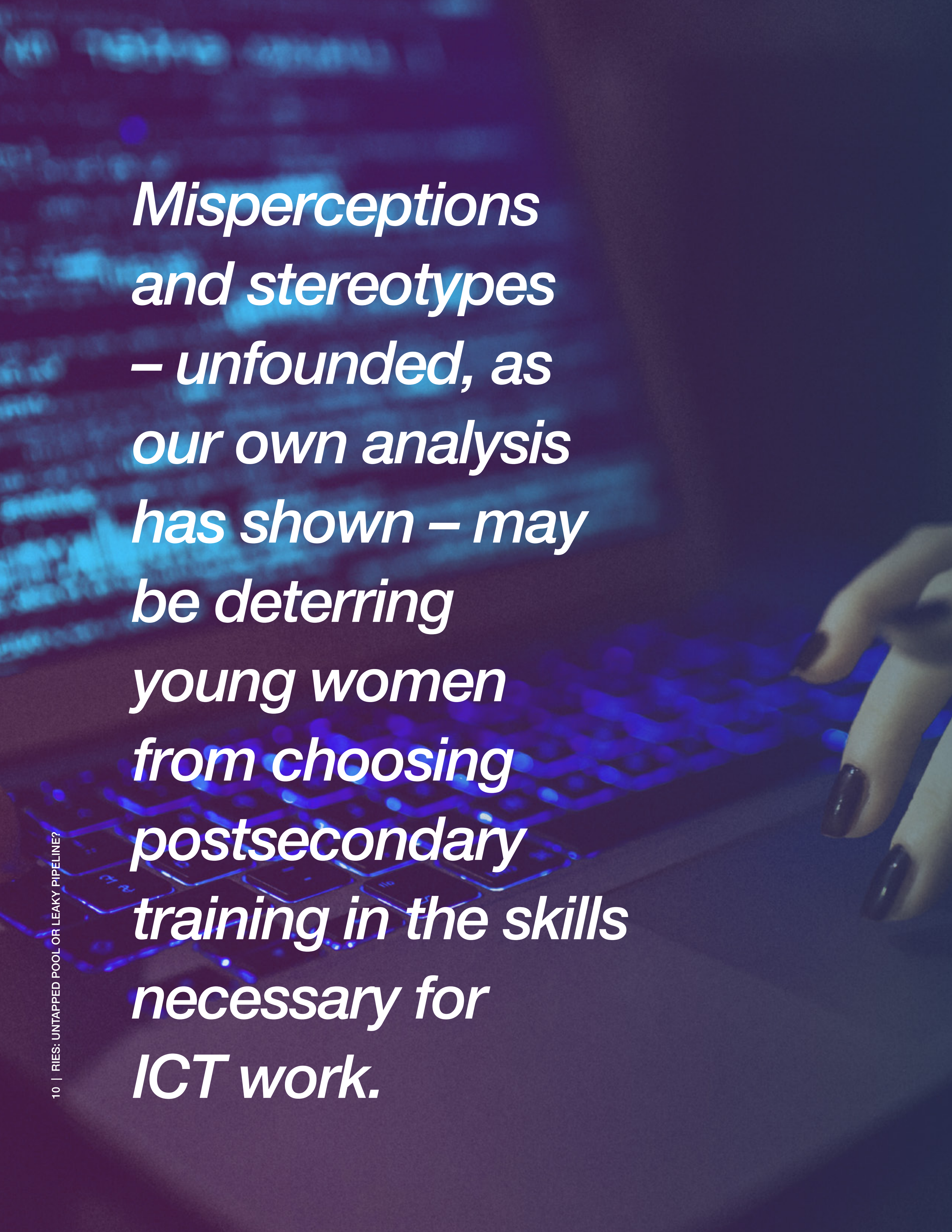
Differences in applications used daily at work for men and women working in 25 ICT categories



15 Of course, these measures are not exhaustive, and there may be differences in skills that are not captured in PIAAC data. Still, what we can glean from the data is an encouraging indication that men and women share similar responsibilities within the field.

> *This means that, as far as the distribution of technical tasks and responsibilities is concerned, the ICT sector is quite equitable*

This finding is particularly surprising, given that we find evidence to suggest that divisions of tasks based on gender does occur among non-ICT occupations in the wider population, where women are more likely than men to be handed less technical assignments. This means that, as far as the distribution of technical tasks and responsibilities is concerned, the ICT sector is quite equitable (at least as far as can be measured through our data). It is therefore even more puzzling (and also more disturbing, given the efficiency and equity implications) that women have lower levels of participation than men do in ICT careers.



Misperceptions and stereotypes – unfounded, as our own analysis has shown – may be deterring young women from choosing postsecondary training in the skills necessary for ICT work.

3 REPRESENTATION IN ICT OCCUPATIONS

The empirical takeaways from the PIAAC data tell us that no matter how ICT occupations are defined, women continue to be underrepresented in the field. This trend is not driven by differences in men and women's ICT-related skills, however. Instead, it appears that pursuing a career in an ICT-related occupation is more a matter of whether respondents acquired a postsecondary education in a STEM-related discipline. Our results show that women and men have similar likelihoods of being employed in ICT occupations when they both hold degrees in STEM disciplines. Therefore, it would appear that the pursuit of an ICT career is closely tied to the decision to pursue a STEM-based postsecondary education.

At the same time, we have found evidence in the data to argue that the role employers play in ICT representation should not be overlooked. The fact that women in the industry are more represented in the public sector than the private sector indicates that the public sector is doing a better job of attracting women to ICT positions. Still, there is much headway to be made to utilize this relatively untapped segment of the workforce.

ICT Gender Gap in Canada: Explanations Identified in the Literature

It is perhaps surprising that the ICT sector has failed to attract women given that opportunities for employment within the sector are growing as Canada transitions to a more digital economy. What explains the ICT gender gap, identified in the previous section? PIAAC data alone cannot provide us with a definitive answer to this question.

However, there is available qualitative research that identifies and analyzes the key explanations for this gap. These conversations point to supply side misperceptions and stereotypes – (beliefs which are unfounded, as our own analysis has shown) which may be deterring young women from choosing postsecondary training in the skills necessary for ICT work.

The "Leaky Pipeline"

A colloquial term referring to situations where young girls and women self-select out of certain fields of study, which in turn prevents them from pursuing types of careers relying on that training once they enter the labour market.

Sealing the Leaky Pipeline: Encouraging Female Participation within the ICT Sector

Despite similar aptitudes for mathematics between young women and men[16] and similarly equal participation in advanced mathematics courses at the high school level,[17] young women are not as likely as young men to enter postsecondary programs leading to ICT careers. Our analysis of the PIAAC data has similarly suggested that the ICT gender gap in Canada is driven less by technically-trained women foregoing ICT careers and more by young women choosing not to pursue training leading to ICT occupations. This reality was the driving force behind the 2016 Tech Toronto report calling for public policy initiatives to "target youth at key junctures in their career decision-making processes, both before and during high school."[18]

Boys were roughly ten to twelve times more likely to expect to work in ICT-related jobs than girls, while boys were just under three times as likely to expect to become science and engineering professionals.

Why is there this "leaky pipeline"? A major explanation identified in the literature is the damaging effect of stereotype bias on young women's educational and occupational aspirations.[19] Young girls can encounter stereotypes and perceptions about women's abilities that play a pivotal role in the choice to pursue STEM fields of study – perceptions that are not borne out in reality, as we've seen in our analysis of the PIAAC data. Perceptions of incapability, alongside stereotypical labels of "geek" or "nerd" for women who choose to pursue applied fields often act as a deterrent for young girls to develop affinities for these pursuits.[20]

At the same time, perceptions of inadequacy to compete or belong in an arena that is traditionally dominated by men only serves to perpetuate the belief that women do not belong in the STEM/ICT sector.[21] There seems to be an image issue associated with women's pursuit of streams that lead to careers in ICT; a perception which views the pursuit of applied occupations as uninteresting or irrelevant and limits the abilities of women to provide substantial contributions to their fields, while also leaving too few female role models to overcome this image.

These perceptions can have real consequences for career aspirations. Using data from the 2015 Programme for International Student Assessment (PISA), researchers noticed significant gaps in Canadian girls' and boys' aspirations for becoming professionals in ICT careers. In fact, boys were roughly ten to twelve times more likely to expect to work in ICT-related jobs than girls, while boys were just under three times as likely to expect to become science and engineering professionals.[22]

16 Caranci, B., Judge, K., Kobelak, O. (2017). Women and STEM : Bridging the Divide. TD Economics, 1 -13.
17 Dooley, M., Payne, A., Steffler, M., & Wagner, J. (2017). Understanding the STEM path through high school and into university programs. Canadian Public Policy, 43(1), 1–16. https://doi.org/10.3138/cpp.2016-007.
18 Tech Toronto. (2016). How Technology Is Changing Toronto Employment.
19 Mueller, Truong, and Smoke (2018); Cukier, W. (2007). Diversity, the Competitive Edge: Implications for the ICT Labour Market, no. March. Information and Communications Technology Council. https://www.ryerson.ca/diversity/.
20 Mueller, Truong, and Smoke (2018).
21 Cukier, W. (2007). Diversity, the Competitive Edge: Implications for the ICT Labour Market, no. March. Information and Communications Technology Council. https://www.ryerson.ca/diversity/.
22 OECD. (2018). Bridging the Digital Gender Divide. OECD Digital Economy Papers. OECD Publishing, Paris.

Gender Equity in the ICT Workplace

As far as we can understand with the data, the leaky pipeline remains a major driving force behind women's lower levels of involvement in ICT occupations. However, the wider research in this area has identified several structural forces that also contribute to the low retention of women in the field.[23]

One of the biggest issues that has been identified is that the abilities of women and men are not equally recognized.[24] Despite strong aptitudes in the field, women experience barriers to upward mobility that are partly due to stereotypical biases that often fail to situate women as "good-fits" for ICT positions. Gender biases which influence hiring and promotion are particularly problematic, given that we have found that women have near equal aptitudes in ICT- related skills and carry out the same tasks as men in the field.[25]

Our findings from the PIAAC data also indicate, perhaps unsurprisingly, that the ICT gender gap in Canada is smaller in the public sector (where governments as employers enforce diverse workforces) than in the private sector. However, the reality is that many more ICT jobs are in the private sector than in the public sector.

To complicate matters further, provincial and federal governments have limited purview over private employers. While federally regulated ICT companies practice government-enforced diversity tracking,[26] privately held companies are not required to follow these guidelines. Therefore, there are limits to the degree to which governments can use legislation and regulation to curb discrimination, harassment, and other adverse behaviours.

So, what can policymakers do to address this problem? One suggestion is to provide government-backed incentives to encourage transparent hiring and promotion metrics among private employers. Employers in the ICT industry could be incentivized to share information on their hiring and promotion practices through favourable taxation policies that reward those employers who demonstrate transparent metrics and meet government-defined standards for women in the industry. Other, non-financial, options to encourage transparency may be to create opportunities to recognize private employers who practice fair and equitable treatment of employees as an inexpensive way to encourage favourable practices in the field.

Overall, the reasons women's participation in ICT careers is greater in the public sector than in the private sector should be approached as a case study for ways to improve representation. Such a case study might highlight additional workplace initiatives governments could encourage the private sector to adopt as well.

23 Hari, A. (2017). Who Gets to 'Work Hard, Play Hard'? Gendering the Work–Life Balance Rhetoric in Canadian Tech Companies. Gender, Work and Organization, 24(2), 99–114. https://doi.org/10.1111/gwao.12146; Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking Congruity Between Goals and Roles: A New Look at Why Women Opt Out of Science, Technology, Engineering, and Mathematics Careers. Psychological Science. https://doi.org/10.1177/0956797610377342; Cukier, W., Yap, M., Holmes, M., & Rodrigues, S. (2009). Gender and visible minority status: Career advancement in the Canadian information and communications technology sector. 17th European Conference on Information Systems, 776–787 ST–Gender and visible minority status: Retrieved from https://www.ryerson.ca/content/dam/diversity/AODAforms/Publication/2009/Gender%20and%20Visible%20Minority%20Status_Career%20Advancement%20in%20the%20Canadian%20Information%20and%20Communications%20Technology%20Sector_2009%20AODA.pdf.

24 Orser, B., Riding, A., & Stanley, J. (2012). Perceived career challenges and response strategies of women in the advanced technology sector. Entrepreneurship & Regional Development, 24(1-2), 73-93.

25 Standing Committee on the Status of Women. (2015). Women in Skilled Trades and Science, Technology, Engineering and Mathematics Occupations. Library of the Parliament.

26 Cukier, W., Yap, M., Holmes, M., & Rodrigues, S. (2009). Gender and visible minority status: Career advancement in the Canadian information and communications technology sector. 17th European Conference on Information Systems, 776–787 ST–Gender and visible minority status: Retrieved from https://www.ryerson.ca/content/dam/diversity/AODAforms/Publication/2009/Gender%20and%20Visible%20Minority%20Status_Career%20Advancement%20in%20the%20Canadian%20Information%20and%20Communications%20Technology%20Sector_2009%20AODA.pdf.

To address the lack of female involvement, policies need to account for the occupational environments encountered by women.

4 POLICY RESPONSES

As the ICT sector and the broader digital economy continue to grow, the representation of women in this area remains an important concern for policymakers in Canada and Ontario. Greater demand for talent carries the risk of labour shortages in this key area of the economy if almost half the potential workforce is disinclined to pursue careers in this field. At the same time, insofar as this growing field represents an important driver of individual and collective prosperity, it is highly problematic if women are underrepresented.

Fortunately, the federal and provincial governments can do much to encourage young women to choose postsecondary training leading to ICT career paths. In fact, Canadian governments have a history of programs and initiatives encouraging students to choose ICT and STEM training, though the track record of these initiatives in encouraging women to take up this field is uneven at best.

This echoes findings from other data sources. Data from the 2016 census, for example, shows that there has been little change in the proportional growth of women in STEM postsecondary fields of study between 1993 and 2015. While enrollment in STEM fields as a whole has increased, the rate at which men and women enter a STEM education has remained relatively stable.[27] Underrepresentation will therefore remain a consistent issue unless the enrollment rates of women in STEM programs significantly overtake those of their male counterparts. Fortunately, there is some evidence of increased female participation occuring in pockets--the University of Toronto, for example, has reported that their first year engineering programs are now comprised of roughly 40 percent women.[28]

Past and Current Policy Approaches

Skill shortages in the ICT sector have been part of the Ontario government's mandate as far back as the late 1990s, when the provincial government sought to address gaps in employment by increasing postsecondary education enrollment in computer science and engineering.[29] The Government of Ontario sought to "double the pipeline" of workers qualified in computer science and engineering programs by creating the Access to Opportunities Program (ATOP).[30]

27 Cansim table 477/0019, calculated by researchers at the Mowat Centre. This data excludes international students.

28 "U of T Engineering News" (2016). University of Toronto. Retrieved from: https://news.engineering.utoronto.ca/women-make-40-per-cent-u-t-engineering-first-year-class/.

29 Axelrod, P., Wellen, R., Trilokekar, R. D., & Shanahan, T. (2013). Making policy in turbulent times: Challenges and prospects for higher education. McGill-Queen's Press-MQUP.

30 1998 Ontario Budget. (1998). Government of Ontario.; Cukier, W., Yap, M., Holmes, M., & Rodrigues, S. (2009). Gender and visible minority status: Career advancement in the Canadian information and communications technology sector. 17th European Conference on Information Systems, 776–787 ST–Gender and visible minority status: Retrieved from https://www.ryerson.ca/content/dam/diversity/AODAforms/Publication/2009/Gender%20and%20Visible%20Minority%20Status_Career%20Advancement%20in%20the%20Canadian%20Information%20and%20Communications%20Technology%20Sector_2009%20AODA.pdf.

The federal government has programs like CanCode and "Choose Science," educating girls at a young age about careers in STEM/ICT fields. In doing so, these campaigns position these types of careers as viable and engaging opportunities and combats traditional stereotypes of "female occupations" or "pink-collar" positions

While the main goal of ATOP was to promote technical skill development by widening postsecondary institution access, the program was criticized for failing to account for the gender segmentation which occurred across these fields of study. Critics argued that neglecting to consider the role gender plays in occupational choices only served to further entrench gender boundaries.[31]

ATOP is not the only program to exclude gender from the conversation. The Federal Economic Development Agency for Southern Ontario (FedDev) launched the Youth STEM initiative in 2010 in a bid to improve opportunities for students in STEM postsecondary fields of study through paid business internships, academic fellowships and seed funding for young STEM entrepreneurs.[32] Like ATOP, the Youth STEM initiative also failed to recognize the male-dominated composition of STEM (and by extension ICT) fields.

Similar issues have also been identified in other multi-partner initiatives, including the Graduate Enterprise Internship Initiative and the Scientists and Engineers in Business Initiative. While these initiatives are critical to increasing internal labour supply within ICT fields, they have done little to improve the disproportionately fewer number of women within these occupations.

Recognizing that the "leaky pipelines" of early career choices can lead to labour shortages, the federal government has recently devised the CanCode program. Funded under the 2017 Innovations and Skills Plan, CanCode initiatives focus on supporting the development of coding and digital skills for students from kindergarten to grade 12. These initiatives are especially aimed at those young Canadians that are typically underrepresented in the STEM/ICT sector. By equipping these students with skills that are required in the ICT sector, the program opens occupational avenues to jobs that are in-demand and are typically well paid.[33]

The federal government has programs like CanCode and "Choose Science," educating girls at a young age about careers in STEM/ICT fields. In doing so, these campaigns position these types of careers as viable and engaging opportunities and combats traditional stereotypes of "female occupations" or "pink-collar" positions.[34]

31 Shortt, D., & O'Neill, K. (2009). ICT and Women. Information Technology Association of Canada, Canada.
32 Federal Economic Development Agency for Southern Ontario (2014). Federal Economic Development Programs, 319–340.
33 Caranci, B., Judge, K., Kobelak, O. (2017). Women and STEM : Bridging the Divide. TD Economics, 1 -13.
34 Miller, C. C. (2016). As Women Take Over a MaleDominated Field, the Pay Drops. New York Times, March 18, 2–6. https://doi.org/10.1017/CBO9781107415324.004; Carmichael, S. G. (2017). Women Dominate College Majors That Lead to Lower-Paying Work. Hardvard Business Review. Retrieved from https://hbr.org/2017/04/women-dominate-college-majors-that-lead-to-lower-paying-work.

As national priorities shift to emphasize STEM/ICT skill development the federal government has also continued to utilize the Youth Employment Strategy (YES), a federal initiative that has focused on developing technical skills through on-the-job work experience.[35] YES emphasizes two streams of governmental assistance, Career Focus and Canada Summer Jobs. These streams provide monetary support to employers and organizations to recruit youth for occupations in STEM and ICT fields, particularly women and other members of traditionally disadvantaged segments of the population.[36]

Provincial methods of support also take a youth-centric approach to addressing pipeline issues.[37] Nova Scotia, for example, developed the Student Summer Skills Incentive which provides monetary support for employers to create STEM-related summer jobs for postsecondary school students. In Prince Edward Island, the Youth Internship Program—Technology in the Trades program is an innovative provincial approach to encourage youth to develop skills directly related to technology.[38] In British Columbia, the provincial government launched a technology strategy that centers on STEM education to provide youth with digital skills in their early years to better establish a “baseline of digital literacy.”[39]

In Ontario, there have been several efforts to incentivize employers in specific industries (including those in STEM and ICT) to hire youth through the Graduate Apprenticeship Grant for Employers, the Canada-Ontario Job Grant, and the Employing Young Talent Incentive. Additionally, Ontario offers the Specialist High Skills Major Program which allows high school students to specialize in courses related to specific industries while at the same time meeting the requirements of their high school diplomas.[40] These programs assist students wishing to specialize in ICT to undertake computer and communication technology courses as part of the requirement of secondary school completion.[41]

Ontario’s public schoolboards have also developed programs to entice more students to pursue careers in STEM and ICT. The Peel District School Board’s SciTech and International Business and Technology (IBT) programs foster development in science, mathematics, and technology, by integrating opportunities to learn these disciplines into the existing curriculum. In other examples, the Toronto District School Board has launched a pilot project which works to feature STEM lessons in the classroom, while the Halton District has launched a STEM-focused high school in Aldershot Ontario.[42]

35 White, L., Dhuey, E., Jansen, A., Foster, D., & Perlman, M. (2018). Training and Skills Development Policy Options for the Changing World of Work.

36 Government of Canada. (2018). Youth Employment Strategy. https://www.canada.ca/en/employment-social-development/services/funding/youth-employment-strategy.html.

37 White, L., Dhuey, E., Jansen, A., Foster, D., & Perlman, M. (2018). Training and Skills Development Policy Options for the Changing World of Work.

38 White, L., Dhuey, E., Jansen, A., Foster, D., & Perlman, M. (2018). Training and Skills Development Policy Options for the Changing World of Work.

39 Information and Communications Technology Council. (2016). A National Strategy To Develop Canada’s Talent In a Global Digital Economy. https://www.ictc-ctic.ca

40 Government of Ontario. (2016). Gender wage gap strategy consultation.https://www.ontario.ca/page/gender-wage-gap-strategy-consultation#section.

41 Government of Ontario. (2016). Gender wage gap strategy consultation. https://www.ontario.ca/page/gender-wage-gap-strategy-consultation#section.

42 Aldershot High School: I-STEM. (2018). Halton District School Board. Retrieved from https://www.hdsb.ca/schools/Pages/Program%20Accommodation%20Studies/Burlington%20Secondary%20School%20Program%20and%20Accommodation%20Review%20(PAR)%20Implementation/Aldershot-HS-Focus-Exploration.aspx.

Policy Recommendations

Our analysis of the PIAAC data indicates that women are less likely to pursue careers in the information and communications technology field than men, regardless of the occupations included in the definition of the ICT industry. This lack of participation is less the product of skills deficiencies between women and men and more a matter of the fields of study girls and young women pursue as they prepare for their entry into the labour market. While employer-side explanations do seem to exist—given our data indicating a difference in representation between the public and private sectors—the underrepresentation of women in the ICT sector can be thought of as a supply-side issue.

Efforts are therefore needed to improve young women's perceptions of ICT careers

Encouraging women to participate in the digital workforce is not only a Canadian concern, and international research has documented a gap in female participation in ICT professions across the G20 countries included among the OECD.[43] Efforts are therefore needed to improve young women's perceptions of ICT careers. The following suggestions are avenues the Canadian federal and provincial governments can explore to encourage more female participation in ICT fields.

As we have seen above, the federal and provincial governments are already active on the supply side of the ICT gender gap problem. Our analysis of PIAAC data has not only underscored the importance of this strategy, but also pointed to educational choices as a particularly important point of intervention.

The existing programs outlined above, seeking to encourage young women to pick up ICT skills and training, are a promising start. But many of these initiatives are too recent to properly assess whether they have had a lasting positive effect on the industry. It is therefore important to continue to monitor how these programs are affecting the ICT industry, enhance those that are shown to be effective, and make adjustments where needed.

In addition, stronger efforts can be made to promote successful women in ICT occupations to further improve the visibility of women working in the field. One possible avenue for this is to find opportunities to connect girls and young women with women who have successfully entered the ICT industry. These connections often serve to provide positive female mentors and role models working in ICT occupations, improving outcomes for women aspiring to navigate ICT careers.[44] One promising step forward is the results of the Canada 150 Research Chairs Program, where 60 percent of the appointments are held by female leaders in research. However, the government should strive to make equitable advancements in the wider Canada Research Chairs Program (CRCP), where women are still among the minority of professionals holding research appointments.[45]

43 OECD. (2018). Bridging the Digital Gender Divide. OECD Digital Economy Papers. OECD Publishing, Paris.
44 Orser, B., Riding, A., & Stanley, J. (2012). Perceived career challenges and response strategies of women in the advanced technology sector. Entrepreneurship & Regional Development, 24(1-2), 73-93.
45 Plans to increase women's leadership in higher education yields results. (2018). Government of Canada. Retrieved from http://www.chairs-chaires.gc.ca/media-medias/releases-communiques/2018/equity-equite-eng.aspx?pedisable=true; Canada Research Chairs. (2018). Government of Canada. Retrieved from http://www.chairs-chaires.gc.ca/about_us-a_notre_sujet/statistics-statistiques-eng.aspx.

There are several suggestions that have been made for the global community to improve women's ICT participation that could also apply to Canada.[46] Increasing digital access for disadvantaged groups—by way of improving network access in rural areas, or by facilitating access to digital technologies for low-income individuals—would go a long way towards helping develop the skills that are crucial to a digital economy. Fostering women's entrepreneurial pursuits in ICT may also do much to shape the field. Perhaps most importantly, however, is the OECD's suggestion to produce annual reports on gender participation in the digital economy. Producing research that uses consistent methodologies and measurements would allow policymakers to continue to track the progress of programs aimed to improve women's representation in ICT-related education and careers.

As the digital economy continues to become a central driver of economic growth, ICT occupations will only continue to grow in importance. Addressing labour shortages in the field and ensuring the fruits of its growth are inclusively distributed are therefore important policy goals. Achieving them requires policymakers to come up with effective responses to the ICT gender gap. Our analysis of PIAAC data and of policy research in the field has helped map out the challenge and highlight starting points and avenues to addressing it.

46 OECD. (2018). Bridging the Digital Gender Divide. OECD Digital Economy Papers. OECD Publishing, Paris.

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