

SKILLS FOR THE POST-PANDEMIC WORLD ∴ MAY 2021

Digital Infrastructure for the Post-pandemic World

CATHERINE MIDDLETON



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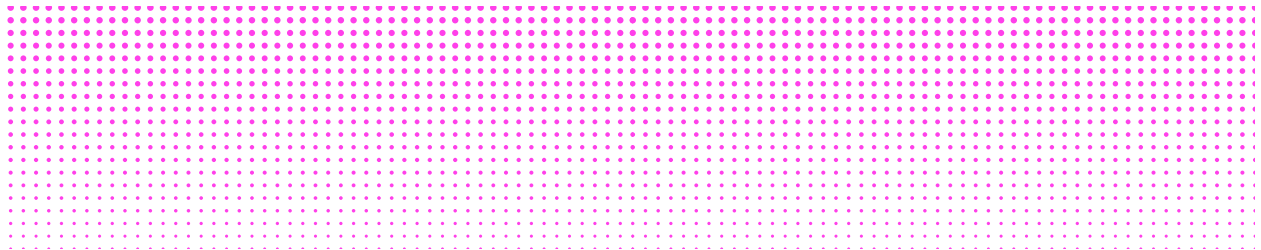


The Future Skills Centre is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead. The Future Skills Centre was founded by a consortium whose members are:



The Future Skills Centre is funded by the **Government of Canada's Future Skills Program.**

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ABOUT THE PROJECT

Skills for the Post Pandemic World tackles key questions facing policymakers, employers, training providers and workers. It is urgent that society turns to face the fundamental changes in the labour market precipitated by the COVID-19 pandemic, and many players must rise to meet the new conditions of a post-pandemic world.

Society will slowly reopen and business will resume, but there will be no “return” to normal: the pandemic has dragged the future of work into the present. Digitization, work from home, plus other steepened trajectories and intensified shifts well documented in the future-of-work discourse are here now, and likely to stay.

Building on the collaborative success of the **Skills Next** series, the Public Policy Forum (PPF) and the Diversity Institute (DI), funded by the Future Skills Centre (FSC), and with new support from Microsoft, join once more to face these rapid societal shifts head-on, with research looking at the future of skills, training and retraining in ways that will chart a path forward as the pandemic continues to unfold.

The goal of this series is to build a robust policy ecosystem that supports the mobility needed for workers and employers to navigate the new reality. To do this, we examine eight key topics:

1. **Job polarization in Canada: Skills for the post-pandemic world**
2. **Digital infrastructure for the post-pandemic world**
3. **New working arrangements**
4. **Building inclusive workplaces**
5. **Immigration and the success of Canada's post-pandemic economy**
6. **Innovation in post-secondary education**
7. **The mother of invention: Skills for innovation in the post-pandemic world**
8. **Supporting entrepreneurship and SMEs**

For more information about the project, please contact: [Andrée Loucks](#), Policy Lead (PPF) and [Michael Crawford Urban](#), acting Director, Research, Special Projects (FSC).

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Canada 

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Dr. Middleton is an expert on digital inclusion and held a Tier II Canada Research Chair in Communication Technologies in the Information Society from 2007-2017. Her research focuses on the development and use of communication technologies, with specific interests in mobile devices and fixed and wireless broadband networks. She is also interested in how Canadians use (or don't use) the internet in their daily lives.

Dr. Middleton's research projects have investigated the use of ubiquitous communication technologies in organizations, the development of next generation broadband networks (including Australia's National Broadband Network), competition in the Canadian broadband market, and Canadians' internet use. She was the Principal Investigator for the Community Wireless Infrastructure Research Project and the Co-Investigator on the Canadian Spectrum Policy Research Project and is a member of the Ageing + Communication + Technologies research team.

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FOREWORD

SKILLS FOR THE POST-PANDEMIC WORLD

COVID-19 made a devastating debut on the world scene and launched a new era of how we live and work in our global society. The pandemic ushered in dramatic changes and deepened inequalities: health and economic crises, border closures, lockdowns, mass job losses and the curtailment of educational activities. Nevertheless, it also accelerated innovation and particularly the adoption of new technologies, compressed adoption cycles from years to weeks and transformed entire sectors – government, health care, education, retail, financial services and more.

As we see the prospect of a post-pandemic chapter ahead – thanks in part to the incredible pace of vaccine development and production – we are also challenged to imagine a different way of working, learning and living.

At the Future Skills Centre, we focus intently on ensuring that Canadians have the opportunities and resources to thrive in the future of work. It is critical to ensure that everyone, especially under-represented groups who have been disproportionately impacted by the pandemic, can access opportunities to succeed and share in Canada's prosperity. We are also committed to ensuring employers have access to the talent they need to innovate and grow. As we plan for a future after the pandemic – one in which digital skills and connections have become even more essential – we can't stress enough the urgency of developing skills strategies, policies, and programs that enable us to rebuild better and more inclusively.



This paper, part of the **Skills for the Post-Pandemic World** series of research reports, explores the importance of digital infrastructure for the skills ecosystem – a basic fact that has been profoundly illustrated by the impact of the pandemic on work and education. It highlights how access to this basic and essential infrastructure is unevenly distributed across Canada in terms of geography but also in terms of the diverse populations that make up our country. The analysis also investigates how the pandemic has compounded this inequality, thereby further underlining the critical importance of addressing it. More positively, the author offers recommendations on how to do just that, whether by exploring how to get the most out of the cheapest and most ubiquitous technologies or by identifying where to target government funds, attention and effort. Please join us in considering what these findings mean for skills training and opportunities in Canada.

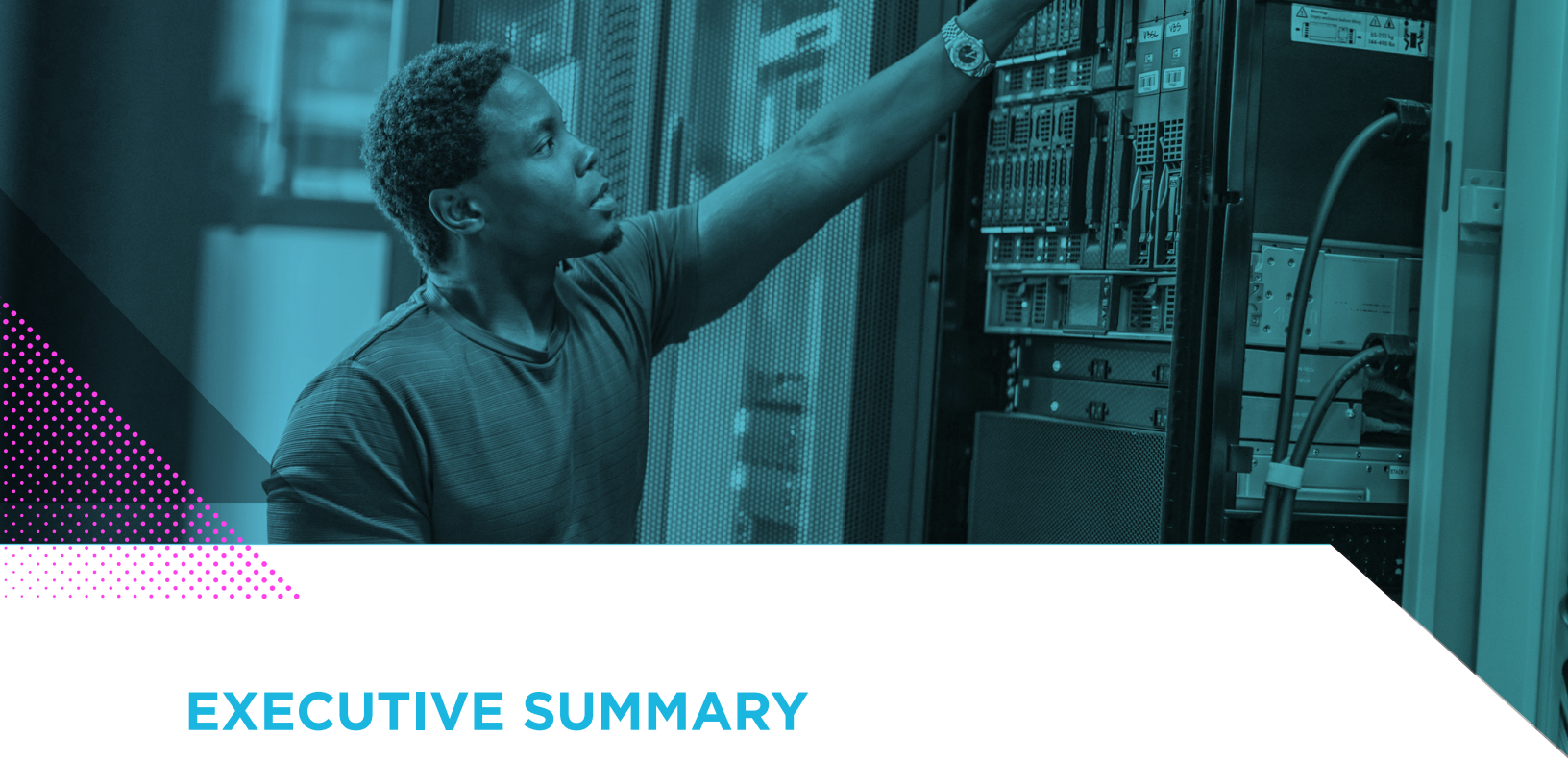
We thank our partners at the Diversity Institute and the Public Policy Forum for convening this research and these discussions. This is a crucial conversation as we turn our collective energy towards rebuilding our economies and educational systems to be better and more inclusive so that we can all share in a more prosperous future. We also thank the Government of Canada for its support of a national future skills strategy that builds on evidence generation and practical delivery of skills training and assessment programs.



PEDRO BARATA

Executive Director, Future Skills Centre





EXECUTIVE SUMMARY

If Canadians thought the country was speeding towards a digital economy before the pandemic, they couldn't help but feel it had arrived — virtually overnight — after the virus touched down in Canada.

Indeed, the need for Canadians to work and study from home to flatten the pandemic's infection rates has become the foundation for much business activity today. When lockdowns hit in March 2020, many working lives, not to mention social lives, went from in-person to online. A total of 4.7 million Canadians who do not normally do so started working from home. As of December 2020, nearly a third of Canada's workforce was still working from home, including 2.8 million people who would not normally do so.

Ironically, while digital business and education theoretically could ensure better access to both for a larger number of Canadians, restricted internet access will block this for many. In short, the digital transformation has been experienced unevenly and served to deepen some inequalities through structural and discriminatory societal barriers.

Access to a computing device and a reliable internet connection is essential according to Canada's broadcasting and telecommunications regulator, which named broadband internet a "basic service." And yet, it's not a service accessible to everyone. Geography and affordability both play roles in limiting access for many. There are still locations in Canada where internet service is inaccessible or impractical. Either the quality is non-existent or unacceptable or the cost is prohibitive — sometimes it's both. Residents of Nunavut, for example, pay six times more for broadband service than the average Canadian. Internet providers respond to market demand

and, in these sparsely populated regions, it's clear government subsidies are necessary to make good on the CRTC's assertion of access as a right. Affordability remains another challenge for some urban and rural households alike.

Internet inaccessibility is often a problem for households already experiencing barriers to accessing education or employment. The CRTC found that in 2020, just 34.8 percent of First Nations reserves and 45.6 percent of rural households had reliable and affordable internet access, compared with 98.6 percent of urban households. Access among those who speak neither French nor English — often new Canadians — slips to 90.6 per cent. This discrepancy helps to explain the high numbers of racialized households in the Greater Toronto Area that are finding at-home schooling challenging. More than 25 percent of such households said their children were not able to complete their homework because they didn't have access to a computer at home.

A federal government “connectivity strategy” from 2019 set the goal of providing good connectivity to 98 percent of Canadians by 2026, and 100 percent by 2030. Meanwhile, programs such as Rogers' Connected for Success, TELUS' Internet for Good and the federal government's Connecting Families exist, but don't offer the basic standard speeds of connectivity. And in well-served households with multiple users — school-aged children and parents who are working from home, for example — even this standard is proving to be inadequate.

Compounding the barriers of geography and income are such factors as time and access. Those who can't afford internet service are relying on public access, much of which — coffee shops and municipal buildings, for example — has been shuttered during the pandemic. Places such as libraries require travel time from users and such places are operating at reduced capacity. Households stuck sharing computing resources may find similar conflicts.

Recommendations

This report focuses on initiatives that can be implemented in the short term to increase accessibility to online training and improve the availability of digital infrastructure. Among them:

- Public internet access points;
- Financial support for household internet access;
- Awareness and sustainability of digital infrastructure initiatives; and
- Exploring training opportunities enabled by television and telephone.

INTRODUCTION

As the COVID-19 pandemic shifts work and education online, it exposes the impacts of gaps in the digital infrastructure that enables these new forms of socio-economic participation. This report outlines the need for fast and affordable internet access, functional computing devices, and the time and space in which to use them. It also explains how people with low incomes, and those in non-urban communities, are most likely to be excluded from online employment and skills training opportunities because they do not have access to adequate digital infrastructure. Building on this analysis, the report closes by offering recommendations on how to improve public internet availability and increase the flexibility of online skills training programs to allow broader participation from the very communities that are most likely to benefit from opportunities to improve their employment outcomes.

There are many ways of defining and categorizing the skills needed for success in the workplace.¹ This report does not examine the development of specific skill types (ICT literacy, problem solving, numeracy, communication, for example.) Rather, it offers a general overview of issues affecting the availability and access to online skills training.

The report begins by unpacking the concept of digital infrastructure. While the minds of many readers will likely focus on frequently discussed components of the digital infrastructure ecosystem, such as broadband internet service, this report also highlights other important, but less often discussed components, such as digital television broadcasting as well as softer, but still critical, components such as digital literacy.

Once this more expansive perspective on the digital infrastructure ecosystem has been developed, the focus shifts to a discussion of some of the barriers to access experienced by individuals and households, both at the level of the device and at the level of access to the internet. This leads directly into a discussion of the two barriers to access which are the most common: geography and cost.

This section serves to highlight how those who live in rural and remote locations — a population within which Indigenous people are overrepresented — and those with lower incomes, face the steepest challenges to accessing online skills training and employment opportunities.

This analysis is extended in the next section, which examines how efforts to overcome challenges also often create secondary challenges that compound difficulties.

The underlying premise of this report is that augmenting skills training opportunities by improving access to digital infrastructure can lead to better employment outcomes.² In this spirit, the report closes with a series of recommendations. These recommendations are not focused on projects designed to extend internet connectivity to unserved and under-served areas. Such projects have long timelines and ongoing initiatives to improve affordability have had insufficient impact to date.³ Rather, this report offers a series of recommendations that focus on initiatives that can be implemented more immediately to increase the accessibility of online training and improve the availability and usability of digital infrastructure that supports working from home.

DIGITAL INFRASTRUCTURE FOR THE ONLINE ECONOMY

In thinking of the digital infrastructure that supports online work and skills training, access to a computing device and an internet connection are assumed to be essential. This combination is indeed the foundation for much online economic activity today and it forms the main focus of the analysis in this section.

But before discussing the issues impacting access to computing devices, software, internet access and other obvious components of the digital infrastructure ecosystem, this section begins with a discussion of lower-tech options, such as television or telephone service, which might be more easily accessible to many populations, such as people with low incomes, people with limited digital literacy or people living in rural and remote communities. It is important to start with these low-tech options because, while provision of skills training through these options may not be as sophisticated as more technologically advanced tools and approaches, opportunities for improved training through these tools can be more easily, cheaply and immediately implemented and will, in many cases, be more accessible to those populations in greatest need.

LOW-TECH OPTIONS FOR SKILLS TRAINING

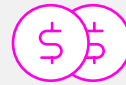
While the distribution of households with traditional television service has recently been dropping by an average of 3.6 percent every year — and is lowest amongst the 18 to 34 age bracket — 97 percent of Canadians over the age of 18 still watch non-internet television every month.



Canadians watched an average of

26.3
hours

of traditional
television per week.



With household spending on communications rising

22%
between 2015 and 2019

across the country, well above the rate of inflation, designing skills solutions for households that cannot afford the rising costs of mobile devices and internet connections will be critical.⁶

Most households, even those with very low incomes, have a television set⁴ with 82 percent of anglophone Canadians over the age of 18 still watching non-internet television every month.⁵

In households with a DVD player, people can watch video training materials without the expense of a television service. Video content can be distributed by mail or in-person. In some parts of Canada, television channels are available free, over the air, including provincial public television (TVO, TFO, Télé-Québec) and CBC/Radio Canada. Educational programming and community television are available across the country in “basic” TV packages for \$25 per month or less.⁷ Dedicated training initiatives can be delivered via community television channels. Additionally, initiatives can be developed to use scheduled television programming as the foundation of language and cultural training (perhaps supplemented by print materials.) If the household has access to more than a basic TV service, a broader range of programming is available.

Television sets can also be used as internet-access devices. “Smart” TVs, which are becoming cheaper and increasingly ubiquitous, can connect directly to the internet, and older, non-smart TVs can be connected to the internet using inexpensive streaming hardware. An internet-connected television provides access to free video streaming from sites such as YouTube, thus providing a vast resource of educational video content. Internet connectivity is discussed below, but it is worth noting here that a community Wi-Fi offering would allow affordable or free internet access to households that cannot afford a dedicated internet connection. The initial set-up of smart TVs or streaming hardware can be somewhat complicated, but once set up, they are very simple to use (for instance many TV remote controls now have buttons for applications such as Netflix and YouTube). Multiple languages are supported and voice searching (speaking the search request) is possible, making this form of access highly accessible even for low-literacy individuals.

These options do not generally incorporate interactive training and would support only the most basic forms of instruction. Nevertheless, given the potential reach and ease of use of these options, they should not be discounted. In particular, these low-tech approaches can be valuable to help lower literacy, low income and rural and remote populations develop basic skills and improve their employment prospects, and can effectively support self-directed, asynchronous learning.

To facilitate interactive training, students and instructors must be able to communicate in real time.

The simplest way of establishing this connection is by telephone. With access to a landline or a mobile phone, a person can listen to a live training session (e.g., by joining a Zoom call) and participate in the session by asking questions or sharing ideas and experiences. A phone call also allows an instructor and a student to communicate directly and can supplement training provided by video. Telephone service is widely available across the country⁸ and literacy requirements are low. But for those who only have a mobile phone available to them, service quality may be poor, and per minute billing may make participation expensive.

GOING ONLINE

Statistics Canada reports that 4.7 million Canadians started working from home at the end of March 2020, as lockdowns were imposed across the country. As the pandemic continues, some employment has shifted back to the workplace, but, as of December 2020, there were still 2.8 million Canadians working at home who would not normally do so. Combined with the 2 million who normally work from home, this amounts to 28.6 percent of the workforce.⁹ Jobs that can be done at home typically require higher levels of education than those that cannot be done at home, and include roles in management, science, computing, finance, law and administration.^{10,11} To remain employed, individuals in these roles need to acquire or have access to the digital infrastructure that supports working from home. Essentially the same infrastructure is needed by individuals wishing to undertake online training to improve their employment prospects. This section describes the infrastructure that is essential to support work (in the types of jobs listed above) and learning in an online environment.

Devices

Smart TVs allow viewing of training materials, but a computing device is required for more interactive activities, (e.g., meetings) and to use software to create, review and edit materials or to interact with online resources that support work and learning. The four primary computing devices in use today are smartphones, tablets, laptops and desktop computers.

Smartphones support voice and video-calling, messaging, allow for creation, editing and sharing of photos and videos, provide location-specific functionality (maps and navigation, for example) and run a wide variety of applications, also called apps.

With a smartphone, a person can join a videoconference and interact with the conference via text, audio or video.

Apps can be designed specifically for training purposes and a variety of productivity apps, such as Google Docs, are available to allow document viewing and editing. Smartphones are highly portable devices, but are expensive and can be fragile (for instance, cracked screens are common, reducing usability). To take full advantage of the functionality of a smartphone, an internet connection is required. It is also difficult to use a smartphone as the primary device for online work, given the small screen size, limited software functionality and slow data-entry using the onscreen keyboard.

Tablets have similar functionality to smartphones, but are physically larger. Some people find that the larger size makes the device easier to use. All tablets can connect to the internet, with built-in connectivity being an optional add-on. The primary means of engaging with a smartphone or tablet are by voice or touch. External keyboards can be added to facilitate typing. Tablets are often less expensive than smartphones, although fully featured tablets may cost as much or more than laptop computers.

The distinction between tablet devices and laptops is somewhat blurred, with some laptops offering hybrid functionality such as detachable keyboards and touch inputs. Generally, laptops have more computing power and can run software that is not available, or not easily used, in an app format. Laptops do not generally have built-in internet connectivity, but can connect to the internet using Wi-Fi or a network cable, supporting use in multiple locations. It is now common for laptops to have a video camera, microphone and speakers for use in video-conferencing, video-recording and audio/video playback.

Desktop computers are designed for use in a fixed location and must always be plugged into an electrical power source to operate. Desktop computers have larger monitors than laptops and interaction with the computer is primarily through a mouse and keyboard. A desktop computer can be connected to the internet using a network cable or Wi-Fi and it is unusual to have a built-in internet connection. Desktop computers can run a full range of software and tend to be less expensive to purchase than laptops.

Software and peripherals

Apps are downloaded directly onto smartphones and tablets, requiring internet connectivity. Most computer software is also obtained by download, but software can also be distributed by physical media such as a USB drive. Much of the basic software required to use the internet for everyday activities is pre-installed on computers, available for free download or accessible for free online. For training purposes, access to specialized software can be provided in computer labs (accessible in-person or remotely) or over the internet. Educational institutions can negotiate free access to software programs for their students and educational discounts are often available when software is not free.

To engage fully in online training, participants require access to audio and video, meaning a camera, microphone and speakers.

These are built into smartphones, tablets and laptops, but may be damaged if devices are dropped or broken. Newer desktop computers have built-in support for audio and video, whereas older devices may need an external camera or speakers. Audio quality is improved on all devices with the use of a headset. People who are not comfortable reading from a screen may prefer to print training materials and will require access to a printer.

Internet

People access the internet using home internet connections, mobile internet connections and public access points. Home internet and mobile internet services are obtained through a contract with a service provider. Canadians in urban and some rural areas are connected with a wireline connection, meaning there is a physical connection to the premises (via copper wire, co-axial cable or fibre-optic cable). Where a wireline connection, which is more reliable, is not possible, service may be available via a fixed wireless or satellite connection. A home internet service can support multiple devices through a Wi-Fi network and this is how individuals typically connect their smartphones, tablets and laptops to the internet when at home.

Mobile internet access provides built-in connectivity whereby internet access (often described as mobile data) is bundled with the device and can be used anywhere there is coverage¹² at any time. Mobile devices can be used in “hotspot” mode, allowing other devices to share internet access with the device creating the hotspot. For example, a mobile phone can create an internet “hotspot” that can be used by a laptop or desktop computer to connect to the internet. It is also possible to purchase a stand-alone mobile hotspot, which is designed for the sole purpose of providing internet access and can be used with any computing device that supports Wi-Fi connectivity.

Digital literacy

Participation in online digital training or working online requires access to the internet and to a device. But simply having access to these tools is not enough — people also require sufficient digital literacy to use these tools effectively. At a minimum, to participate in online training, people should be able to:

- connect devices to the internet, using a Wi-Fi hotspot, for example;
- send and receive emails (email is frequently used to register for training programs and to access online resources);
- use a web browser to search for information and go to specific web pages;
- download and install apps and/or software programs; and,
- join a video conference and manage audio and video settings.

Those who find themselves working from home during the pandemic need the skills noted above and need to be able to connect securely to employer resources, share files and maintain communication channels with colleagues, clients and others. Employees may have support from their employers to set up network connections and devices to work from home. Individuals undertaking online training may get some support from their training provider, but are more likely expected to figure out how to make things work on their own.

Space

In addition to an internet connection and suitable device(s), it is also important to have an appropriate physical space when working from home or participating in online training. It may not be possible to have a private, dedicated space. However, an ideal space within an individual's residence has the following characteristics:

- free from distractions;
- conversation is allowed (i.e. there is no expectation of silence);
- clear (uncluttered) surface for the device, allowing the device to be viewed comfortably and facilitating keyboard access (for laptops and desktops), many people will also benefit from space to rest books and paper and to allow note-taking by hand;
- comfortable ergonomic seating;
- sufficient level of lighting to view the screen and keyboard, as well as any books or papers; and,
- close access to power for recharging so device(s) can be used comfortably when plugged in.



COMPLEXITIES OF DIGITAL INFRASTRUCTURE

The section above provides a general overview of the digital infrastructure ecosystem, including the devices, knowledge and environmental conditions needed to enable online access to work and training environments. This section explores various factors influencing a person's capacity to acquire the reliable, affordable internet service and suitable computing devices needed to participate in online training or to work from home, taking into account different personal and household circumstances.

INTERNET ACCESS

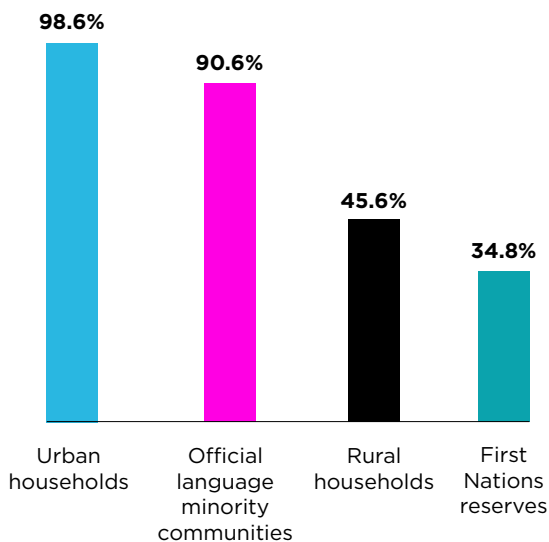
There are still many locations in Canada where internet service is not available or is of such poor quality or so exorbitantly expensive that it is effectively inaccessible to many potential subscribers. For example, residents of Nunavut pay six times more for broadband services than the average Canadian household.¹³

In other many remote locations where internet service is available, the quality is insufficient to support online work and training. Long before the arrival of the pandemic, it was well known that limitations on rural broadband connectivity were hampering the growth of the service sector in rural economies. While one study found that the consumer goods sector was not significantly impacted by broadband availability, the service sector has become increasingly tech-enabled, with customers and citizens learning to depend on reliable broadband for basic public services, education and business functions.¹⁴ While the move to digital business and education models has the potential to ensure access to a greater proportion of Canadians, restricted access to the internet is blocking this potential for many.^{15, 16}

In 2016, Canada’s telecommunications regulator, the CRTC (Canadian Radio-television and Telecommunications Commission), determined that “Canadian residential and business fixed broadband internet service subscribers should be able to access speeds of at least 50 megabits per second (Mbps) download and 10 Mbps upload [known as 50/10] and to subscribe to a service offering an unlimited data allowance.”¹⁷ According to the CRTC’s most recent update, approximately 54 percent of rural Canadians and 65 percent of those living on First Nations reserves are unable to access internet service that meets these standards.¹⁸ The **Federal Government’s 2019 connectivity strategy**¹⁹ was updated in 2020 and aims to provide broadband connectivity at 50/10 speeds to 96 percent of the population by 2026²⁰, with 100 percent to be connected at these speeds by 2030.

In its 2016 ruling, the CRTC explained that households need download speeds of 50 Mbps and upload speeds of 10 Mbps to support telework, videoconferencing and real-time collaboration.²¹

Figure 1: Broadband internet service availability across different households at 50/10 standard speed



Source: Derived from Infographic 4.4, Canadian Radio-television and Telecommunications Commission. (2020). **Communications Monitoring Report.**



The COVID-19 pandemic has accelerated the adoption of all three activities, and many households are now finding that a 50/10 connection is insufficient to support multiple household members engaging in these activities simultaneously.

To support online training, especially that which incorporates videoconferencing and synchronous interaction, a 50/10 broadband service has become the de facto minimum acceptable infrastructure.

Recently published CRTC data do not reflect the impact of the pandemic, but do show that historically many households in Canada with access to broadband services at speeds of 50/10 or higher choose to subscribe to service packages offering lower speeds.²² Some do not subscribe to 50/10 service because it is more expensive than lower-speed service packages²³ and, prior to the pandemic, a sub 50/10 service level was sufficient for many households. Programs that offer “affordable” internet to low-income households, including [Rogers Connected for Success](#), [TELUS Internet for Good](#) or the federal government’s [Connecting Families](#) initiative do not currently offer packages with 50/10 connectivity. It is not impossible to use a slower speed connection to participate in online training and skills development, but the experience will be inferior to that enabled by a faster connection, especially if multiple individuals are using a household connection at the same time. Moreover, many internet service packages impose data caps that limit the amount of data a household can use in a month without triggering overage fees. As households rely more heavily on the internet to support work and education, both of which tend to be data intensive, data usage is spiking and households without unlimited data plans are facing unanticipated and costly overage fees.²⁴

Neither the CRTC nor the federal government offer a definition of affordability, although both recognize the need for more affordable telecommunications services in Canada.

Data from Statistics Canada published by the CRTC²⁵ shows that, in 2017, Canada’s lowest income households spent 5.4 percent of their incomes on mobile and internet services, more than 2.5 times the average across all income quintiles.

In making budgetary choices, some families have sacrificed food purchases to cover internet expenses.²⁶ Recent research shows that households in the GTA (Greater Toronto Area) report being more worried than the Canadian average about paying both cellphone and internet bills with this effect being heightened amongst racialized households.²⁷ Though internet infrastructure is more widely available throughout the GTA, a lack of affordability amongst low income urban households puts it out of reach for many.

Some households only have intermittent internet access as, for instance, service may be disconnected when bills are overdue, or households may limit their use of the internet at the end of their monthly billing period to avoid exceeding the download cap. To help address this problem some libraries, school boards and universities loan mobile hotspots to households to provide free internet access at home and some communities provide Wi-Fi connectivity to

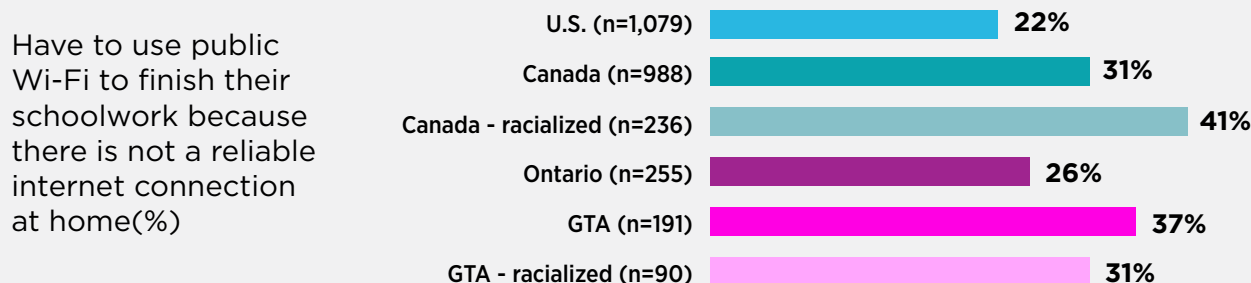
residents, either for free or at a reduced cost (e.g., **the City of Toronto is providing free Wi-Fi access in some low-income apartment buildings**). But for many people with poor internet access, filling gaps in intermittent access requires travelling to a public Wi-Fi hotspot location. Indeed, for many, publicly provided Wi-Fi is the only source of internet access. In the context of a pandemic that has severely limited access to public spaces, this dependence has become a significant challenge. Lockdowns have closed community centres, universities and colleges and cafés, and people are discouraged from making visits to friends and relatives that might in the past have provided internet access. The spaces that do remain open (e.g., libraries) are operating at reduced capacity to allow social distancing and may also limit operating hours.

Recently collected data show a lack of access to adequate internet has made it particularly challenging for families to support their children in online schooling delivery in Canada compared to the U.S., as well as more challenging in urban Canadian areas and in particular as reported by self-identifying racialized Canadians.

Across Canada, just less than one third of parents with children learning at home reported that they were likely to need to access public Wi-Fi to enable their children to finish and submit homework. Figure 2 shows these findings and compares the Canadian average with racialized households in the GTA. Households that rely solely on mobile internet service face serious limitations related to device functionality, data caps and associated pricing. If the only device available is a smartphone, it may constrain the user's capacity to participate in online training or work from home as smartphones are unable to run some common software programs and are not ideal for working with documents. On a per-gigabyte basis, mobile internet is more expensive than comparable fixed internet service.²⁸ As online work and training are data intensive, households using their mobile internet connections for videoconferencing, viewing videos and downloading documents will quickly exhaust their monthly data limits.

Figure 2. Challenges for children accessing the internet for schoolwork

It is very or somewhat likely that, as your children do their schoolwork at home due to the coronavirus outbreak they:



Source: Environics Institute, Diversity Institute, and Future Skills Centre (forthcoming). Survey on Employment and Skills, Wave 2 (December 2020).

DEVICES

Some people do not have access to a suitable device to work from home or partake in online skills training, and there are fewer devices per person in lower-income households. For example, 15 percent of households earning \$20,000 annually or less and 20 percent of people aged 60 or older do not have smartphones.²⁹

Further, Toronto households earning less than \$50,000 have fewer computers per person than other households in Canada.

Affordability is the primary reason for this lack of access. Purchasing a new device is not possible for everyone. There are organizations such as **Computers for Success Canada**,³⁰ Free Geek (**Toronto** and **Vancouver**) and **Renewed Computer Technology** that sell or give away refurbished computers. These computers are typically several years old and while refurbishment means that they are fully functional, they have limited capacity for upgrades and may not have sufficient computing power to run the latest software packages. Households unable to upgrade their devices every few years also experience similar limitations.

Affordability also influences whether individuals have their own devices or must share them with other household members. With schooling and work happening at home, there may be competing demands to use devices at specific times of the day. For those whose only access to devices is through public access points (at libraries or schools, for example), participating in a training program necessitates the additional burden of travelling to the public access location,

which limits their options to training taking place at certain times. Furthermore, as mentioned previously, devices available for public use may not have the specialized software needed to support more advanced skills training. And with pandemic restrictions closing many public access sites, some people may no longer have any means of undertaking online training.

Programs that have focused on distributing technology to schoolchildren during the pandemic have been essential to mitigating against its worst effects for children who do not have technology and in helping ensure they are not getting left behind in their education.

Indeed, in a recent survey, almost 30 percent of respondents reported it was likely their children would not be able to complete schoolwork because of not having access to a computer at home. Similarly, slightly more than 30 percent of parents reported concerns that their children might need to complete their schoolwork on a cellphone (Figure 3).

In response, many community-based efforts have emerged to ensure that all families have access to technology on which children can learn. Kiwanis clubs in Eastern Ontario raised funds to buy laptops for families in their communities who can't afford them and local charities such as Calgary-based Education Matters co-ordinated donation drives and distribution campaigns for its young local scholars. Provincial and territorial chapters of the federally funded Computers for Schools Plus program have also been mobilizing their existing networks to facilitate fast technology distribution to students.³¹ Finally, individual school boards have been investing and distributing technology in co-ordination with provincial and territorial governments, local educational institutions and other non-profit organizations.³² Across the country, educators and families have recognized the need to address digital gaps in technology availability in their own communities. Despite these efforts, persistent gaps amongst vulnerable populations represent very real barriers to educational access for many children, and more co-ordination of efforts is required.

Figure 3. Children with challenges accessing devices needed to complete schoolwork

It is very or somewhat likely that, as your children do their schoolwork at home due to the coronavirus outbreak they will

Not be able to complete their schoolwork because they do not have access to a computer at home



Have to do their school work on a cellphone



Source: Environics Institute, Diversity Institute, and Future Skills Centre (forthcoming). Survey on Employment and Skills, Wave 2 (December 2020).

This discussion illustrates a number of potential barriers to obtaining affordable internet service that offers sufficient speed and capacity to support online training and working from home and outlines the restrictions some people face in obtaining a suitable device to support their online activities. The burden of “technology maintenance,” defined as the activities needed to source and maintain access to functional devices and reliable internet connectivity, is high for low-income households. Unfortunately, these households are more likely to use devices and internet connectivity technology that is “disproportionately cheap, broken, borrowed and dependably unstable.”³³ But access challenges are not limited to, or fully revealed by focusing on, low-income populations. Other demographic groups also find it particularly difficult to obtain the digital infrastructure needed to go online, a topic addressed more fully in the next section.



THE DEMOGRAPHICS OF EXCLUSION

Canada has a publicly funded education system, but to fully participate in this system requires internet service and digital devices. This not only means internet availability at the desired location of use, but also capacity to pay for devices and connectivity. In this section, the focus is on two fundamental barriers which present significant obstacles, blocking many individuals' access to online skills training and employment opportunities, namely geography and income.

Geography remains a significant barrier, with adequate internet service being unavailable to large numbers of households, especially among Indigenous peoples,³⁴ regardless of ability to pay for the service. The second fundamental barrier impacting households irrespective of where they live is income. Substantial financial resources are required to pay for internet service and for computing devices, and without sufficient disposable income, it is difficult for households to free up the time and create the space needed to engage fully in online training opportunities.

As skills training can lead to better employment outcomes, it is likely to be of particular value to those who are unemployed and those with low incomes. Indigenous peoples,³⁵ persons with disabilities,³⁶ new immigrants³⁷ and racialized people³⁸ have higher rates of unemployment than the general population. Statistics Canada shows that 11 percent of the Canadian population (almost 4 million people) belonged to “low income” households in 2018, meaning their disposable income was below the poverty threshold.³⁹ Almost a third of children in female lone-parent families (230,000 families), and more than a third of adults under the age of 65 (1.4 million people) not living in an economic family, are classified as low income.⁴⁰

A 2016 **Backgrounder on Poverty in Canada** confirms that “unattached people aged 45 to 64, single parents, recent immigrants, Indigenous people (First Nations, Métis and Inuit) living off reserve and people with disabilities are more likely to be poor.” Disadvantage is often compounded as multiple aspects of identity intersect and overlap.⁴¹ For example:

immigrant women and Indigenous women have been slower to recover jobs in the pandemic, further entrenching their already disproportionate representation in the low-income category (as discussed further in another paper in the Skills for the Post-Pandemic World Series, Building Inclusive Workplaces: Implications for the Skills Agenda post-COVID-19).^{42, 43}

Analysis of Statistics Canada’s 2018 **Canadian Internet Use Survey** (CIUS) data as shown in Table 1, demonstrates how members of communities that are more likely to be poor are also less likely to have internet access, and those in Indigenous and rural communities⁴⁴ are more likely to indicate that cost is a reason for not having access. The CIUS does not provide data on users with disabilities, but according to the **2017 Canadian Survey on Disability**, only 81 percent of Canadians with a disability are internet users (as compared to 91.3 percent of the population overall).

Table 1: Characteristics of Internet users and non-users in Canada, 2018

	Population overall	Immigrant*	Rural or small town resident	Indigenous person	Lowest income quintile (≤\$35K)
Internet access at home	93.6%	94.9%	89.8%	86.0%	78.3%
Used internet from any location in past 3 months	91.3%	90.5%	87.8%	85.2%	74.0%
No internet access at home due to cost of internet service (as % of those without access)	27.6%	27.6%	32.8%	44.2%	28.4%
No internet access at home due to cost of internet equipment (as % of those without access)	19.0%	20.3%	23.0%	31.9%	20.2%

*Landed immigrant or permanent resident, includes recent and established immigrants

Source: Data analysis by author using the public use microdata file: Statistics Canada. (2020, September 8). Canadian Internet Use Survey: Public use microdata file, 2018. <https://www150.statcan.gc.ca/n1/daily-quotidien/200908/dq200908d-eng.htm>

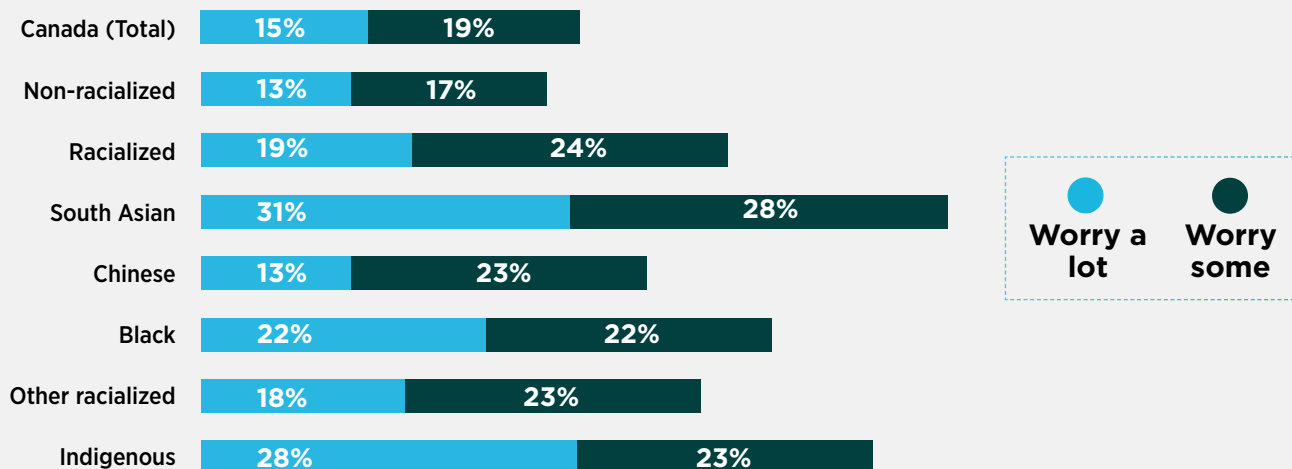
Respondents to the CIUS include people who are not interested in internet access. Research focusing specifically on low-income populations in Canada who do want internet access reinforces the finding that cost is the major barrier to access, with 70 percent of survey respondents describing it as the main reason they do not have home internet access.⁴⁵

Within the GTA, low-income residents, racialized residents and parents with children at home are all much more likely to be worried about paying for their home internet and cellphones (see Figure 4 and Figure 5). Additionally, households in the GTA identifying with different racialized groups reported starkly different levels of worry, with, for example, Latin American and South Asian families reporting much greater levels of worry than East Asian and Caucasian households.⁴⁶

People living in low-income households are also more likely to be “space poor,” due to poor housing conditions. For instance, a study of Toronto’s housing market found that “demographic cohorts that have a higher risk of being excluded from suitable housing or from Toronto’s housing market altogether ... include seniors with low-income or complex health issues, households with low income, lone-parent households, Indigenous peoples, visible minorities and immigrants.”⁴⁷ At a time when millions of Canadians who do not normally work from home are now doing so, this further exacerbates pressure on households who have to share computing devices and have slow or data-limited internet connectivity.

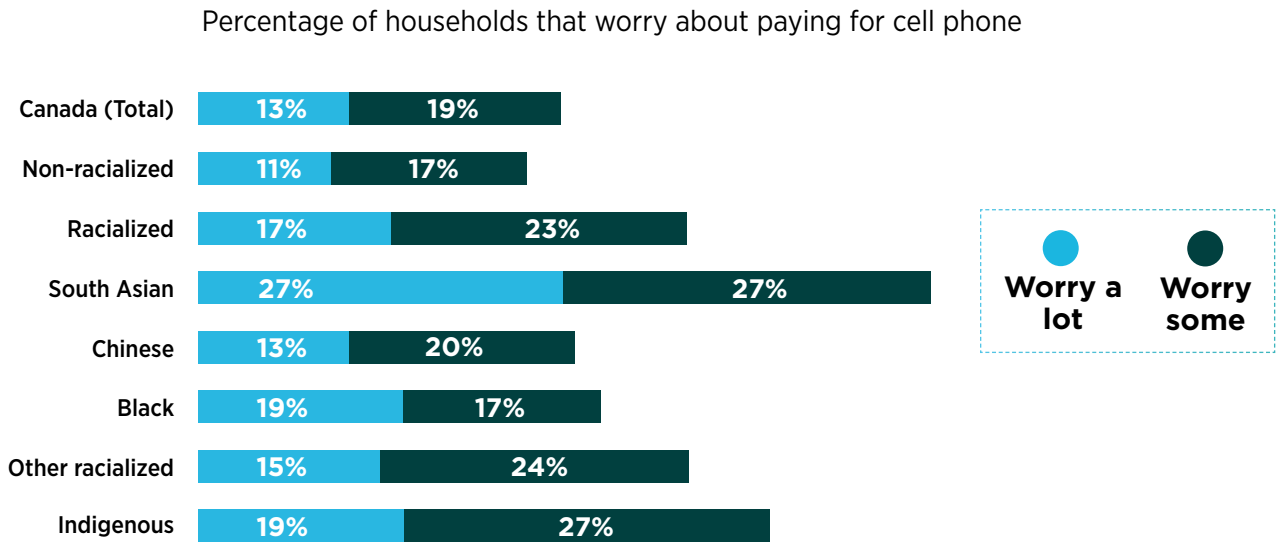
Figure 4. Concern about ability to pay for home internet service by racial/ethnic household identity

Percentage of households that worry about paying for home internet service



Source: Environics Institute, Diversity Institute, and Future Skills Centre (forthcoming). Survey on Employment and Skills, Wave 2 (December 2020).

Figure 5. Concerns about ability to pay for cell phone, by racial/ethnic household identity



Source: Environics Institute, Diversity Institute, and Future Skills Centre (forthcoming).
Survey on Employment and Skills, Wave 2 (December 2020).



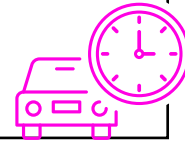
COMPOUNDING BARRIERS TO ACCESS

Income inequalities and a lack of essential physical infrastructure in rural and remote areas make it difficult for many people to obtain the digital infrastructure necessary to undertake online training or work from home. The adage “it’s expensive to be poor” captures the reality faced by many groups that would benefit most from opportunities to increase their skills and access new employment prospects in that they are often the ones who face the highest barriers to accessing the online resources that would help in realizing these opportunities. This section explores this reality and explains how, in some cases, household and individual actions taken to manage digital infrastructure deficits can perpetuate lack of access and create new secondary barriers to online engagement.

Internet access, a computing device and a suitable space are needed to work from home, and to participate in online skills training. The other necessary enabling condition is time. For scheduled training events, participants need to be available at the scheduled times. In an environment with reliable access to adequate digital infrastructure, attending training at given times is as simple as opening up the training materials and joining in. But when one or more elements of enabling digital infrastructure is not available, a learner needs to take action to assemble the necessary combination of a reliable internet connection, dedicated access to a device and use of an appropriate space at the time of the training activity.



When there is no internet access available at home, or the access is inadequate, people need to travel elsewhere to obtain access which substantially increases the time commitments required for their training activities. These challenges have only been made more vexing during the pandemic.



This travel may involve taking public transit within cities or travelling to the nearest population centre for those in rural areas. For a person with internet at home, a one-hour class requires a one-hour commitment. For someone without internet at home, several hours may be needed to facilitate attendance at the one-hour class, and this time taken to travel “to the internet” reduces time available for other income generation or skills training activities. Additionally, internet availability and training schedules may not align (e.g., a 60-minute limit for computer access in a public library may not allow sufficient time to attend a class), resulting in exclusion from particular training activities.

Timing is also a concern when devices are shared. Participants in skills training programs may have limited choices for when they can attend training. For instance, they are not able to participate if the only available training times conflict with device usage needs of other household members. The decision to keep children home during the pandemic rather than risk in-person instruction⁴⁸ has resulted in women spending more time at home with children during the day (in some cases dropping out of the workforce to do so),⁴⁹ likely prioritizing their children’s use of shared devices over their own.

Women who are not able to participate in online training because they don’t have device access, or dedicated time to do so, miss opportunities to develop the skills that would enhance future employment outcomes and allow them to increase their earnings.

For lower-income and non-urban households, actions needed to maintain technology access (such as taking time to travel to a location where internet access is available, sharing devices with multiple household members and reducing spending on food to pay an internet overage fee) create secondary barriers to online access. Such barriers are not faced by households that have sufficient income to buy new devices for all members that need them and pay for faster, unlimited internet service.

Recent research suggests that more than a third of families are earning less than they were before the pandemic (see Figure 6).⁵⁰

Has the total amount of money you earn from work changed as a result of the COVID-19 pandemic?



46%

There has been **no change** to the total amount of money that I earn from work as a result of the COVID-19 pandemic



36%

As a result of the COVID-19 pandemic, I am **earning less** than I was before



12%

As a result of the COVID-19 pandemic, I am **earning more** than I was before



6%

Cannot say

Figure 6: Changes in individual income during the pandemic

Source: Source: Environics Institute, Diversity Institute, and Future Skills Centre (forthcoming). Survey on Employment and Skills, Wave 2 (December 2020).

Changes brought about by COVID-19 are exacerbating these barriers. As incomes fall for some, those with low incomes may find it more difficult to pay for computing devices and internet connectivity, even as this infrastructure becomes more critical to support employment and educational opportunities.

The time and space a parent might have had to participate in training prior to the pandemic often disappears when the entire family is forced to work and participate in school from home. Access to the family computer is no longer possible during the day as it is needed for children’s schoolwork, or for a family member to participate in paid employment and a comfortable workspace may be ceded to another along with the device.

For households with multiple devices, increased contention for internet access may reduce the quality of individual connections and the increased data usage required to support video-intensive online work and schooling may cause families to exceed their monthly data caps. Families find that low-speed internet connections are insufficient to support simultaneous activities, perhaps resulting in poor-quality videoconferencing (“frozen” screen, audio dropouts) and buffering video

downloads, whereas families without any connectivity are excluded entirely from online work and learning. Participation in online learning requires a minimum level of digital literacy, but it is difficult to acquire these baseline skills if the only available training is online.

RECOMMENDATIONS

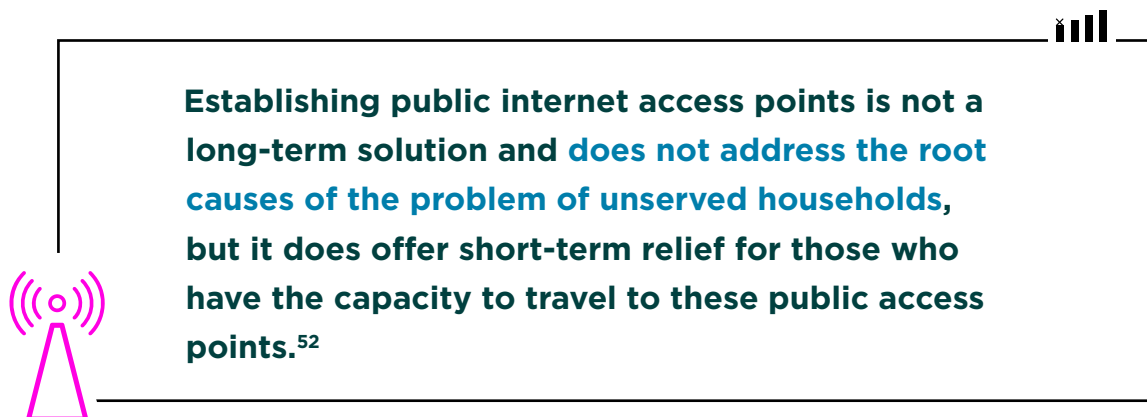
To recap, the two primary reasons households do not have internet access are that service is not available to them where they live (a particularly serious issue in rural, remote and Indigenous communities) or it is not affordable (this is the more common reason in urban households). Neither of these issues can be easily or quickly resolved, resulting in the full or partial exclusion of many households from online work and training opportunities. As mentioned earlier, projects to extend internet connectivity to unserved and under-served areas have long timelines and ongoing initiatives to improve affordability have had insufficient impact to date.⁵¹

This report does not offer recommendations to improve these ongoing processes. Rather, it focuses on initiatives that can be implemented more immediately to increase the accessibility of online training and improve the availability and usability of digital infrastructure that supports working from home. It also offers recommendations to address the time and space challenges related to the lack of digital infrastructure, with suggestions regarding the design of online training initiatives and encouraging flexibility in work from home arrangements.

INTERNET ACCESS AND COMPUTING DEVICE RECOMMENDATIONS

Having a poor internet connection is better than having no internet connection. But for the purposes of undertaking training or working from home, internet service that is too slow or has download limits presents the same challenges as having no internet connection at all. The two remedies are to provide alternative locations where those without home internet can connect or to provide sufficient quality internet to these households. Computing devices must be available in both scenarios.

Public internet access points


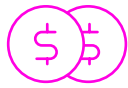


Financial support may be needed to pay for this travel, or to pay for childcare while an adult “goes to the internet” (this could be built into a model that finances training). Potential locations for public access points include common spaces in public housing communities, schools, First Nations’ band offices, hospitals or medical clinics, government buildings, libraries, community centres, sporting facilities and places of worship. Communities that serve dispersed rural or remote populations should have a minimum of one public access point. Access points could be operated by owners of individual facilities or a single entity could manage multiple access points (e.g., board of education, local government).

Access points should offer high quality Wi-Fi that supports multiple users and does not limit downloads or duration of use. Even if a building is not open 24/7, the Wi-Fi network should be available at all times. Ideally, there would be some physical space at the public access point in which people could have private conversations, and the availability of childcare would make it easier for parents to manage competing demands on their time. If the location is suitable, the public access point could also provide computing devices for use on the premises. Access providers may need to be subsidized to pay for the increased demand on their connection, to purchase computing devices or to renovate locations to provide usable space for people to work or attend training sessions.

Financial supports for household internet access

For the 87 percent of Canadian households that do have access to 50/10 internet service,⁵³ the remedy to slow or data-capped internet is to upgrade the service package.



When households change or express a desire to change providers, internet service providers may provide better internet pricing. But upgrades (or subscriptions for first-time users) often come at a cost that low-income households cannot bear.

Financial support, whether in the form of vouchers⁵⁴ or rebates, could be provided as part of a skills training program to allow households to get good-quality internet service at home. In the case of working from home, employees can request financial support from their employers. Additionally, consumer advocacy groups and social services agencies could exert pressure on providers to improve the quality of service offered through the targeted low-cost access programs mentioned above.

Financial support (e.g., vouchers, rebates, outright purchase) is also needed to allow individuals to get the devices they need to support participation in online training initiatives. Institutions that provide training can loan devices for use during training programs, but to ensure long-term capacity to engage in the online economy, individuals need their own devices. Computers (desktop or laptop models) have more flexibility and computing power than lower-end tablets or smartphones and are the preferred access devices for participating in general skills training or supporting work from home.

Awareness and sustainability of digital infrastructure initiatives

As many people may be unaware of programs that provide affordable internet access and devices, it would also be helpful for groups that support low-income and geographically excluded populations to maintain lists of low(er) cost internet service providers and programs that provide devices⁵⁵ and make these available in print format as well as online. An example of this kind of initiative is the government of Canada's Connecting Families program, hosted by Innovation, Science and Economic Development Canada. This \$13.2 million investment will be distributed over five years and is linked to the announcement in Budget 2017 of the Innovation and Skills Plan, a comprehensive agenda to bridge the digital divide for Canadian families who cannot access home internet due to cost. This funding contributed to launching Computers for Success Canada, discussed above, which now hosts a platform that allows eligible Canadian families to access subsidized internet service packages for as low as \$10 per month from partnered providers of broadband. These partnered providers already

include the top five incumbent telecommunications service providers (TSPs) (Bell, Rogers, Shaw, TELUS and Videotron).⁵⁶

In response to the COVID-19 pandemic, a number of temporary arrangements were established to provide internet access and computing devices to under-served populations. While government initiatives and regulatory processes should eventually deliver results in the form of ubiquitous, affordable internet access, current initiatives should plan to support households' connectivity and device needs for a minimum of three to five years. As training opportunities help individuals improve their skills and increase their incomes, their needs for subsidized digital infrastructure should diminish.

TRAINING DESIGN AND DELIVERY RECOMMENDATIONS

Back to basics

This report opened with a discussion of the opportunities enabled by television and telephone. These low technology options for disseminating training materials should not be discounted, as they are easily accessible even for those without the use of a computer, with low digital literacy and no internet access. For instance, the paradox of trying to train someone to go online when the training itself is online can be addressed by developing step-by-step instructional videos that can be distributed in DVD format. Additionally, devices can be preloaded with instructional videos and training exercises and used without an internet connection. This could be effective for teaching people to use basic productivity tools, including word processing and spreadsheets. Subject matter expertise can be developed by reviewing slides, video or custom-built apps, and knowledge can be tested with self-grading quizzes. For people without reliable internet access, a device and the associated training programs can be refreshed from time to time by bringing it to the training provider for updates or through the mailing of physical media such as USB drives.

There are benefits to participating in live interactive training sessions, including the opportunity to ask questions as materials are presented, and to interact with and learn from others in the session. All the widely used videoconferencing systems have the option for people to join sessions by telephone. Any touchtone telephone has this functionality. By designing training sessions to be inclusive of audio-only participants, the sessions can be accessible to those living in areas where internet service is not available, and those who don't have access to a computer at the time of the session, but do have access to a telephone.

The importance of flexibility

Obtaining access to the digital infrastructure needed to participate in online training can be a time-consuming exercise. Those reliant on access to the internet outside the home not only have to take the time to travel to the internet, but they also experience limits as to when such access is available and on the duration of their access. These limits can make it difficult or impossible to participate in synchronous (real-time) training activities at specified times. For those with home internet access, device-sharing can also make it difficult to join a training program at a specific time. For example, individuals who are sharing devices with their children may not be able to join programs during school hours or might only have access to a device for a portion of a scheduled session.



Even individuals who do have a device and a reliable internet access connection can find it difficult to participate in training programs at particular times if they are not able to access a quiet, comfortable workspace at those times.

Training programs designed to be flexible can accommodate the challenges articulated above. There is certainly value in live, interactive instruction, but this will not work for everyone. Recording live sessions and allowing people to catch up at their convenience is helpful. Modularity in program design allows people to complete segments when they do have internet access, a device, time and space.

This might mean completing several modules at once when the conditions are suitable, taking a break while internet access is difficult or a device is not available, and returning to complete the program at a later date. To support this approach, open-ended timelines for completion are also beneficial. Individuals may find it difficult to complete a course in a 12-week format (the usual format for a college or university course) but may be able to complete it in 16 weeks.

For individuals relying on public internet access and shared devices, cloud-based training programs will be beneficial. This means that the training materials are stored on a central computer and can

be accessed over the internet from any location and any computer. The most flexible cloud-based options support mobile phone and tablet access as well as computer access, extending the ways that a user can engage with the materials. For those who have their own devices, but don't have reliable internet access, options to download training materials when they do have access, and complete the work offline, are also invaluable.

CONCLUSION

For low income households and people living outside Canada's urban areas, obtaining the digital infrastructure needed to work from home or participate in online training can be expensive and time consuming. These communities are most likely to benefit from improved employment opportunities made available through online access, and also the least likely to be able to go online. Whether the constraints relate to geography or income, the effects are similar – actions taken to mitigate poor internet access and to obtain access to sufficiently functional computing devices is a time-consuming exercise that reduces individual flexibility and availability to participate in online skills training or paid employment. Increased flexibility in design of training programs, coupled with programs designed to reduce the cost of digital infrastructure and to make it available in public locations are needed to reduce inequities and facilitate participation in online skills training and employment for everyone. Doing so can help to spark a virtuous circle whereby participants will gain improved skills that will enable better employment outcomes,⁵⁷ which will in turn reduce the need to support these individuals' access to this increasingly essential digital infrastructure ecosystem.



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