

Levelling Up:

The Quest for Digital Literacy



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PRESS START: INTRODUCTION



Community organizations, libraries, and social programs across the country are helping people apply for jobs online, open social media accounts, and learn basic office software. Kids are playing with programming toys in the classroom and competing in robotics competitions. And coding bootcamps and post-secondary programs are training the next generation of digital professionals.

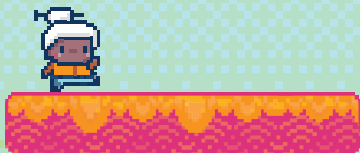
Digital literacy is a fundamental component of 21st-Century literacy and vital for civic and social participation, accessing public services, and succeeding in a digitizing economy. There has been an exciting growth of programs across Canada supporting the development of digital literacy at all ages, both within the formal educational system and delivered by non- and for-profit actors working alongside and in partnership with schools, colleges, and universities. However, the landscape of opportunities for learning digital skills remains fragmented and difficult for some learners to navigate. Many people in Canada are at risk of falling through the cracks, uncertain of the skills they are missing, how to develop them, and how to make sure they are not left behind.

Low levels of digital literacy continue to overlap with other aspects of socioeconomic marginalization and there is a risk that those who are being left behind will be further marginalized. For people who live in urban centres with disposable incomes and high literacy and numeracy rates, it is relatively easy to access the right for-fee training programs to upskill or transition into the growing number of jobs that interface with technology. But despite funding commitments for access to the internet, hardware, and training, there remains a digital divide in Canada. Consistent digital access (to hardware, software, wifi, and data) is a foundational requirement for building and maintaining digital literacy and confidence using technology—yet access remains a challenge for learners with low incomes and those living in remote communities. For some, access to technology and training is only available irregularly and through public support: computers and wifi in libraries and drop-in centres, provincially-funded training and employment programs, and non-profits offering accessible and low-cost beginner classes.

Advances in technology have tremendous potential to boost economic growth and improve quality of life. However, innovation-driven growth and its benefits are not accruing equitably across communities and individuals. People with highly-valued skills are seeing their incomes grow while others are experiencing lower wages, job disruption, or precarious work. Barriers to entry and career progression are contributing to a lack of diversity in many professions that require digital skills. While leaders from the public, non-profit, and private sectors alike recognize the need to invest in digital skills development, there remains a need for analysis around what is being taught and where, what the gaps are, and where there may be a need for new approaches.

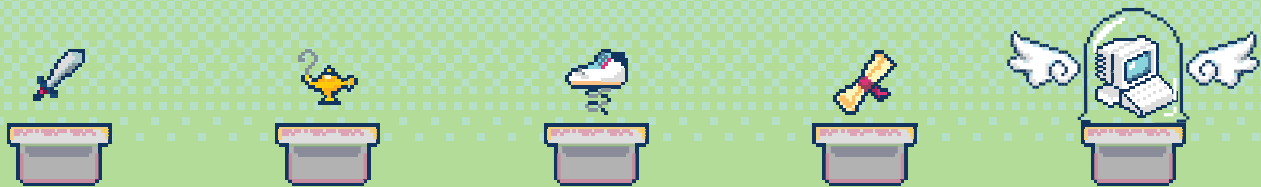
Building on our first discussion paper, [Digital Literacy in a Digital Age](#), and our [Digital Literacy + Coding Pilot](#), this report maps the digital literacy education and training landscape in Canada, from early childhood education to programs for seniors, and from “Introduction to Windows” to machine learning, video game design, and other advanced digital skills and professions. It examines how learners are building pathways through programs and the challenges they face in developing digital literacy, the roles of organizations and educational institutions within the digital literacy sector, trends in curriculum and pedagogical approaches, and it highlights exciting program models across the country. With this report, the Brookfield Institute for Innovation + Entrepreneurship hopes to provide a resource for the digital literacy sector, share successful models, and identify gaps and opportunities for program and policy improvements.

LOADING ... METHODOLOGY



Our report draws on over 90 semi-structured interviews with digital literacy education and training providers across Canada; school boards and teachers known for their successful implementation of digital literacy curriculum; policymakers at all levels of government across the country; and academics studying digital literacy, computational thinking, the digital economy, and technology in the classroom. Interviewees and case studies were selected to reflect a diversity of geographies, learner demographics, pedagogies, program models, sectors, and skills taught. This research would not have been possible without their wealth of knowledge, expertise, and perspectives. A full list of interviewees and experts consulted can be found in Appendix C.

POWER UP: DIGITAL SKILLS + CURRICULUM



DEFINING DIGITAL LITERACY

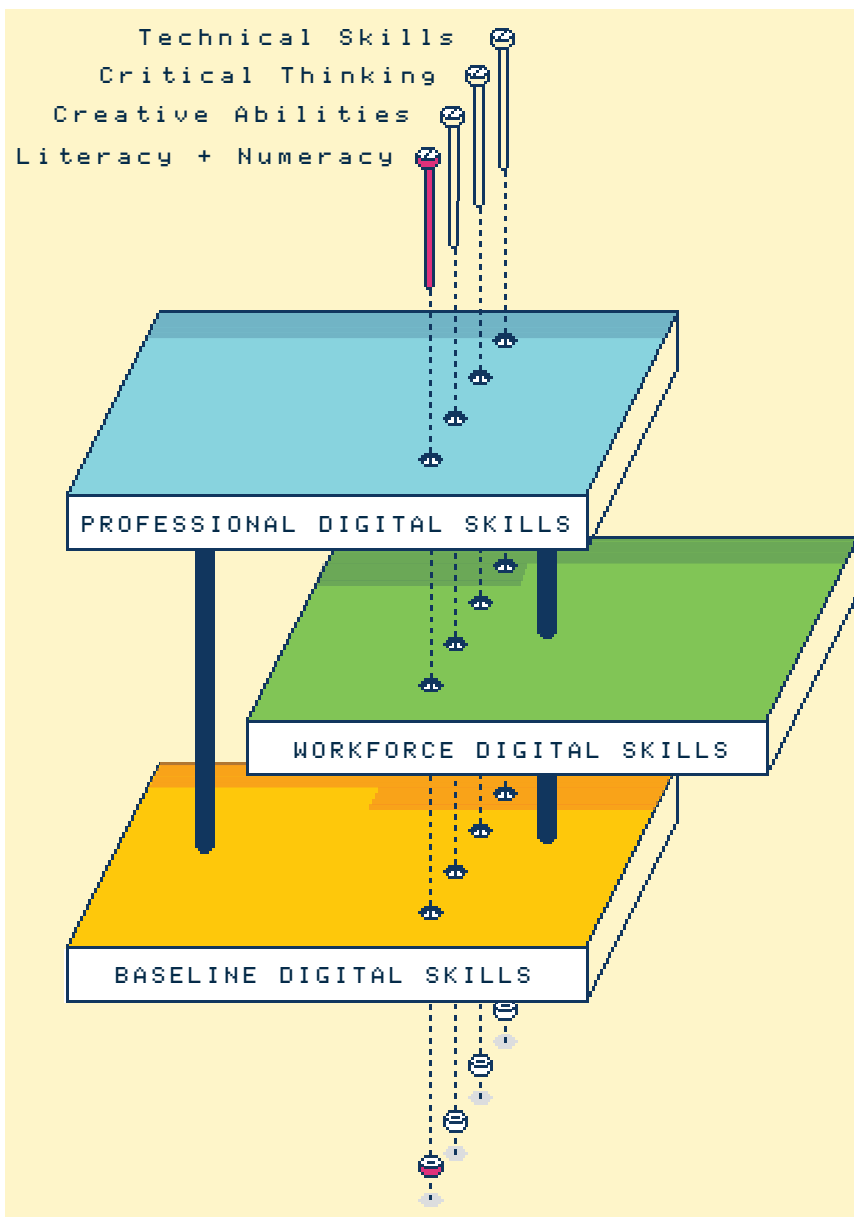
The Brookfield Institute’s working definition of digital literacy:

The ability to use technological tools to solve problems, underpinned by the ability to critically understand digital content and tools. This can include the more advanced ability to create new technological tools, products, and services.

Digital skills are a complex network of related abilities and expertise that continue to evolve as technology advances. Individual learners can advance their skills through education, training, self-study, and practice, but development is not always linear—learners can develop and possess skills at varying levels of proficiency and in different combinations. For instance, some young

learners build beginner “professional” coding skills and computational thinking alongside baseline skills through coding games and programmable robot toys; programmers might “catch up” on workforce skills and software, learning Adobe Illustrator and other design software mid-career; and non-programmers might learn coding as a workforce skill for data analysis and website design. Importantly, these skills do not exist in a vacuum. Each category of skills in this framework is underpinned by traditional literacy skills (reading, writing, and numeracy) as well as critical thinking, creative abilities, and technical skills.

We heard from several interviewees that although coding is an in-demand digital skill, curricula should also include the computational thinking and computer science theory needed to understand, use, and create digital tools and



Professional digital skills: The skills needed to develop new digital technologies, products, and services. This includes, for example, skills needed by software developers and data scientists.

Workforce digital skills: The occupation-specific skills required by a rapidly growing proportion of the workforce. These skills can include tasks that use spreadsheets, digital design, and customer relationship management (CRM) software.

Baseline digital skills: The skills needed by everyone to participate in an increasingly digital economy. This includes being able to confidently interact with technology, such as understanding how to find information, conducting a search on an online search engine, communicating with others, and using a variety of existing software and applications.

products. Advanced digital skills go far beyond coding and web/mobile application development to include: data science; cybersecurity; digital production, creative arts, and interaction design; and emerging fields such as machine learning and artificial intelligence. Some interviewees cautioned that the evolving field of digital literacy might not be ready for rigid definitions and preferred more flexible approaches to literacy and skills levels, while others called for more consistent requirements, particularly for universal baseline skills. Though not intended to be exhaustive, this section highlights some of the content currently being taught across the country and identified by our interviewees as in-demand, both from learners and employers.

INTRODUCTION TO COMPUTERS

The ability to use a computer, (as well as smartphones and other digital devices) is becoming increasingly vital for civic and social participation, accessing public services, and succeeding in a digitizing economy. Where governments are encouraging service users to use online service channels and reducing in-person access hours, learning baseline digital skills is becoming imperative to accessing government information, supports, and programming.

Youth and adult programs across the country—in both formal and informal educational

institutions—are teaching baseline digital literacy skills and beginner classes. This can involve teaching learners: how to use a mouse and keyboard to navigate computer and web environments; how to use common software programs (e.g., the Microsoft Office Suite, the Adobe Suite); how to access online services and basic interactions (e.g., online job hunting, online banking, booking travel); how to use email and social media; and how to interface with non-computer digital technology such as smartphones, digital cameras, and e-readers.

“For the most part, our focus on digital skills is on the basic digital skills that people need to become employable in a variety of sectors and transitioning people back into the labour market [with a] broader focus on increasing access and reducing the digital divide that low-income individuals experience. We’re interested in how a certain level of digital skills can create access to the labour market, and to city services that people with low incomes need to stabilize their lives. Increasingly, we know that access to recreation and all kinds of other things requires a basic understanding of how digital platforms work.” —Jennifer Posthumus, Manager, Employment and Social Services, City of Toronto

“Governments ... are moving to an e-governance model that is supposed to provide better access to information, forms, and documents, as well as quicker response times. Yet not everyone has access to online services, and not everyone has the digital skills to use these new platforms. So, the government, in essence, is moving to digital governance but not ensuring everyone has the tools to access these services. This has important consequences for people’s lives. In BC, you cannot apply for welfare without going online. The welfare office does not have computers or if they do, they are often not able to show people how to use them to apply for services.”
—Dr. Suzanne Smythe, Assistant Professor, Faculty of Education, Simon Fraser University; Member of the Downtown Eastside Literacy Roundtable

CYBERSECURITY, DATA PRIVACY + DIGITAL HYGIENE

Interviewees noted that cyber/information security, data privacy, and “digital hygiene” are foundational components of digital literacy, enabling safe use of devices and online environments and protecting users from harm and personal security breaches. K–12 digital literacy curriculum often includes some components addressing these needs: learning ethical and responsible behaviour when using technology (e.g., related to privacy, copyright, and intellectual property laws); healthy approaches to using technology (e.g., avoiding screen addiction); and integrating digital awareness into other areas of health and interpersonal curriculum (e.g., related to sexting, cyberbullying, digital citizenship, and online etiquette). Some training and education programs offer more advanced information and cybersecurity curricula such as extra-curricular competitions and industry certifications preparing graduates for entry-level positions in the tech sector.

“People should be able to assess, roughly, what kinds of risks they put themselves in when they use various software. This means, to me, having a sense of what happens when you use an app or website—how data is transmitted and what possible places it could be stored, and how it could be reused. There are two angles: the first is digital literacy regarding code and networks, the second is understanding information and software as infrastructure. Just as when you think about roads as infrastructure you immediately consider their safety, thinking of the internet as a kind of infrastructure leads to similar questions.” —Florencia Herra-Vega, CTO, Peerio

Canadian Cyber Defense Challenge (National)

Cybersecurity competitions such as the [Canadian Cyber Defense Challenge](#) (CCDC) invite teams of middle and high school students to find and fix cybersecurity vulnerabilities through either real-time day-long events or online during specified competition windows. The CCDC is designed around the industry's Digital Forensic Incident Response process. Participants work to discover breaches, contain and remediate incidents, determine how breaches occurred, analyze the compromised and affected systems, identify what attackers had access to and what information was stolen, and present their findings to a non-technical audience.

CCDC launched in 2011 with eight teams from Manitoba high schools. In 2018, 24 teams (including four post-secondary teams) competed. The organization has also hosted several workshops and training sessions at the high school level. CCDC teams have been invited to compete in the [Cyber Patriot](#) games, a high school competition hosted by the Air Force Association in the US.

receiving social assistance, employment insurance, or are underemployed in their field (through direct government-offered course offerings or tuition subsidies).

“It really depends on the group that you’re in, but everyone needs to feel comfortable using a computer and the software they need to use on the job. If you can’t use a laptop, Microsoft Office Suite, programs like Excel or PowerPoint, it’s game over. Especially Excel—it’s one of the best basic skills you could have.” —Andrea Niles-Day, Director of Project Governance and Performance Measurement, RBC Capital Markets

“Right now, we have a few people in the class that are the people who we saw getting left behind in the job market. We have a very experienced traditional communications expert who worked for years as a government speechwriter but now her CV is lacking anything digital and there’s a gap that she needs to fill to show she’s current and modern. We have someone in our class right now who was a project manager who wants to build his skills in digital project management ... Courses like ours are helpful to send a message to hiring managers that they know HTML or SEO.”²

—Marina Byezhanova, Co-Founder, Les Labs Inc.

THE DIGITAL OFFICE ENVIRONMENT

As technology evolves and becomes more pervasive, individuals feel more pressure to remain up-to-date, increasing demand for lifelong learning opportunities and seeking out training on commonly used software such as the Microsoft and Adobe Suites. The emergence of informal education and training opportunities such as bootcamps and online learning programs have reduced barriers to learning both for a wide range of people employed in jobs across the economy, and for those who are seeking to enter the labour force. Interviewees pointed to the lower cost of technology and the availability of online resources for self-study as providing learners with more opportunities for skills development and even career switching. In many jurisdictions, digital skill upgrading is also available for individuals who are

Emploi-Québec de l'Île-de-Montréal Professional Development Courses (Quebec)

Emploi-Québec de l'Île-de-Montréal, in partnership with [Regroupement des collèges du Montréal métropolitain](#) and the [Commission scolaire de Montréal](#), offers subsidized continuing education courses for employed private sector workers and self-employed individuals who are overqualified for the positions they currently hold and want to improve their professional and technical skills. Courses with digital content include web design, graphic design and multimedia, network administration, architecture, engineering, and office software.

Courses are offered by school boards and public and private colleges (including [L'École des arts numériques, de l'animation et du design](#), and [Institut des communications graphiques et de l'imprimabilité](#)). They cost individual participants \$2 an hour or \$60 for a 30-hour course. Every year, more than 6,000 individuals enroll in a course through this program.³

DATA LITERACY

A number of interviewees highlighted data literacy as a key component of digital literacy and a vital skill for the future of work and learning. Data literacy includes the ability to consume, produce, and think critically about data, as well as the ability to work with large data sets, understand how they were produced, and analyze and interpret them.⁴ This is an important component of digital literacy programs at all ages: it is key for researchers working with large datasets, high school students learning social media sentiment analysis, and anyone seeking to better understand statistics and data.

City of Toronto's Employment and Social Services (Ontario)

[Toronto Employment and Social Services](#) (TESS) provides employment services, training, and supports for recipients of Ontario Works (OW) on behalf of the City and the provincial Ministry of Community and Social Services. Approximately 50 percent of current clients have received OW for more than two years and nearly 50 percent report feeling unready to start looking for work. TESS offers intensive supports and services to prepare clients to seek, obtain, and maintain employment.

In 2018, TESS's Occupation-Specific and Sector-Focused training includes programs that:

- + Prepare participants to interact with and efficiently navigate software used in call centre environments;
- + Teach basic computer skills that prepare clients to work within a variety of customer service environments;
- + Provide technical and professional skills for participants to earn their Microsoft Office Specialist (MOS) certification in MS Excel;
- + Provide access to globally recognized IT certifications including Cisco IT Essentials and CompTIA A+;
- + Teach basic hardware, peripheral devices, and Windows systems tools;
- + Teach how to configure and manage Windows 10 applications and network; and
- + Provide training in website building, video editing, podcasting, videography, graphic design, and social media.

TESS's Occupation-Specific and Sector-Focused Training is offered tuition-free for recipients of OW and includes access to additional supports such as funding for transportation and subsidized child care. Programming is delivered by contracted service providers and cannot be offered by colleges or university programs that would qualify recipients for the Ontario Student Aid Program.

“In the future, data science is not going to be an exclusive specialized area for a select few. It’s going to be part of any computerized work stream. The more computer-based and automated we become, the more data will be infused into every job and role and industry.” — Shingai Manjengwa, Founder and Director, Fireside Analytics Inc.

“Where things are moving with interfaces, they are becoming more dynamic, augmented reality, virtual reality, hard to say if those trends will catch on ... but also interfaces are verbal and spoken, where there is no screen and you are interacting with devices that try and anticipate what to respond by talking to them. So I think designers will now have to adapt to ways of bringing personality to spoken interface and that’s going to be pretty interesting.” — Andrew Hladkyj, Coordinator, Web Design Program, Sheridan College

DIGITAL MEDIA + ARTS

Interviewees emphasized the significance of digital media and arts both as a medium and as an engine for learning and experimenting with digital literacy concepts. At the professional level, design disciplines have rapidly evolved to include a wide range of skills that blur and overlap, including user experience and user interface design, graphic design and illustration, electroacoustics and sound engineering, and information design. These skills span fields as varied as video game creation, product design, advertising, web and mobile development, film, music, and digital publishing. As forms of media have evolved, the tools of the trade—and the skills needed to apply them—have evolved alongside them. For example, in visual and user interface design, industry standard tools and practices have expanded from creating static products to include animation, interaction design, and prototyping in tools such as InVision.

“We’re a video game arts organization. The context we provide our programming in is art but people are learning the technical skills within it. ‘Video games’ is hard enough for people to grasp as a technical field, much less an art field. Bringing these things together helps people build the skills to express themselves creatively but also lead to a creative industry job that helps them support their art practice.” — Jennie Robinson Faber, Executive Director, Dames Making Games

York University + Sheridan College Joint BDes (Ontario)

York University and Sheridan College offer a joint Bachelor of Design: a four-year degree in visual communication, information design, and interactive/multimedia design. Courses include data visualization, interactivity, prototyping and usability, and information-mapping and networks. A number of their alumni have gone on to positions with tech companies including Facebook, Google, and Amazon.

Louis Riel Arts and Technology Centre (Manitoba)

The Louis Riel School Division’s Arts and Technology Centre offers an eight-credit high school certificate in Broadcast Media. The certificate includes training in the production and transmission of video and audio programming for radio, TV, and the internet; preparing learners for entry-level employment in the broadcasting industry; and teaching them to produce and edit their own short films, documentaries, and commercials. The certificate includes a four-week work experience placement.

BEYOND CODE: COMPUTATIONAL THINKING + ADAPTING TO NEW TECHNOLOGICAL DEVELOPMENTS

Coding is being taught throughout the digital literacy education and training landscape, from programming Dot Robots and Raspberry Pis in elementary schools to intensive career-transition bootcamps preparing learners for careers as programmers. However, a number of interviewees reflected on the need to look beyond coding to computational thinking and computer science theory, and to ensure that the broader population, not just programmers, can understand the logic and operations of computer systems and other technology embedded in modern life.

From programmers themselves, we heard about the value of critical thinking and problem-solving alongside core competencies in operating systems and programming language design, systems analysis, and security. From policymakers, teachers, and program leads, we heard that understanding how computers work and how to work with them was more important than writing lines of code, and that the ability to learn and adapt was imperative in a landscape where programming languages release frequent updates and software, platforms, and apps are constantly evolving.

“Do you have the skills and approaches to research when things change? It used to be that graphic design was dominated by QuarkXPress, then Adobe’s Creative Suite, and a lot of resources were poured into that. But now Sketch is changing things. If we can teach skills that are adaptable and based on general theories, I think people can adapt and see what is the best path.”

—Ahmed Sagarwala, Manager of Industry Relations, Masters of Digital Media, Ryerson University

“The world might be focused on coding right now, but that will not be the focus tomorrow. Technology is changing at an exponential rate and we will need to embrace new technologies at a rapid rate to keep up. Thus, we want to look beyond coding. If we focus on building tenacious learners who can readily engage with technology, and are critical thinkers and creative problem solvers, then we can teach people to be engaged learners and contributors who can have an impact on our world locally and globally.”

—Dr. Gina Cherkowski, Founder, STEM Learning Lab Inc.

“For high school [students], how you collaborate, the transferability of skills to workplaces, critical thinking, how you generalize, and understanding big data, are more important than specific technology skills.”

—Policymaker, Ministry of Education

“[When I hire,] I look for good communication and critical thinking skills—for the ability to ask good questions. Developers need to be able to listen to people state a problem and convert that into a system that combines computers doing kind of ugly, clunky things in a way that hopefully makes sense. Most of that is about listening properly and translating.”

—Florencia Herra-Vega, CTO, Peerio

“[Students] should have the experience of using coding to learn something about their world. Digital literacy is a tool, a way of communicating, the key is how we bridge the gap from relevant experiences to use coding and data analysis, to have a deeper understanding of ourselves and the world around us.”

—Non-Profit Program Lead

“I know it’s kind of a nebulous term, but for us a big barrier is just computational thinking in the broad sense. Most of our users and most researchers aren’t going to be doing a lot of programming per se but they do need to be able to do automation. They do need to coordinate analyses; they do need to be sure analyses can be routinely executed and remixed. So a basic mental model for how computational tasks are executed and how the output of one inputs into the next and that workflow.” —Dr. Jonathan Dursi, Senior Research Associate, HPC4Health

WORLD MAP: LANDSCAPE OF DIGITAL LITERACY EDUCATION + TRAINING

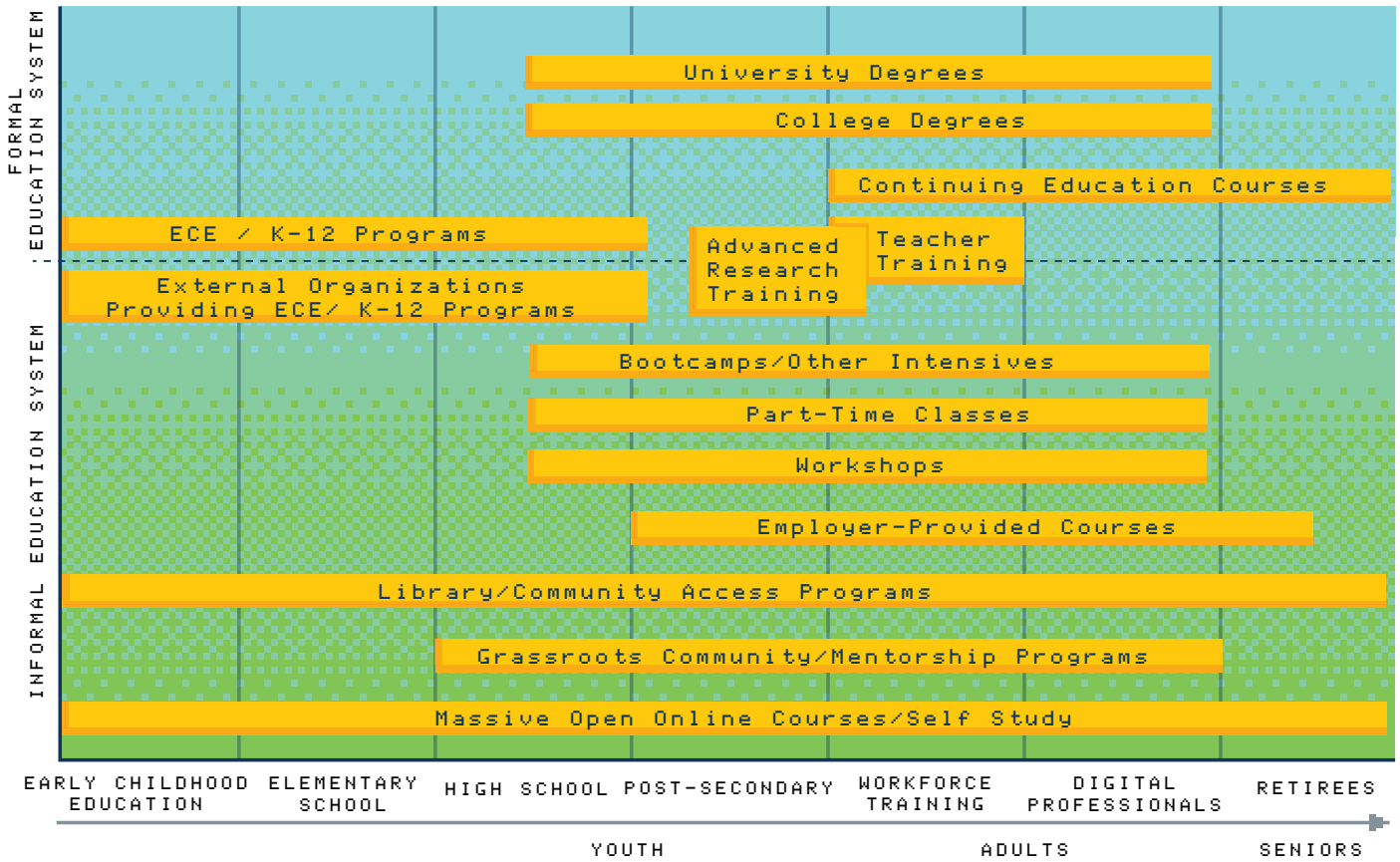


There are a broad range of education and training programs in Canada for fostering digital literacy. These programs employ a variety of approaches (including mentorship, for-fee training, and community-based programming), and serve different target audiences including youth, seniors, post-secondary students, and professionals. In response to the growth of the digital economy, increased digitization of society and communication, and reductions in the cost of technology, K–12 and post-secondary institutes have developed new programs and infused technology into the classroom as a learning tool. Organizations situated outside of the formal education system are continuing to grow in size and number as evidenced, for example, by the rise of the intensive full-time bootcamp model in the past decade.

However, program and sectoral categories are not neatly divided. Many larger organizations offer a range of programming for different ages, skills, and skill levels and learners move between sectors and program types, sometimes enrolling concurrently in multiple options. Bootcamps see an influx of computer science students for their summer programs alongside their core demographic of career-switchers, high-powered computing research centres are offering classes and tutoring for PhDs and postdoctoral researchers, and for-profit companies specializing in computational thinking and science, technology, arts, and math (STEAM) are selling digital literacy modules that schools can add to their core curriculum or as after-school and summer programming.

Below, we explore the landscape of digital literacy education and training and the types of programs offered within it.

Digital Literacy Education and Training Organization Landscape



D I F F I C U L T Y L E V E L , D I G I T A L : N A V I G A T I N G T H E L A N D S C A P E

A heightened awareness of the importance of digital literacy is spreading among educators, policymakers, and learners. However, the digital literacy and skills needs of individuals, and the paths to addressing these needs, are often unclear. The journey is complex: there is no one prescribed method or place to develop digital literacy skills, to learn what they are and what they can enable a learner to do, and to discern which ones are needed. While it is important for everyone to have some level of digital literacy, everyone may not need to attain the same level and their goals may shift throughout their lifetimes as careers and technologies evolve. Success might look like proficiency with email, search engines, and other everyday operations; alternatively, it could mean continual training in new programming languages and frameworks.

Across Canada, there was a reported lack of coordination among programs and jurisdictions. The landscape of informal education remains an open marketplace in which learners who have the funds to do so can choose from a variety of programs, in-person and online, while those who do not may be left behind. From interviewees, we heard that learners regularly move between sectors, programs, and fields, building career pathways that may pivot and take sharp turns or missteps. A number of interviewees talked about the lack of a digital literacy “pipeline”, “pathway,” or “ladder”, describing the landscape in Canada as fragmented and confusing for adult learners to navigate. Interviewees operating programs outside of post-secondary institutions noted that some of their participants were current students looking to supplement their university or college curriculum with more hands-on technical training or tutorship, and that colleges and universities were directing students to them. Many program leads for intermediate and advanced programs called

for better digital skills training at earlier stages of education and training, wishing that learners came to them with stronger foundational skills. From program leads and educators, particularly those outside of the formal education system, we heard that there was a need for better coordination and collaboration in order to fill gaps, reach students, and share and coordinate curriculum.

Interviewees also reported learners asking for wayfinding and navigational support, to help identify their skills gaps, choose between programs, and develop professional pathways and goals, noting that there are significant financial risks to “getting it right” for those who pay for high-cost programming (e.g., post-secondary education, continuing education, and bootcamps). Being able to find the right program often requires some level of digital literacy to research programs and identify funding opportunities to support one’s education (though some beginner programs still market themselves using community newspapers and posters at local social services).

There is also a need, both for policymakers and for program delivery leads, to better track student outcomes and pathways through the landscape of digital literacy education and training programs. Although there is solid national data on the number of learners completing bootcamps and STEM post-secondary education programs, there remain data gaps that impede robust analysis of the sector and of digital literacy in Canada. While some organizations are tracking this for their own programs, particularly if they are receiving government or foundation funding, there is no body in Canada compiling this information to examine the landscape as a whole, or the routes learners are taking between programs or throughout their careers.

Overview of some key data gaps

- + National enrollment, participant demographics, and prior education and training for all programs, not just post-secondary institutions.
- + Data on enrollment in non-STEM digital courses at the post-secondary level (e.g., web layout for journalism students, R and Python for social scientists).
- + Overall participant outcomes such as dropout rates, completion, employment, further education.
- + Learner pathways between programs and throughout careers (e.g., identifying how many computer science students are taking summer bootcamps, which programs are helping learners transition into the tech sector)
- + Program evaluation, including looking beyond outputs to assess participant learning and development, effective curriculum, and scalable models.

[On how students choose to take computer science in high school] “Sometimes it’s by chance: they put it down as an elective, or sometimes the guidance counsellors suggest it ... I taught a lot of math and I would encourage them to take computer science in Grade 10. I talk to teachers about how to use outreach to build your program. Maybe you need to change your approach in how you teach it? Have your high school students go into elementary schools and make games and make applications; invite Grade 9 students to come in and check it out; have students showcase their work.” —Lisa Floyd, Director of Research and Inquiry, Fair Chance Learning

“The gaps in Canada’s digital literacy education and training are largely due to the size of the country with two official languages and 13 different Ministries and Departments of Education. To be able to provide training to rural communities, Northern communities, training in both official languages, with many different curriculums is a challenge. We would like to see more training and support for educators through leadership as well as federal and provincial funding.” —Kate Arthur, Founder and Executive Director, Kids Code Jeunesse

“[We need] collaboration across all groups and defining pathways for learners going through various programs across the country. We have a culture where we don’t declare winners, but I think identifying the programs that work across the learning journey of participants and helping them grow and reach more learners would be valuable.” —Melissa Sariffodeen, Co-Founder and CEO, Canada Learning Code

“Canada does not have a national [digital] literacy policy, so there are a lot of gaps and duplication of services. Having a concerted policy on how to address lower levels of literacy would be helpful. Right now, it is a very grassroots and one-off. People are overworked and understaffed. From an innovation standpoint, it is challenging because of the time it takes for new and innovative ways to reach a significant population of adults to sell them on continued education. It is expensive and doesn’t fit neatly into a department. Provinces are focused on formal education and post-secondary, so there are fewer resources dedicated to addressing the people falling into the cracks.” —Non-Profit Program Lead

“The key is to coordinate these various programs with disparate definitions of literacy and skills. There is a varied landscape in program delivery across the country ... If we have shared definitions of needs these will be more effective. We need to know which gaps we are trying to fill for different populations. A unified understanding of digital skills and literacy, nationally and between government departments, will help us all achieve policy objectives.” —Toby Harper-Merrett, Executive Director, Computers for Success Canada

FEATURES



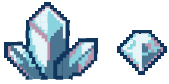
Resilience

To successfully reach an exit point, all learners need to have some level of resilience and perseverance.



Gold Pieces

Learners start with different levels of gold pieces, with no opportunities to collect more. Learners can use them to unlock Gold Locks to access learning opportunities and equipment.



Digital Literacy Gem

By collecting Digital Literacy Gems, learners are able to improve their digital literacy and skills.



Exit Point

Learners can win by reaching an exit point.



Self-Study

Learners that can access Self-Study can collect two times the Digital Literacy Gems for a short period.



Community Bell Jar

Bell Jars carry additional Digital Literacy Gems and equipment that can be accessed by learners.

EQUIPMENT



Tech Blade of Reckoning

Using the Tech Blade, learners can cut through barriers to access learning opportunities, equipment, and devices for self-study.



Summoning Lamp of Mentorship

With the Summoning Lamp, learners gain access to mentorship.



Scroll of Literacy

The Scroll of Literacy empowers learners with improved access to Digital Literacy Gems.



Kicks of Proximity

Learners equipped with the Kicks can leap over obstacles and access learning opportunities more easily.

OBSTACLES



Thorny Vines of BYOD (bring-your-own-device)

The Thorny Vines of BYOD block a learner's access to learning opportunities, but they can be cut with the Tech Blade of Reckoning.



Gold Lock

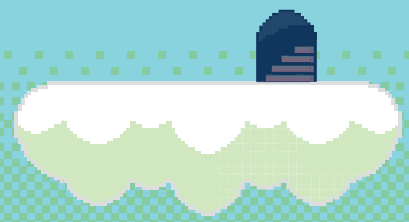
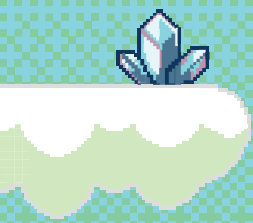
Some learning opportunities and equipment are blocked by Gold Locks. Learners without enough gold pieces are barred from entry.



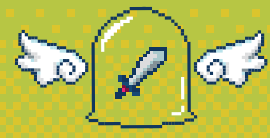
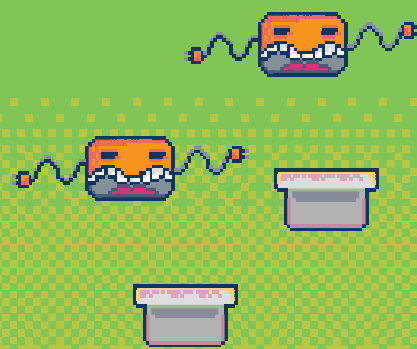
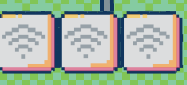
Unforeseen Circumstances

Unforeseen Circumstances plague the pathways to learning opportunities. Learners with the right equipment can overcome Unforeseen Circumstances in battle or avoid them altogether.

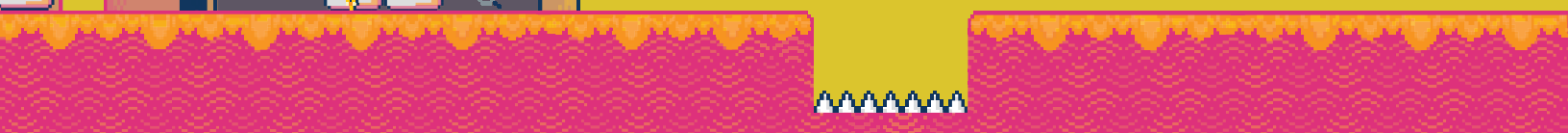




EMPLOYEE TRAINING



AFTERSCHOOL



GETTING TO LEVEL ONE: THE FORMAL EDUCATION SYSTEM



K-12 EDUCATION

The K-12 education system is providing a substantial amount of digital literacy education in Canada, from early childhood education to high school. Led by provinces, territories, and First Nations,⁵ digital literacy priorities span from coding as a major area of focus, to the infusion of technology across the curriculum, to increased technology use in the classroom. However, beyond provincially or territorially-mandated curriculum, describing how approaches to digital literacy training and education are delivered becomes more complex from district to district, and from school to school. Decisions made by school boards, schools, and even individual teachers change how students experience digital literacy education and by the time students leave high school, disparities in digital literacy levels can already be substantial.

“Digital literacy is a huge area. We are focused on one small part that is computational thinking and expressed through computer programming and physical computing. Our overall goal is to work with education systems to make sure they are equipping students with the necessary skills so they can create and communicate with the tools of the 21st century.” —Kate Arthur, Founder and Executive Director, Kids Code Jeunesse

“It runs the gamut—you hear of teachers at the far end of the spectrum who are completely skeptical of why coding is such a critical skill; that this is a government agenda, a political agenda, driven by corporate interest that kids need to be doing this for their future, and teachers are pawns in this agenda. Then there are those that are curious and see that ‘kids like this’ so they create some opportunities to explore. They’re willing to step out of their comfort zone and try but they don’t have any awareness or skill in digital literacy... And, of course, there’s the superstar cutting-edge teachers who are bringing Arduino boards into the classroom for their Grade 8 kids to problem-solve together, without clearly knowing what they’re going to do. These teachers are courageous and willing to jump, with both feet, into the deep end.” —Non-Profit Program Lead

“Countries like the UK and France have already integrated coding and computational thinking into their primary education systems. Canada may struggle to develop a pipeline of skilled workers in relevant areas if we do not formally facilitate education pathways to data science, cybersecurity, and other high demand technology careers from as early as high school. I commend the efforts thus far, but there is more work to be done to ensure that Canada has a technologically skilled and diverse workforce in the future. An art history, psychology or accounting major, a teacher, doctor or lawyer with coding skills, will be better positioned to succeed in jobs of the future.” — Shingai Manjengwa, Founder and Director, Fireside Analytics

Coding in schools

Coding is currently a subject of intense discussion within the K–12 education sector. In recent years, provinces including British Columbia, Nova Scotia, and New Brunswick have formally introduced coding into their curricula, coupled with funding commitments to support teacher education and classroom technology.

In British Columbia, the provincial government announced \$6 million in funding in 2016 to launch coding curriculum from kindergarten to Grade 9, with optional classes in Grades 10 through 12. Beyond coding, [British Columbia’s Applied Design, Skills, and Technologies curriculum](#) includes high school classes in web development and computer programming, digital communications and media design, electronics and robotics, and coding for manufacturing.

In the same year, the government of Nova Scotia made a \$1 million investment to support coding in schools. This included the implementation of coding curriculum from kindergarten to Grade 12, access to computer programming learning opportunities through the [Nova Scotia Virtual](#)

Yukon Digital Literacy Framework

Developed by technology leaders from Yukon schools and consultants from the Yukon Department of Education, the [Yukon Education Digital Literacy Framework](#) is a set of guidelines to help teachers address digital literacy with their students, grounded in technology as a tool for inquiry and engagement, and providing suggested competencies for each grade.⁶

The following competencies are outlined for students in Grades 10–12:

1. Design, develop, and test a digital learning game to demonstrate knowledge and skills related to curriculum content.
2. Select digital tools or resources to use for a real-world task and justify the selection based on their efficiency and effectiveness.
3. Employ curriculum-specific simulations to practice critical thinking processes.
4. Identify a complex issue; develop a systematic plan of investigation and present innovative solutions using digital tools.
5. Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
6. Design a website that meets accessibility requirements.
7. Model legal and ethical behaviors when using information and technology by properly selecting, acquiring, and citing sources.
8. Create media-rich presentations for other students with examples and commentary that demonstrate understanding.

[School](#), and partnerships with organizations like [Brilliant Labs](#) and [Acadia Robotics](#).⁷

The New Brunswick government’s 10-year education plans (for both English and French schools), released in 2016, committed to giving learners access to coding and digital literacy in

schools, alongside other priorities such as literacy and numeracy, arts, career readiness, and early childhood education.⁸ In 2017, the provincial government committed to \$6.25 million for the continued implementation of its education plans.

At the K–12 level, many coding activities are focused on learning to build websites and games from scratch but can be more complex depending on student and teacher interest. Educators are exploring coding with younger students using unplugged activities without computers, and tools like [Scratch](#), [Hopscotch](#), and [Blockly](#)—visual programming languages that are block-based and event-driven (e.g., dragging and changing the position of components to complete a task such as drawing a rectangle). Where schools offer a deeper exploration of subjects such as computer science, industry-specific uses of technology, and robotics, these courses are usually available from Grades 10–12.

There is no universal agreement on how to introduce coding concepts into the formal education system, how much students need to know, or whether all students need to know how to code. The idea that coding is replacing traditional literacy or becoming a “third literacy” (in addition to literacy and numeracy), is a source of trepidation for some educators and policymakers, raising concerns that students are being streamed exclusively into high tech careers or that other kinds of literacy will be left behind. Others are enthusiastic about bringing coding in schools but note that educator priorities should also include student privacy, safety, digital hygiene, digital citizenship, and digital research.

Not all provinces and territories are moving toward integrating code into their curricula— in some regions, coding is encouraged at the district and classroom levels. For instance, many schools participate in initiatives such as the [Hour of Code](#), or partner with third party organizations such as [Let’s Talk Science](#), [The Learning Partnership](#), and [Actua](#) to deliver coding experiences to students. This is explored in more detail in *Partnerships with third party training and education organizations* ([page 25](#)).

“In general, I don’t think we need to be giving every child a giant dose of computer science education. We don’t all need to be computer scientists; we just need to have a basic lack of fear of computers and the things they do. I suspect that is best achieved by incorporating critical thinking about computers, as well as writing code in various ways, into existing subject matter.” —Florencia Herra-Vega, CTO, Peerio

“There’s a huge STEM push with getting people to understand code. I failed math in Grade 12, but I became a technical director in the animation and visual effects industry. I couldn’t understand math through writing, but once I could command line it and see a visual representation, I learned how to use it.” —Dr. Michael Carter, Assistant Professor, School of Creative Industries, Ryerson University

“Even without changing the curriculum, it could be taught in a way that refers to much more modern methods of inquiry and research ... Say you are teaching a class in biology, and you’re looking at epidemics (e.g., flu) and you want to teach the kids about what happens. With 10 lines of Python programming you could mine Twitter, plot it on a Google map, and show how the flu is spreading in real time, or almost real time...They won’t become expert programmers, but they will have an idea of what can be done with the data.” —Dr. Daniel Gruner, CTO, SciNet, University of Toronto

Infusing technology throughout the curriculum

As an alternative to a coding-for-all approach, some provinces and territories have chosen to infuse technology and digital literacy concepts throughout the curriculum. For example, Manitoba and the Northwest Territories have developed and adopted “Literacy with ICT,” an approach which they describe as “thinking critically and creatively,

Earl Haig Secondary School (Ontario)

[Earl Haig Secondary School](#) offers computer studies courses for Grades 10–12, as well as industry-recognized certificates from [CISCO Networking Academy](#) and [SAS](#). Curriculum includes introductions to networks, security, and hardware; robotics; programming network devices; game development and multimedia interfaces; object-oriented programming languages (Python, C++, and SAS); and the ethical use of computers and information technology.

“At Earl Haig Secondary School, with the support of the administration, it was possible to build the computer studies program to address the needs of digital learners. It includes teaching traditional algorithmic languages: Python, C++ augmented and enriched with CISCO Academy Internet of Things and SAS programming. Last year for their culminating project [my students] did data analysis for the Ministry of Advanced Education and Skills Development, analyzing data on apprenticeship dropouts. Data analysis is much more than crunching and coding; it is actually problem-solving and that is quite different when compared to most fashionable and popular approaches to coding. While a lot of coding is done for the ends of learning syntax and algorithms, computer studies should have the final goal of empowering critical thinking and problem-solving with new computational tools and methods.” —Dr. Sacha Noukhovitch, Computer Science Teacher, Earl Haig Secondary School; Founder, STEM Fellowship

about information and about communication, as citizens of the global community, while using ICT safely, responsibly, and ethically.”⁹ Rather than teaching digital literacy in separate classes, this approach seeks to integrate digital literacy across existing curriculum subjects. Individual teachers are also using this approach in other jurisdictions, developing creative ways to apply coding, data analysis, social media, digital media, and online collaboration tools to existing curriculum, as well as inviting students to use digital technology as a tool for learning and sharing their results. Many interviewees also considered coding to be a helpful way to engage students across subjects such as art, science, or math in a problem-solving capacity.

Focus on Information Technology (FIT) Program (National)

The [Focus on Information Technology \(FIT\) IT program](#), created by the [Information and Communications Technology Council \(ICTC\)](#), is a certificate program designed for secondary school students who are interested in developing information, communication, and technology (ICT) skills, as well as business skills. The FIT program partners with schools across Canada to offer programming in four concentrations: interactive media; network systems and operations; software design and development; and business and information analysis. They allow students to explore skills including web design and development, programming and database development, systems architecture, and technical and communications platform maintenance. The FIT program also offers certificates that students can earn while completing their secondary school diplomas that mark completion of industry certifications, work experience, or co-op courses.

“We’re interested in bringing the digital world into the classroom, beyond learning to use computers. Teachers used to book the computer labs to play games. Now, it’s more about mindset: how tools can be used in different areas, teaching [students] how to be safe online, or how to conduct research online.”

—Chris Stacey, Curriculum Technology Consultant, Yukon Education

“At the formal school level, the expectation is that a student can use technology safely, ethically, and responsibly, and can use it for any inquiry that they’re interested in, within the subject they are studying in the curriculum. Each of these things, at one point, is taught. For example, maybe students are using a spreadsheet for a data-heavy class, then later they use a spreadsheet because they need to collect and organize their own data and they want to represent it visually. The teachers are teaching their own subject areas, but they’re also teaching Literacy with ICT as it is developmentally appropriate.” —Policymaker, Ministry of Education

“Technology can be used as a way to represent learning that is already happening ... Instead of making a poster or creating a skit, students can code a story or build a game to show their learning. Technology has the power to help us teach in a more integrated way. By connecting all subjects and leveraging technology, teachers can bring science and art into social studies and math classrooms. In doing so, we can transcend traditional subject separation and foster deep learning that uses technology in a way that is meaningful and not superficial. How we actually learn is by connecting the dots. By removing siloed subjects and using technology purposefully, students can and will connect more dots.” —Dr. Gina Cherkowski, Founder and CEO, STEM Learning Lab Inc.

“Some things that come to mind more specifically that would be useful in schools: a little bit of writing code; it could be making websites, making games, something fun and/or practical to give students a sense that code is useful and not that daunting or dry; some possibility for integrating the use and design of algorithms in math, science, economics, or any subject where it is relevant, to give students a sense of the kinds of things that can be automated; an inclusion of questions regarding ownership and transmission of data into civics classes.” —Florencia Herra-Vega, CTO, Peerio

“I think that digital literacy should come as a kind of universal changemaker for all the subjects ... It’s not that traditional school is wrong, it’s simply that modern generations [might have] battled the effects of gravity in [video] games more frequently than in real life. This type of student would better understand the fundamental laws of physics from ... finding patterns in data. And thus, they will come to the same understanding but in their own way.” —Dr. Sacha Noukhovitch, Computer Science Teacher, Earl Haig Secondary School; Founder, STEM Fellowship

Wikwemikoong Robotics Team (Ontario)

Since 2014, a team of predominantly female high school students from Wikwemikoong Unceded First Nation, Manitoulin Island has competed in local, provincial, and international robotics competitions, including qualifying for the quarterfinals and winning the Highest Rookie Seed at this year's [FIRST Robotics Competition](#). FIRST competitions invite teams of high school students, coaches, and mentors to build game-playing robots over the six-week competition period, including design, manufacturing, and coding. In 2018, Wasse Abin Wikwemikong High School teacher Chris Mara was recognized with a Prime Minister's Award for Teaching Excellence for his role as a coach and mentor. The team is the longest running First Nations robotics team in Canada, growing from a team of five working in Mr. Mara's classroom lab to a team of over twenty with a dedicated lab for building industrial robots.¹⁰

Teacher education models

From school boards, curriculum developers, and teachers themselves, we heard that many educators need additional guidance in how to infuse technology into curriculum, how to teach coding and computational thinking, how to effectively use technology for learning, and in some cases, how to use it in general. The speed with which technology evolves poses challenges to institutions developing training for future teachers and professional development for current teachers. In contrast to other curriculum subjects, technology curricula and practices need to adapt quickly to changes in the personal technology students are bringing into the classroom and have access to at home, amendments to how online behaviour is legislated and what is expected, and developments in emerging platforms and programs. Rather than an emphasis on formal education for pre-service teachers or intensive study of technological concepts, many interviewees emphasized the value of taking an inquiry-based approach and learning with your students, cultivating a culture of learning

through confidence building, being willing to try unfamiliar hardware and software and work with unfamiliar concepts, and an openness to failure and iteration.

Some jurisdictions are employing “train-the-trainer” models, with digitally-adept teachers receiving formal training and serving as peer mentors and facilitators within their schools or school districts.¹¹ Instructional coaching is another approach, in which lessons are co-taught with digitally-adept teachers and trainees are encouraged to learn alongside their students.

Traditional teacher professional development bodies, such as the [Ontario Council for Technology Education](#) and [CODE BC](#) (the professional specialist association for educators supporting BC's Applied Design, Skills, and Technologies curriculum) are providing teacher education through professional development conferences and mentorship. Additional qualifications are available through provincial teachers' colleges on topics such as media literacy and integrating information and computer technology into instruction. External non- and for-profit organizations are also offering programs including conferences, professional development workshops, and “teacher summer camps”. For example, The Learning Partnership's [Coding Quest program](#) supports teachers with in-service workshops, online resources, and a flexible curriculum framework that can be adjusted to a teacher's level of expertise. Other models such as [Code, Create, Teach](#), a national initiative by [Kids Code Jeunesse](#) and [Lighthouse Labs](#), focus on introducing teachers to coding and computational thinking to demystify them and introduce ways that they can be applied in the classroom.

“We focus on creating an environment where teachers are comfortable and ready to learn about computational thinking and how to bring it back into their classroom and into their curriculum. We have a lot of experience working with different levels of education, from a local classroom to a Ministry of Education. We love to work with schools where we train everyone—the janitor, the school director, gym teacher—everyone learns basic computer programming so they can support each other.” —Kate Arthur, Founder and Executive Director, Kids Code Jeunesse

“A lot of teachers tend to teach the way that they were taught, and some of them may not have used or been exposed to a lot of technology when they were going to school. A lot of it is just getting their heads wrapped around how to use the technology first of all, and second how to use it in the classroom.” —Non-Profit Program Lead

“A lot of teachers are keen to learn, and keen to bring higher levels of digital literacy into the classroom. Because we are more separate, more remote, this is a way for students to connect to the rest of Canada. I think one of the struggles [in Yukon] is the sense of isolation for students and teachers. Students feel disconnected and they want to feel that they have the same opportunities as other Canadian kids. Some teachers are naturally keen, and others are wary, but as long as there’s guidance, they’re willing to follow.” —Chris Stacey, Technology Assisted Learning Consultant, Yukon Education

STEAMLabs Maker Educator Bootcamp (Ontario)

The [Maker Educator Bootcamp](#) by [STEAMLabs](#) is a 10-week part-time course for educators who want to learn maker skills, technologies, and teaching methodologies. The program charges a fee of \$560 including materials and does not require participants to have previous tech experience. It focuses on HTML/CSS, soldering (including Arduino programming), 2D and 3D design, the Internet of Things,¹² and digital fabrication through designing, planning, prototyping, and iterating on a physical project.

CODE BC (British Columbia)

[CODE BC](#) is a joint initiative between the BC Ministry of Education, the [BC Teachers’ Federation](#) (BCTF) and [Computer Using Educators of BC](#), one of 32 BC provincial specialist associations comprised of volunteer BCTF members who share expertise and organize conferences and training. Recent CODE BC training included a two-day workshop in student learning modules for ICT, held in locations across the province, and taught by senior instructors from Lighthouse Labs and Kids Code Jeunesse. The official resource package for the BC Ministry of Education’s train-the-trainer coding and computation thinking support sessions is [available for free online](#).

Partnerships with third party education + training organizations

A number of third party education and training organizations (both non- and for-profit) are offering curriculum and programming within the K–12 school system, as well as teacher professional development, before/after school programs, and camps over school breaks. These organizations often provide equipment, technical expertise, and digital literacy pedagogy, offering creative programming that supports and works within existing provincial education curriculum. Examples of third party education and training programs include those offered by STEM Learning Lab, Fireside Analytics, Fair Chance Learning, and the Digital Literacy Project offered by the Atwater Library and Computer Centre.

“In Canada and internationally we are working with some very forward-thinking schools—some who move quickly and push the boundaries and others who are more methodical as we work to achieve systematic and sustained change. Through our work with teachers and schools, we are increasing teacher capacity in regards to digital literacies and technology as well as equipping teachers with the tools to design for deep learning through robust, integrated problem-based learning activities. It is an exciting time to be in education!”

—Dr. Gina Cherkowski, Founder and CEO, STEM Learning Lab Inc.

“There is a mismatch between digital learners’ own knowledge acquisition practices and traditional schooling system ... The existing hierarchical schooling structure does not leave much room for student-centered, interdisciplinary project-based learning—and for the change of educator roles from predominant instruction to student team learning management. In my teaching practice, I am able to implement the new learning only as temporary small-scale in-class activities that do not form cross-curricular and interconnected knowledge acquisition [that is] much-desired by students.” —Dr. Sacha Noukhovitch, Computer Science Teacher, Earl Haig Secondary School; Founder, STEM Fellowship

“It was important to offer a credit for the high school data science course because formalizing the experience signals to learners, from different backgrounds, that this is important. The curriculum is academically rigorous, and the lessons are challenging, the skills gained in the course are directly linked to modern jobs, and the workforce demand is so great that learners should have their efforts formally recognized.” —Shingai Manjengwa, Founder and Director, Fireside Analytics

Brilliant Labs (Atlantic Canada)

[Brilliant Labs](#) is a non-profit organization in New Brunswick (but expanding operations across Atlantic Canada), that works with educators to bring creative, technology-enabled learning spaces and workshops into schools.¹³ In April 2018, it was announced that the Newfoundland and Labrador Department of Tourism, Culture, Industry and Innovation will contribute \$250,000 for Brilliant Labs to provide students with hands-on participation in STEM-focused activities.¹⁴ Additional funding is being provided by the Atlantic Canada Opportunity Agency and the government of Nova Scotia.¹⁵

POST-SECONDARY EDUCATION

Universities and colleges are also supplying a substantial amount of adult digital literacy education and training in Canada, including both core digital curriculum that prepares students for professional careers in the tech sector and programs that make heavy use of digital software and tools (e.g., statistics, graphic design, publishing). We heard from professors at both colleges and universities that the digital literacy levels and quality of digital work of students entering post-secondary education is uneven. Some students were substantially behind their peers, while others were arriving with already launched digital careers and their own high-end equipment for digital media production.

Across Canada, there were almost 70,000 students enrolled in mathematics, computer science, and information sciences in 2015–2016, up 20.4 percent since 2005–2006 (although this at least partially reflects an increase in overall enrollment). This accounts for 3.4 percent of total post-secondary enrolment.¹⁶ Within other Statistics Canada instructional program categories, it becomes more difficult to parse out which students are receiving digital education. In 2015–2016, almost 80,000 students (or 3.9 percent of students enrolled in post-secondary education) were enrolled in “visual and performing arts and communications technologies” which includes both traditional arts (e.g., theatre, music, opera) and communications technologies programs in graphic design, digital media, electroacoustics, etc. Anecdotally, we heard from bootcamps and part-time program leads that they were seeing an influx of post-secondary students enrolling during vacations and throughout the school year to gain supplementary training and support, but there is currently no way to track the number of students who are dually enrolled.

“One thing I’ve noticed year to year is the level of knowledge coming in from high school varies. Some have never touched code before, some have quite a bit, and it’s that disparity that is a challenge in teaching, especially for first year.” — Andrew Hladkyj, Coordinator, Web Design Program, Sheridan College

“The prosumer¹⁷ level is actually pretty great. There have always been high level students, but now the medium level is pretty good—more people can shoot decent video and edit. They went on eBay, they bought their own stabilizer, or got into audio in high school, downloaded a copy of Final Cut, this is all cheap now. No high-school student would have owned a high end three-chip camera¹⁸ 15 years ago. It makes that iterative way of learning and repetition much more accessible. They’re shooting, editing, and making films with their friends. They’re getting experience that they would normally only get at the university level.” —Dr. Richard Lachman, Director of Zone Learning, Ryerson University

Universities

A number of interviewees from the informal education sector saw universities as both a vital institution in the sector, and slow to adopt and adapt to changing technology, offering outdated curriculum or a lack of hands-on learning. We also heard from innovative university programs about how they are changing their approaches, including incorporating technology into the classroom and into learning. They are shifting to more job-ready training, increasing the digital components of formerly analog programs, and partnering with industry to offer co-op placements and work-integrated learning so that students gain exposure to the digital skills, tools, and practices being used in the workplace.

Across sectors, we heard from interviewees that post-secondary education alone is not enough. At the advanced level, digital literacy requires ongoing professional development and self-teaching. Even among highly skilled professionals and educators, we heard that many felt they had not had sufficient formal training in the work they do, often self-teaching and filling in the gaps themselves throughout their careers.

At the more advanced levels, high-performance computing facilities¹⁹ attached to universities and research hospitals across Canada are providing support to graduate students and junior researchers in command line programming and working with large datasets. This includes teaching classes in scientific and advanced parallel computing, R, Python, and providing drop-in support and help desk functions.

“There is a lot of lack in basic digital literacy, surprisingly enough, because a lot of the people who participate in our courses do have some sort of computing background from universities, but it seems that they’re lacking the practical angle.” —Non-Profit Program Lead

“Students have found that [support] services are overwhelmed and trying to book time with a tutor can be difficult. The program that we have is more about supporting an interface and the code supports the user experience more whereas the tutors tend to be more specialized. What the tutors offer doesn’t always click with the type of curriculum we have.” —Andrew Hladkyj, Coordinator, Web Design Program, Sheridan College

“I think it’s been really helpful for me to work with a variety of different professionals, not just other developers. Every time I see a technical problem from the perspective of someone with a different background than mine, I level up. On a more technical side, I’ve benefited greatly from reviewing basics of operating systems design, programming language design, and networking—things that I did not pay enough attention to when I was studying computer science because, at the time, I did not see the utility as I do now.” —Florencia Herra-Vega, CTO, Peerio

“I still feel like a total imposter, like I’m missing the prerequisites for everything I help users with. Coming through a research program, everything I learned, I learned on my own. All of my programming styles are based on one programmer that established the platform that I initially worked from. And I struggled when I started using supercomputers but it was all based on reading tickets with that organization and getting things to work based on those conversations.” —James Desjardins, Advanced Research Computing Consultant, SHARCNET

“Universities need to be investing in highly qualified support—I think that’s the big issue right now. And that will [need to] be part of the graduate and undergraduate experience, that students won’t just have an IT support help desk to go to if they can’t connect to wifi, but if they’re trying to process a statistic, they can go somewhere and get it resolved in a couple hours. It’s not a comment on the course content necessarily, but about how the research support is handled because right now it’s on the backs of research funding which is totally transient.”

—James Desjardins, Advanced Research Computing Consultant, SHARCNET

“Within the University of Toronto, we’ve been trying to find a way to become an accredited teaching unit within the university. It’s not only for the status of our people, but also so we can craft our own programming and we don’t have to depend on departments to let us teach their students out of the goodness of their hearts. It’s a way for us to teach our courses in a way that is central to the university. Computer literacy for research is becoming as essential as literacy and numeracy: learning to read and write in proper English and learning mathematics ... Every field of research needs it.” —Dr. Daniel Gruner, CTO, SciNet

Dev Degree (Ontario)

[Dev Degree](#) is a work-integrated learning program co-founded by Carleton University and Shopify in 2016. During the four-year computer science degree program, students split their time between their studies at Carleton and work placements with Shopify. Dev Degree students receive competitive salaries that include paid vacation, and their tuition costs are covered by Shopify. Throughout the program, students work on Shopify teams and are provided with developer training—including front- and back-end development, mobile development, and distributed computing—in addition to computer science courses.

“[We] had noticed that often when people come into a tech company, graduated with a computer science degree, they are still missing a lot of skills and experiences. We call that the gap: the gap between education and industry. We’re not seeing that gap close. And just watching how universities work, they’re not in a good position to address that gap, they just don’t have the skills and experience. Think about Shopify or Amazon or Google or Netflix or any tech company with large distributed systems: huge amounts of data, things are mission critical, user experience is imperative. There’s just no way to simulate that in the classroom, you need to use real-world problems ... Our vision was: what if we could address that gap while students are studying, instead of afterward?” —Andrea Ross, Senior Engineering Lead, Education, Shopify

Colleges

Colleges across the country are offering a broad range of digital literacy programs including degrees, postgraduate certificate/diplomas, and transfer programs to universities. Subjects include: computer science; web and mobile app design and development; information and network systems; graphic design and illustration; video game design; and sound engineering. The focus is on preparing students for entry into the workforce and ensuring that curriculum meets industry standards for entry-level employees.

“Our web and mobile app design and development program was designed to create a graduate that was job-ready. The program was created by identifying industry partners who are looking to hire and discussing with them what it is they would want in graduates, making sure the programming would produce the people they want, and keeping in touch with them through advisory committees to make sure it’s current.” —Margaret Heldman, Dean of Science, Langara College

Audio Recording Technology at Vanier College

Vanier College (Montreal) offers a one-year, full-time “Attestation of Collegial Studies” in [Audio Recording Technology](#). ACS programs (or AEC in French) are targeted at adult learners who are “outside the usual path of education from high school” and have been out of full time school for at least one year. Coursework includes classes in synthesis, audio theory and technology, multitrack recording, and sound design. Graduates are employed in sound and rehearsal studios, radio and television stations, live sound venues, and operating home studios. The program is intended to transition learners into the industry, not as preparation for further study in electroacoustics or sound engineering. As audio recording is increasingly a computer-based environment, applicants should have basic digital literacy but do not need to have experience with sound software. Tuition is \$8,000 for a 630-hour program.

Post-secondary continuing education courses

Post-secondary, non-degree courses are usually targeted toward adults interested in professional development, certification, or preparing for application to a degree program. Often taught by practitioners, continuing education courses can be available in-person, online, and in short, intensive programs. In order to reflect emerging disciplines, areas of interest, and industry skill demands, universities and colleges are continuing to expand their continuing education offerings: these include digital and social media (e.g., Carleton University’s [Digital and Social Media Certificate](#) and Simon Fraser University’s [New Media Journalism Certificate](#)); data analytics and machine learning (e.g., McGill University’s [Professional Certificate in Data Science and Machine Learning](#) and Sheridan College’s [Predictive Analytics and Machine Learning course](#)); and other industry-relevant skills and tools (e.g., Dalhousie University’s [AUTOCAD Certificate Program](#) and the University of Toronto’s [coding bootcamp](#)).

DEVICES + INFRASTRUCTURE IN SCHOOLS

The deployment of digital systems and tools at the district, school/institution, or classroom level can include the use of learning management systems such as [Brightspace by D2L](#), [Blackboard Learn](#), or [Moodle](#); ebooks and online content; presentation tools such as interactive whiteboards; laptops, tablets, and smartphones; classroom-friendly programmable computers robots such as [micro:bits](#) or [Dot Robots](#); and assistive technology such as screen readers or closed captioning. Digital tools are used to varying degrees in classrooms depending on several factors: what hardware, software, and infrastructure (e.g., wifi) is made available; what policies are in place at the school, school board, or institution level; and, significantly, how knowledgeable and comfortable individual teachers are with incorporating them into lessons.²⁰ According to some interviewees, this can contribute to an approach that is uneven and siloed from classroom to classroom.

The question of how to equip instructors and students with the right devices to address teaching and learning needs is also increasing the need for different kinds of technical support. For example, loaner laptops or other digital tools supplied by schools give instructors and students access to basic software and to the internet but may not suffice if software needed for a lesson is not already installed; devices that are locked to a school domain can limit activity in the interest of security. Some school districts reported that they keep a supply of unlocked devices to enable teachers who want to try something “outside the box.”

At the K–12 level, we heard that some jurisdictions left the choice of software to the school board, with different school boards choosing to purchase Office 365 or Google Apps for Education. In Ontario, the [Ontario Software Acquisition Program Advisory Committee](#) (OSAPAC) advises the Ontario Ministry of Education on software license purchasing and distribution. At the post-secondary level, the execution and effectiveness of technology in the classroom can depend heavily on the instructor: some produce high-quality course videos for students to watch at home and coding algorithms to help with grading; others ban laptops entirely.

Park West Fibre Optic Co-op (Manitoba)

In Western Manitoba, the Park West School Division and the Hamiota, Yellowhead, and Prairie View municipalities have launched a non-profit internet co-operative, the [Park West Fibre Optic Co-op](#), to build a backbone fibre optic line that connects every school in the division, along with the towns of Russell, Birtle, Strathclair, and Inglis. Residents will see an improvement in internet speeds from the current state of 10–100 megabits per second to up to 1,000 megabits per second, with monthly subscriptions costing around \$60.²¹

“In all of our classrooms there are different learning styles that depend on the environment, the school and the teaching style. You might have a teacher saying ‘no cellphones’ in English class, and then a science teacher says ‘bring out your cellphones’. Every classroom is different which can be problematic for students. With such different classroom expectations it’s almost like as if students have whiplash, they don’t know whether to stand or sit. From an IT perspective, we try to keep as many things as open as possible. We offer open wifi for anyone who is allowed access (teachers, students and guests). [There is] wifi in all of our buildings for everyone.” —Clarke Hagan, Director of Information Systems, Louis Riel School Division

“The infrastructure isn’t necessarily built for the kinds of technologies that are being integrated. We’ve moved away from computers to Chromebooks, iPads, and tablets, which are very functional in a lot of ways ... We say we want [students] to learn to code but we’ve taken away the device they need to code.” —Dr. Julie Mueller, Associate Professor and Director, Teach Digital Lab, Wilfrid Laurier University

“Collaborative classes ... they’re not about digital technology. They’re about 21st-Century skills, communication, and production. [Students] end up needing to use a lot of productivity and prototyping tools, like [Slack](#), [InVision](#), [Proto.io](#), and tools that determine the best meeting times across time zones.” —Dr. Richard Lachman, Director of Zone Learning, Ryerson University

“My algorithm looks at a student’s Tweets, hashtags, how they composed it, and if there’s media attached. When I mark it, they receive their mark through a direct message. I have certain tools that summarize a post, so that I can mark 120 assignments a week. I used to have TAs but now I don’t, so my bot is a TA. If I like or share something by a student, they know that the bot will track it, which has a direct impact on their mark.” —Ahmed Sagarwala, Manager of Industry Relations, Master of Digital Media, Ryerson University

Cisco Connected North

[Connected North](#), a program founded by Cisco in 2013 and managed by [TakingItGlobal](#), uses two-way video collaboration technology to deliver digital programming focused on education and mental wellness to remote and underserved Indigenous communities in Canada. The program provides the technology and infrastructure to enable telepresence units in selected schools, which involves working with partners and sponsors to provide or upgrade broadband connections, hardware and software, as well as curriculum and content. In its 27 telepresence-enabled sites, Connected North offers programming that includes:

- + Interactive live sessions with subject matter experts and educational institutions such as museums, galleries, and science centres;
- + “Connected Classroom” live video sessions with classrooms across Canada;
- + Mentorship opportunities for students; and
- + Virtual delivery of preventative mental health and wellness services, such as consultations with healthcare specialists from SickKids Hospital in Toronto.²²

An evaluation of the Connected North pilot by York University found that 80 percent of students found telepresence engagement interesting, 89 percent found science more enjoyable after participating in the program, and 81 percent thought they learned more than they would in a typical classroom setting.

STAGE UNLOCKED: THE INFORMAL EDUCATION SYSTEM



Canada's informal education system—including for-profit bootcamps, non-profit organizations, part-time courses and workshops, mentorship programs, and grassroots communities—plays a vital role in delivering programming adapted to technological developments and trends, testing learning models and formats, creating programming for new industries and technologies, reaching people who are underserved by formal programs, and adapting for community-specific content and delivery. Third-party organizations are often heralded as more agile than their counterparts in the traditional education system, offering shorter programs and iteratively adjusting curriculum from cohort to cohort and in response to changing industry demand and technology. In some cases, models developed by third parties are functioning as prototypes for approaches to training and curriculum design. Some are then adopted into the formal education system or achieve credential status as a path to scale and sustainability.

The number and reach of these programs has grown in the last decade, supported by major government funding commitments, widespread interest, and the growth of the for-profit marketplace. However, the landscape remains fragmented and access is uneven depending on factors such as income, availability, and geography. To date, evaluation has mainly focused on outputs (e.g., graduation rates) rather than outcomes (e.g., skill attainment), impeding robust evaluation of curriculum and program models.



FULL-TIME INTENSIVE BOOTCAMP PROGRAMS

What is a bootcamp?

[Course Report](#), a bootcamp database and research agency, defines coding bootcamps as “intensive, accelerated learning programs that teach beginners digital skills like full-stack web development, data science, digital marketing, and UX/UI design.”²³

Course Report documented 1,043 full time bootcamp graduates in 2016 and an estimated 1,304 students in 2017 from seven major for-profit bootcamps across the country ([BrainStation](#), [Bitmaker Labs](#), [Lighthouse Labs](#), [HackerYou](#), [RED Academy](#), [CodeCore](#), and [DecodeMTL](#)). Collectively, it estimates that the sector generated US\$13.6 million in revenue in 2016 in Canada, up from US\$8 million in 2014.²⁴ Though demonstrative of the sector's growth, these statistics miss some smaller bootcamp programs (e.g., Montreal's [Les Labs](#)), non-profit intensives (e.g., [NPower](#), the [CEE Centre for Young Black Professionals'](#) Digital Technology: Consumers to Creators program, etc.), and those run by university continuing education departments.

Bootcamps are filling a niche for intensive, industry-focused training that is intended to transition people without computer science

backgrounds into programmer, user experience, product designer, and other tech roles. Full-time bootcamp programs usually range from 8–12 weeks in length, although RED Academy offers a 24-week intensive program while some are as short as four weeks. Programs can cost up to \$14,000, and usually provide career counselling and support services to help graduates find full-time employment upon completion of the program.²⁵ For example, Lighthouse Labs reports that in 2016, 96 percent of its web development bootcamp graduates accepted employment opportunities within 120 days of program completion.²⁶ The bootcamp sector is evolving to include not just programming, but design, digital media, and machine learning.

According to Course Report, as of 2017 only two provinces—British Columbia and Ontario—require bootcamps to register with provincial regulatory agencies.²⁷ In 2016, HackerYou and Lighthouse Labs became the first bootcamps in Ontario to register as [Private Career Colleges](#). British Columbia requires coding bootcamps to comply with standards set forth by the Private Training Institutions Branch. Within the province, Lighthouse Labs, BrainStation, CodeCore, and RED Academy are registered with the branch. Where regulatory standards are lacking, the quality of programs and trustworthiness of their credentials for employers may be in doubt and the risk for learners is higher, creating a greater need for transparent information on participant outcomes.

“The relevance of skills changes quickly. One interesting thing about bootcamps is that, in the beginning, they were all teaching Ruby on Rails—it was what was in demand at the time. Curriculum changes with market demand, usually very quickly because it’s not tied to the traditional curriculum development processes of formal education. At one point this shifted to JavaScript, and bootcamps are still changing their curriculum.” —Liz Eggleston, Co-Founder, Course Report

“The majority [of our participants] are career-switchers, on average let’s say 30 years old, people who have university degrees but sort of unrelated to engineering or computer science ... A lot of them are underemployed, or they’re working in restaurants, etc. Most of them have discovered coding on their own before coming here and realized they like it. We take them to the next level and help them get a job.” —Kevin Khoury, CEO, DecodeMTL

“Our professional development courses have had the largest impact on the Canadian economy. We’ve trained 50,000 professionals over the past five years. We’re approaching education and professional development differently—low student to teacher ratio, custom-built online learning portal and content management methods; industry leaders worldwide are contributing to and updating our content constantly to be delivered in real-time. In our full-time programs, 94 percent of our graduates are hired within 180 days, and 88 percent are getting hired in their field of study.” —Jason Field, Founder and CEO, BrainStation

“Our original decision was to create a coding school ... But as we started digging deeper and analyzing where the market gap was, we realized that the gap was more than just teaching one skill or tool. We wanted to start with something that was wider in reach. It’s not just about learning one thing, it’s about being comfortable with digital more broadly so that you can dive deeper.” —Marina Byezhanova, Co-Founder, Les Labs

Insight's Data Science and Artificial Intelligence Fellowship (Ontario)

Launching this year for the first time in Canada, [Insight](#) offers full-time seven-week fellowships for people seeking to transition into careers in data science and artificial intelligence. The program includes free tuition, needs-based financial aid, mentorship, industry connections and interviews, and hands-on projects, and offers a high post-program employment rate for graduates. Data science fellows need to have completed a PhD; artificial intelligence fellows can include academics, graduate students, and software developers without advanced post-secondary education.²⁸

COMMUNITY PROGRAMS

Community programs, including libraries, immigrant service organizations, seniors' organizations, and other social service programs are filling a distinct gap in the digital literacy landscape, providing accessible, low-cost or free, beginner and intermediate programming, as well as drop-in access to equipment and internet for practicing and self-study. Libraries and community organizations offer services that include troubleshooting, tutoring, providing support for completing digital life tasks (e.g., online job applications, banking, travel booking, online government services etc.), access to wifi and devices (including rentable routers and e-readers), and affordable or free training. Some library programs have significantly expanded to include makerspaces that provide training in and access to equipment such as 3D printers, sound and video recording (including instruments and green rooms), virtual reality, digital converters (e.g., VHS to DVD), gaming consoles, programming toys (e.g., Raspberry Pi), and robotics. They offer programming to groups that might otherwise be underserved, creating accessible opportunities for local communities including seniors, youth facing employment barriers, newcomers, and others.

New federal funding through the [Digital Literacy Exchange Program](#) is seeking to further support the sector, offering \$29.5 million over five years for non-profit organizations delivering tuition-free digital literacy training initiatives to groups that are underrepresented in the digital economy.

"We offer a wide range of courses from how to press the power button and 'What is the mouse thing?,' up to Excel, pivot tables, and creating your own websites. We have a range and variety of clients coming in—more seniors, newcomers—heavily run by our private instruction backbone which offers personalized attention that can't be accommodated in courses ... As offices restructure and admin support is gone, people are having to learn Excel sheets and Word documents later on in their careers. The shift from Windows 8 to 10 was a huge shift for casual users of desktop computers." —Kelley Rojas, Computer Course Coordinator, Atwater Library and Computer Centre

"The people who need libraries need the services that libraries offer. They find out through word-of-mouth, community services. We do outreach, a lot of pop up libraries, things to let people know that we're there. We do get referrals—at one point a local Rogers outlet was pointing people to libraries to get started with their new phones. I used to work in the Reference Services department, and the police would direct people to the library to get a pardon kit, both to access technology and also to get assistance working through the process." —Kelli Wooshue, Manager, eServices, Halifax Public Libraries

[On makerspaces in libraries] "Libraries have embraced this digital world and they're doing amazing with little funding. I don't know how they're doing it. Libraries are reskilling—in many ways a Masters of Library Science is an IT degree, it's information science. So their grads are quite savvy, unlike education graduates. They've embraced co-design, user-focus, what patrons and communities need." —Dr. Richard Lachman, Director of Zone Learning, Ryerson University.

Halifax CAP and the Community Technology Network of Nova Scotia (CTNet NS)

Community Access Programs (CAPs) were established in 1995 as a federal initiative to provide people living in Canada “with affordable access to the internet and the skills they need to use it effectively.”²⁹ CAP sites were situated in public libraries, community centres, friendship centres, and schools, and were supported by provincial and territorial governments and non-profit agencies.

When the federal CAP program was terminated in April 2012, it continued to operate in Nova Scotia with provincial support as the Nova Scotia Community Access Program (NSCAP)³⁰ and with the support of internships funded through federal youth employment programs. In January 2017, NSCAP underwent a rebrand that led to the creation of CTNet NS in partnership with the Réseau des Technologies Communautaire de la Nouvelle Écosse.³¹

Halifax CAP runs digital literacy training under the CTNet NS umbrella, delivering both group sessions and personalized one-on-one instruction based on demand and available expertise. It also allows learners to access technology, including wifi, computers, and 3D printers. CAP sites aim to meet the needs of participants who otherwise would not have access to technology or the training to use it. Advanced skills development opportunities and training in topics including web design, robotics, and cybersecurity are also available.

“So much of the world is dictated by technology that being able to understand it in the same way we understand why condensation appears on your windows is important. We want students to walk through the world understanding how things work.” —Melissa Sariffodeen, Co-Founder and CEO, Canada Learning Code

“For students who are very keen, they’re taking the Coding Quest resources and program home and going to the next steps, such as going from Scratch to CSS to Python. Because Coding Quest has online resources operating through Moodle, this allows TLP to add and modify resources and modules as we go. Students do start going down a different path and exploring what’s out there—students in coding and robotics starting to consider careers in engineering that they didn’t think about before. I have seen these opportunities and experiences change a child’s perspective in life.” —Soriana Mantini, National Program Manager, The Learning Partnership

“Leveraging our extensive network of Clubs in diverse communities across Canada, we are an organization that offers a different mode of intervention—one that is rooted in a strength-based and holistic approach to working with children and which prioritizes strong relationships and safe environments in which participants can learn through solving problems and through making mistakes and then trying again. This is crucial to research, experimentation and innovation.” —Denise Silverstone, Director, National Programs and Services, Boys and Girls Clubs of Canada

National Non-profit Programs

Non-profit programs have been expanding significantly in recent years, supported by an influx of federal money, and are playing a vital role in creating programming and curriculum that reaches underrepresented groups, supporting formal education institutions, and expanding access outside of major urban centres. In the next section, we've highlighted some major national programs changing the landscape of digital literacy in Canada and driving curriculum and pedagogy forward with innovative approaches.

Let's Talk Science

[Let's Talk Science](#) (LTS) is a national charitable organization focused on education and outreach to support youth development. LTS develops and delivers learning programs and services that engage children as young as three years old and youth up to Grade 12, with educators in STEM, to support learning and skill development. LTS also provides curriculum-aligned, classroom-ready STEM teaching resources in English and French for teachers through their website. It offers programming that engages students through formats such as in-class activities, mentorship, and hands-on projects. For example, in partnership with the [Canadian Space Agency](#), the [Optimal Environmental Conditions for Life Action Project](#) (launching Fall 2018) will invite teachers and students to collect, explore, and code data from Québec astronaut David Saint-Jacques' six-month mission aboard the International Space Station.

Kids Code Jeunesse

[Kids Code Jeunesse](#) (KCJ) is a non-profit organization founded in 2013 and dedicated to empowering children aged 5–12 and their educators—including teachers, parents, and community leaders—with the skills needed to thrive in a technology-driven society. KCJ works with Ministries of Education, Ministries of Innovation, cities, and school boards to deliver programs including in-classroom workshops, teacher training, customized development, and volunteer-led Code Clubs. Through hands-

on computing and coding education, Kids Code Jeunesse aims to empower children and strengthen their skills in problem-solving, communication and collaboration, and creative thinking.

KCJ's works to help communities accelerate the integration of digital skills learning into children's education. By providing training to educators, developing easily accessible and approachable materials, integrating Code Clubs into libraries and community centres, and reaching rural and urban centres in both English and French, KCJ has introduced coding to over 30,000 children and 3,000 educators across Canada.

Canada Learning Code

[Canada Learning Code](#) (CLC) is a national charity championing digital literacy education and working to equip people living in Canada with technical skills. It is focused on both skills development and confidence-building with technology and digital tools. Founded as Ladies Learning Code in 2011, CLC has evolved to run programming for adults, youth, and educators through five programs: Ladies, Girls, Kids, Teens, and Teachers Learning Code. CLC runs programming regularly in chapters across 33 Canadian cities: it offers day-long and multi-day workshops, a seven-week program for adults, March Break and Summer Camps, and Code Mobile, a travelling computer lab on wheels. CLC delivers project-based, in-person programs with a 4:1 ratio of learners to mentors in every program. Program content ranges from basic digital skills to coding and robotics, including HTML/CSS, JavaScript, Ruby on Rails, Python, graphic design, and introductions to artificial intelligence and blockchain.

The Learning Partnership

[The Learning Partnership](#) (TLP) is a national charitable organization dedicated to supporting, promoting, and advancing publicly-funded education in Canada. Its work includes student programs, training educators and senior education officials, policy and knowledge mobilization, and collaborating with stakeholders across sectors. TLP's student programs strongly emphasize experiential learning and aim to support existing curricula. Many of its programs are made available to all publicly-funded schools across Canada. Programs include Coding Quest, which is based on provincial curriculum and designed for students in Grades 4–6 to create video games, culminating in a regional Arcade student project showcase, and Coding Trek, a program that engages students in Grades 1–3 to complete challenges using coding concepts, numeracy, language, social studies, and science.

Boys and Girls Clubs of Canada

[Boys and Girls Clubs of Canada](#) (BGCC) has been working with national digital education and coding programs through after-school programs since 2007. Leveraging an extensive network of Clubs in diverse communities across Canada, BGCC serves children ages 6–12 and youth ages 13–18.

BGCC's recently launched [Kid Tech Nation](#) program will be run in 20 Clubs across the country, focusing on teaching children aged 7–12 coding and digital literacy skills. Participants are encouraged to exercise their imaginative and artistic skills as they create animations, art, games, and music and develop computational thinking, coding, and communication skills in a fun, beginner-friendly, social, and collaborative environment. Throughout the sessions, participants also learn how many of these skills are used in various industries and careers so that they can see and understand the real-world applications of the concepts they are learning. BGCC also provides opportunities for mentoring and connecting with potential role models.

Actua

[Actua](#) is a national charity with a network of 35 university and college members that deliver coding and digital skills school workshops, summer camps, after-school programs, year-round clubs, and community outreach initiatives for youth in Grades K–12 in every Canadian province and territory. Actua and its network members currently engage over 250,000 youth in 500 communities nationwide, and specifically target girls and young women, First Nations, Inuit and Métis youth, youth living in rural remote and arctic communities, and youth facing other socioeconomic challenges.

Actua and its network members also provide training to teachers to support the integration of coding and digital skill development that meets provincial curriculum requirements. Programs engage youth in developing digital literacy and skills, while also providing opportunities to apply them in relevant problem-solving scenarios. A broad range of technologies are explored, from app creation and robotics to fields such as artificial intelligence and big data. Programs are led by undergraduate students in STEM fields so that participants can meet role models and mentors in these fields. Student/teacher ratios are based on the age of participants and kept low to promote high engagement. Coding and digital skills programs such as [Codemakers](#) are supported by top companies in technology including Google, Microsoft, GE, Lockheed Martin, and Shopify.

PART-TIME CLASSES + WORKSHOPS

Outside of the formal education system, both private and non-profit organizations are offering part-time classes and workshops. In recent years, many bootcamps have expanded their offerings to shorter formats for learners who lack the resources, time, or interest to attend a full-time bootcamp program. Part-time classes and workshops include: for-profit programs (e.g., Les Labs’ training in JavaScript, Wordpress, HTML/CSS, PHP, social media analytics, SEO, YouTube, animation), or [Hatch’s](#) weekly coding classes, camps, and events for students aged 7–14); community makerspace programs (e.g., [STEAMLabs’s](#) part-time courses for kids, adults and teachers in video game programming, robotics, Minecraft, “imagineering,” and “inventioneering”), and art schools like the [Toronto School of Art](#) offering courses in Adobe Illustrator and Photoshop.

EMPLOYER-PROVIDED COURSES

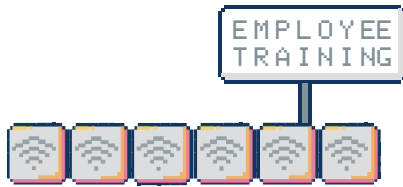
Among employers, there is often no explicit, systematic approach to digital literacy and skills training for their employees, even in the tech sector. We heard from interviewees that pathways for developing these skills are often taken at the individual level, playing out between employees and managers in professional development planning or on-the-job situational training. While most employees need a basic level of workforce digital literacy skills, more specialized training depends on the employee’s industry, their respective teams and responsibilities, and whether they are interested in developing more advanced digital skills.

At the level of basic workforce digital literacy skills, some large employers provide generalized in-house courses for their employees—such as courses on Microsoft Office Suite and other common programs—but many rely on the external ecosystem to provide training and ensure employees are up-to-date in modern software and technology applications. Some large technology companies

offer more formalized training programs, both for employee progression and for ensuring consistency in approaches, tools, and standards across the organization. And some non- and for-profit training programs qualify for the Canada Job Grant, which provides partial subsidies for course tuition for employers seeking to support their employees in retraining or upskilling.

While learners have traditionally acquired workplace skills through formal institutions such as universities, colleges, apprenticeships, and on-the-job training, the emergence of informal opportunities such as bootcamps and online learning programs have reduced barriers to learning. Interviewees pointed to the lowered cost of technology and the availability of online resources for self-study as providing learners with more opportunities for advanced training, skills development, and career switching.

“[There are] opportunities to use further skills and develop on the job. [When hiring] you won’t find a unicorn with all the skill sets you want, but you might find 50 or 80 percent of what you want. Not many people have particular niche jobs in specific contexts. People with baseline skills can be trained, change their roles and change their skill sets, or change areas of an institution. It speaks to the fact that they can learn.” —Andrea Niles-Day, Director of Project Governance and Performance Measurement, RBC Capital Markets



“One of the things I noticed when I started at Shopify was that its three-day onboarding experience was head and shoulders above any other company. When a new developer joins, they need to learn the tools, practices, and technologies, and Shopify’s code base. It’s a lot to learn and requires time to absorb even for the most talented amongst us. There’s no substitute for hands-on practice at this stage. Shopify also has different development teams working with different technology stacks. My team, Computing Education, develops, maintains, and delivers courses and experiences to support Shopifolk for all areas. For example, mobile, web (front and back end), data engineering, data science, security, large-scale distributed computing, devops, augmented reality and virtual reality, and more.” —Andrea Ross, Senior Engineering Lead, Education, Shopify

“Training varies a lot depending on your background. If you are in an entry-level, level one job, you need to spend some time understanding the process ... [We run a] ‘Warm Up program’ that takes level one employees, and before putting them in production, they get a crash course to understand what technologies are used across our teams.” —Industry Interviewee

CODEX

The [CODEX](#) program is a group of initiatives led and funded by [Ubisoft Montreal](#) to support student engagement and retention, and contribute to the development of the next “techno-creative” generation in Quebec. The program’s objective is to use the video game medium as a source of motivation and a learning engine across all levels of education. Ubisoft is investing more than \$8 million over five years (2015–2020) to support 15 initiatives developed in collaboration with partners in the education sector. A key component of the program is the participation of Ubisoft Montreal employees, who work with participants as experts, mentors, and ambassadors. Programming takes various forms at different levels: workshops, homework help, and access to healthy food for primary school students; project-based learning opportunities and competitions at the high school and cégep level; and bursaries, competitions, and internships at the university level.

The CODEX program’s education partners include Kids Code Jeunesse, the [Breakfast Club of Canada](#), [Youth Fusion](#), [Academos](#), the [National Theatre School of Canada](#), [École de technologie supérieure](#), [École des arts numériques, de l’animation et du design](#), [Université du Québec à Chicoutimi](#), [Champlain College of Vermont](#) (Montréal campus), [Polytechnique Montréal](#), and a number of Quebec universities including [Concordia University](#), [Université de Montréal](#), and [McGill University](#).³²

GRASSROOTS PROGRAMS

Grassroots programs—including communities of practice, co-working spaces, networks, and mentorship programs—are more informally developed than other organizations offering digital literacy education and training, often created by and for practitioners and learners whose needs or interests may not be met by other models. They allow participants to explore common interests, develop digital skills within a community of practice, and provide access to networks of people in whom they can see their own experiences reflected. Many grassroots programs are created to fill gaps left by existing programs. They can also develop around an identified need for mutual support and mentorship to face challenges such as racism, misogyny, ableism, and other barriers to entry or progression in developing digital literacy or tech careers.

Co-working spaces and online platforms and collaboration tools such as [Slack](#) and [Meetup](#) have also led to the development of communities of practice where members can share their work and interests and build networks. Larger, volunteer-run communities such as [DesignX](#) in the Greater Toronto Area (a community bringing together people in various design disciplines) or civic tech meetups (communities of people interested in better understanding and finding solutions to civic challenges through technology and design) often hold regular in-person meetups, workshops, lectures, or hack nights for interested members to develop their skills, network, and share their expertise.

“Jennie co-founded a co-working space for game developers, [Gamma]. Looking back this is what helped everything happen. It was a gathering place—even when we weren’t running a program or workshop—a place where people could meet with each other and work on their projects, immediately founding the organization as a community and not a skill-based program. Our longstanding event is our monthly speaker social, but also having the space allowed us to give ad hoc support to people. Participants in the programs would start new projects after the end of it, and make a change in their career and decide to make games. They would come and work out of the space ... Gamma and DMG grew up together and DMG has influenced the broader games community because of that.” —Izzie Colpitts-Campbell, Programming Director, Dames Making Games

“Ottawa Civic Tech is a community of people interested in bringing together technology, design, social activism and other fields to contribute to the public good. We run a weekly meetup every Tuesday where people self-organize into different project teams ... Through the projects ... new members have learned about web scraping, data analysis, and other open data-related skills. Some members have used civic tech projects as a way of practicing and improving their technology skills, alongside courses in mobile app design at Algonquin for example. Guest speaker presentations have also been a useful way of connecting members to other opportunities to develop their skills, for example with [Ontario’s Student Pathways](#) app challenge last fall.” —Sean Boots, Co-Founder, Ottawa Civic Tech; Technical Advisor, Canadian Digital Service

MASSIVE OPEN ONLINE COURSES (MOOCS) + SELF-STUDY

A MOOC is an online model for delivering content to anyone who wants to take a course, with no limit on how many people can attend. In addition to course materials such as lectures, readings, and problem sets, many MOOCs provide interactive user forums to support community interactions among students.³³ Self-study can include pursuing MOOCs, accessing online tutorials and YouTube videos, and working on personal projects to learn and develop digital skills. Online learning resources are numerous and continue to increase, and many are available for free, or at a low cost. For learners who have the motivation, time, resources, and the baseline digital skills to navigate online learning environments, online self-study presents opportunities to develop digital skills and connect to peer learning communities online.

Some MOOCs are being offered by post-secondary institutions, for example the [University of Toronto's computer science series](#): two introductory programming courses and an advanced course in neural networks and machine learning taught by Professor Geoff Hinton, one of the world's leading researchers in machine learning and artificial intelligence. They are also being offered by for-profit companies (e.g., LinkedIn's [Lynda.com](#) platform, [Fireside Analytics'](#) data science curriculum, and [Google's learn-to-code Grasshopper App](#)) and non-profits (e.g., [Code.org's](#) online computer science curriculum for K–12 students, which aims to increase participation by women and underrepresented minorities).

“Students today are much better at teaching themselves things. In my collaborative class they learn to prototype a mobile app. In the same way that in the 18th century you’d know how an epic poem flows, [the students] know how mobile apps should flow, they can prototype and develop something to a high degree of professionalism. They can go on Lynda.com and if yesterday they didn’t know how to do something, today they can. A 17-year-old will say ‘It’s learnable, all things are learnable ... and I’m pretty good at it.’” —Dr. Richard Lachman, Director of Zone Learning, Ryerson University

PROGRAMS TARGETING UNDERREPRESENTED AND/OR MARGINALIZED COMMUNITIES

Across the country, targeted programming is tailored to groups that are underrepresented in the tech sector or that experience lower levels of digital literacy due to lack of access to training, lack of access to technology, or discrimination. The “leaky pipeline” for women in STEM is well-documented, but additional research gaps exist in understanding the barriers faced by people of colour, Indigenous people, people with disabilities, and other groups.

These programs share some characteristics: they are often non-profit, seeking to reduce upfront financial barriers through low or free tuition; they are taught by and for specific communities to ensure that participants see themselves reflected in the ‘experts’; and they include additional wraparound supports in the form of childcare, transit tokens, social service navigation, etc. Some include co-op placements, networking opportunities, and field trips to major tech companies and incubators, to help connect their graduates to the sector. Loaner laptops and software are common, and a few programs offer laptops for participants to keep after the courses finish to further their training and professional development.

For example, the CEE Centre for Young Black Professionals and [WoodGreen Community Services](#) offers Digital Technology: Consumers to Creators, a program that works with learners to obtain and keep employment in the tech sector. This includes wraparound support during training and after graduation: coaching; support with housing, justice, mental health and wellness; employment counselling; and black history and black education. Participants are referred from the City of Toronto's Employment and Social Services division and must be in receipt of social assistance. [Indigicade](#), a video game arts program, offered game design and development training for Indigenous women, Two Spirit, trans and cis women, genderqueer, gender variant, and nonbinary individuals aged 13–24. It was run through a partnership between the Indigenous Routes Collective and Dames Making Games. Along with technical training and collaboration opportunities with mentors, participants were provided with meals, laptops to borrow, and artist fees for those who exhibited their work at the end of the session. Other organizations offering targeted programming to underrepresented groups include the [First Nations Technology Council](#), [Dames Making Games](#), [Pixelles](#), [Black Boys Code](#), [NPower](#), [NextBillion.org](#), and [Chic Geek](#). However, these programs are usually small scale, have limited openings, and many only operate in large urban centres. Without substantial additional funding or changes to how mainstream programs operate and market themselves, ensuring diversity in the tech sector and widespread digital literacy in Canada will remain a challenge.

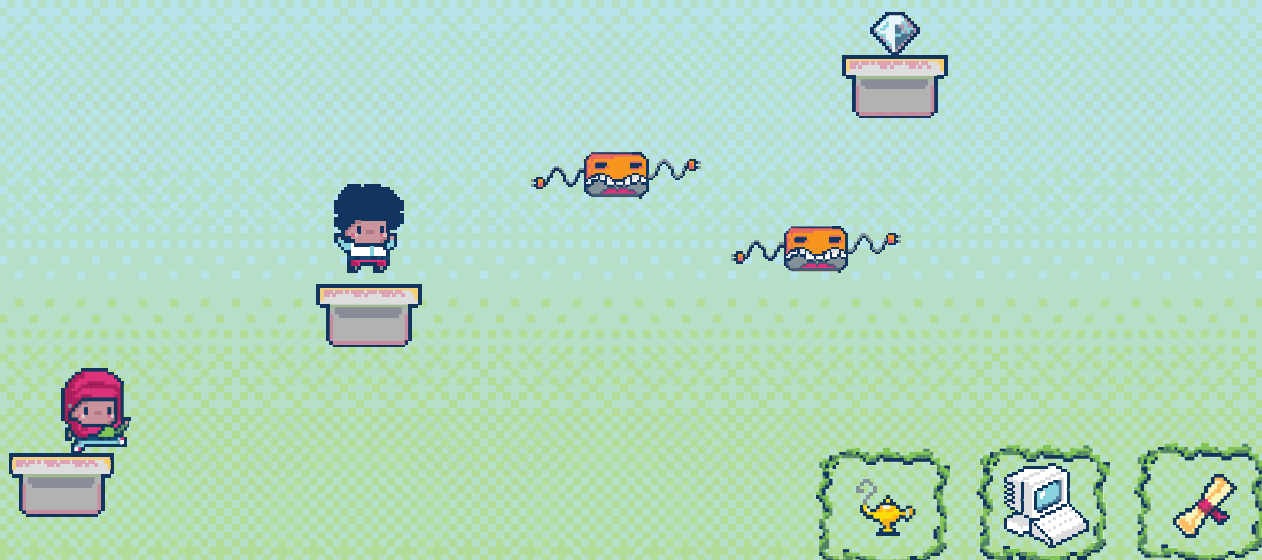
“We want to take away that kind of worry, the things that would hold them back, and let them focus on what they have. We provide the support system that provides things that people who normally aren't at-risk would have. The basics are taken care of, so the students can focus on their work.” —Richard Barrett, Executive Director, TXDL (Techsdale)

“We're taking digital literacy from something that is needed to fit job descriptions to something that supports our understanding of nationhood and reconciliation, creating a more inclusive and equitable tech environment.” — First Nations Technology Council

“For students with disabilities, there are challenges that apply to learning as a student and then there are barriers due to specific disabilities in the university context (e.g., differences in learning styles, challenges in accessing educational material and/or physical locations). There are question marks about applying to certain jobs, disclosing disabilities in the application process, and asking employers for accommodations in the tech industry. Universities are usually capped in terms of their workload to provide this level of personal support to every student with a specific disability.” —Naitik Mehta, Founder, NextBillion.org

“The question is: who gets the good jobs, who gets to take the risks to pursue these new and emerging areas of work that have massive payouts? We need a functioning social safety net so that people can take these risks. The jobs of the future are not always well mapped out. We know that disruptive technology could have a greater disruptive effect on low-income wage earners in the service economy. How do you foster entrepreneurial approaches to employment if you don't have a strong social safety net? How do you support yourself while you are taking the risks that get you ready to make those bold steps? When you are in receipt of social assistance you don't necessarily have the supports that you need to take those risk. You look for much more traditional pathways to employment.” —Policymaker

LADDERS, PIPES + PITFALLS



Different actors across the country are working hard to ensure that everyone in Canada has the digital literacy levels to comfortably use, create, and work alongside technology. However, Canada's vast geography and internet infrastructure gaps, unequal access to technology and training, and a fragmented education and training landscape pose challenges to universally raising digital literacy rates. In the section below, we explore the challenges facing individual learners, teachers, and organizations in developing and scaling successful programming and bridging Canada's digital divide.

BRIDGING CANADA'S DIGITAL DIVIDE

Canada's fragmented digital education and training landscape is contributing to digital divides, potentially widening the gap between those who are succeeding in an increasingly digital economy, and those who are being left behind. Throughout our interviews, it was reinforced that despite investments in training and education, expansion of broadband infrastructure, and computers in schools and community organizations, digital literacy remains uneven across Canada.

A 2013 Statistics Canada study using data from the [Programme for the International Assessment of Adult Competencies](#)' (PIAAC) Survey of Adult Skills found that people living in Canada were above the OECD³⁴ average in technology use and problem-solving skills, defined in this survey as "using digital technology, communications tools and networks to acquire and evaluate information, communicate with others and perform practical tasks."³⁵ However, 15 percent of people living in Canada performed below level 1, unable to use basic email software or a web browser. And there is significant in-country variation: Alberta had the highest share of people scoring high in problem-solving in technology-rich environments at 39.5 percent, compared to Nunavut at only 10.9 percent.

Across the board, we heard that there remains a vital role for government and public institutions in reducing the digital divide including developing and scaling curriculum and setting standards; supporting infrastructure for high-speed internet; equipping schools, libraries, and other community spaces with technology; and funding free or affordable training and employment programs for all ages and skill levels. Without deliberate policies and programs aimed at closing it, the gap between the digitally skilled and those with low digital literacy could widen.

“Digital exclusion and socioeconomic exclusion map pretty well over each other. The indicators of digitally excluded populations are not surprising ... These groups have much higher chance of being excluded generally, and digitally.” —Toby Harper-Merrett, Executive Director, Computers for Success Canada

“In February 2018, Actua released the results of a first-of-its-kind survey, [Coding the Future: What Canadian youth and their parents think about coding](#), which assessed the confidence and attitudes of Canadian kids and parents toward coding and jobs of the future. The results revealed a largely enthusiastic cohort of students and parents, but also a persistent gender gap, a socioeconomic divide, and a concerning lack of opportunity to learn to code inside and outside of Canadian schools.” —Tracy Ross, Director of Network Mentorship, Actua

CHALLENGES THAT INDIVIDUAL LEARNERS FACE

Some researchers, including interviewees quoted here, have noted that patterns of digital inequality and exclusion follow other patterns of disadvantage and are shaped by the intersectional impacts of factors such as language, age, gender, and income.³⁶ For people who live in urban centres with disposable income and high literacy levels, it is relatively easy to access and pay for training, whether to upskill in their professions or to transition into the technology sector. Outside of major cities and for those without disposal income, access to digital literacy training and education can be much more difficult.

Beyond the challenges faced by those who lack foundational literacy and numeracy, different parts of Canada’s population face a range of barriers: these include a lack of digital access (to internet, data, hardware, and software); a lack of access to education and training (due, for instance, to financial and geographic barriers, travel time to

programs, the need for childcare, etc.); not seeing themselves reflected in the field; intimidation and fear of failure (for both beginner and more advanced learners); and a lack of intermediate-level programs.

Digital access

Access to digital technology is “complicated, contingent and precarious” for “adults on the margins”.³⁷ A lack of consistent access to hardware, software, the internet, and cellular data was reported by a number of interviewees as a core barrier to developing and maintaining digital literacy. This lack of access is deeply intertwined with income/wealth, geography, and other socioeconomic factors including housing stability. Without consistent access, learners can fail to progress or falter in their digital progression and in building confidence using technology.

Though the [Canadian Radio-television and Telecommunications Commission](#) (CRTC) has declared broadband internet access a basic service,³⁸ as of 2016 it estimated that two million households across the country (roughly 18 percent) did not have access to download speeds of at least 50 megabits per second and upload speeds of 10 megabits per second. Infrastructure gaps in rural, remote, and Indigenous communities, along with financial access barriers among low-income people living in Canada across the country, are contributing to this challenge. According to a [2015 CRTC report](#), 59 percent of Canada’s lowest income households have home internet access compared to 98 percent of Canada’s highest income individuals. As internet technology improves, disparities are widening in some cases. According to the OECD, fewer than four percent of people living in Canada had high-speed fibre connections (up to 2 gigabits per second) in 2014, below the US at 8.8 percent and the OECD average at 16.5 percent. New providers such as Beanfield Metroconnect in Toronto are offering high-speed fibre connections directly into newer condo buildings—usually at a lower cost and with higher monthly data caps than their neighbours in houses and low-rise buildings.³⁹ To address disparities in internet access at home, some schools and school

boards are installing open wifi, which can have particular benefits for low-income students who are more likely to have cellphones than laptops and may lack a data plan.

Non-profit internet providers, such as [Chebucto Community Net](#) (Nova Scotia), [National Capital FreeNet](#) (Ottawa), and [Toronto Free-Net](#) are helping to provide low-income households with affordable internet access. For example, Chebucto Community Net is a non-profit, volunteer-based, membership-based online provider that has operated in Halifax since 1994. An individual membership costs \$125/year and includes 56K dial-up access, 10MB of file storage space, 2GB of mail storage, and voting membership in Chebucto's operations.⁴⁰ Nationally, Minister Navdeep Bains

“It is hard to talk about any kind of digital literacy framework or model without talking about access. You can think up in your head all the skills you need and put them into levels, but we’ve found in our research that people will have acquired different skills and knowledge along the way. Digital literacy does not lend itself to discrete levels. Context, time, opportunities for practice, access, as well as the design of the platforms people are using all matter. People may have excellent skills in finding information, but they can’t access things that they need. Digital skills don’t promise equity or inclusion. A more successful pedagogical approach is to begin with the problems and issues that people want to use the computer for and proceed from there. People’s digital literacy skills vary depending upon access and opportunities for practice... A lot of these models assume people have ubiquitous, constant access and that technologies are neutral.” —Dr. Suzanne Smythe, Assistant Professor, Faculty of Education, Simon Fraser University; Member of the Downtown Eastside Literacy Roundtable

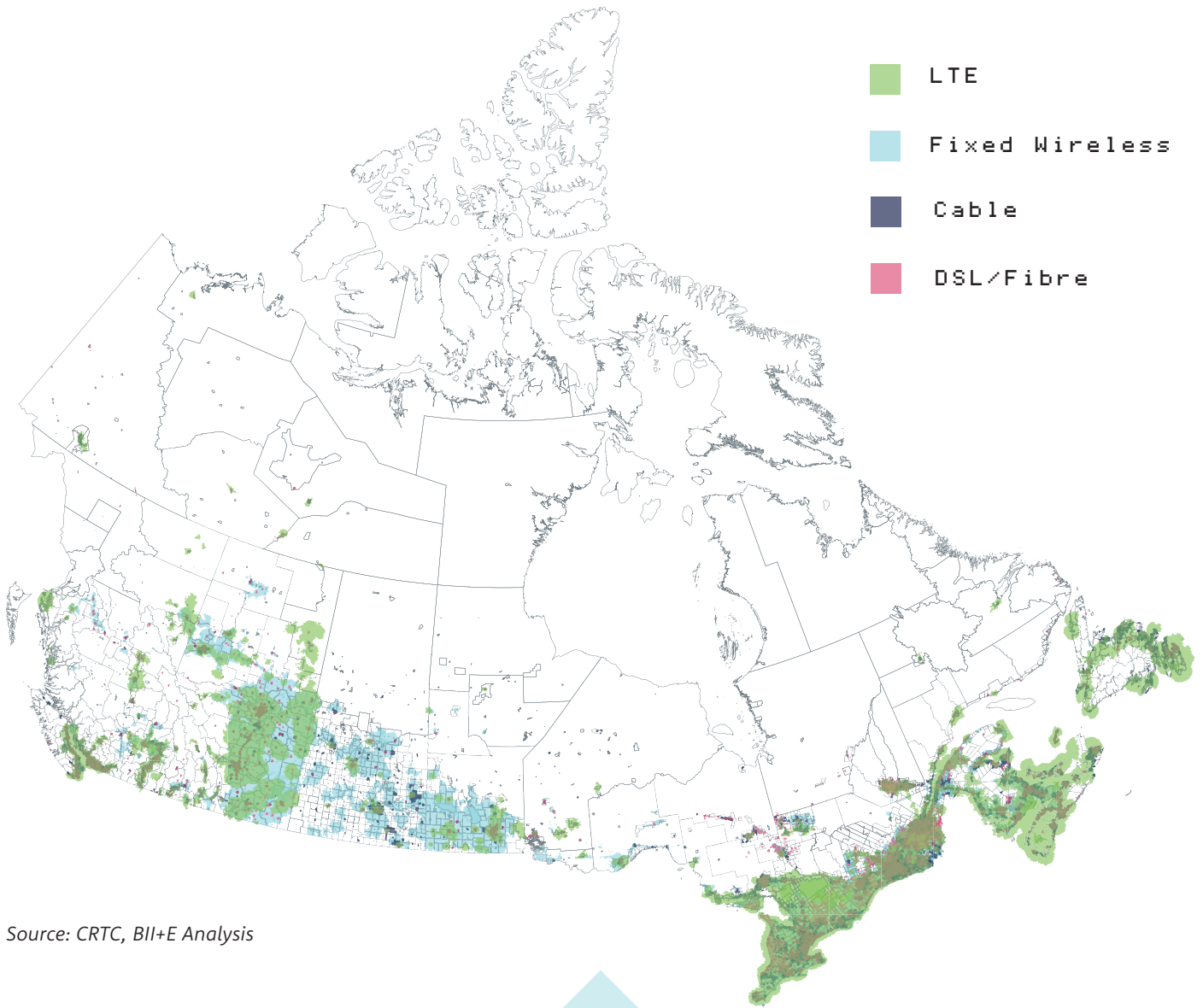
recently announced that many of Canada’s internet service providers have agreed to provide eligible families with at least 100 gigabytes of landline data service for \$10 per month, at target speeds of 10 megabits per second. An estimated 220,000 households across Canada will be eligible for the [Connecting Families initiative](#).

Several interviewees cautioned that providing access to internet or digital devices alone does not improve digital inequalities. Wifi in schools needs to be coupled with laptops to ensure students who cannot supply their own devices are not left behind. Offering equipment during courses does not address the hardware gap for low-income learners once they graduate. Even where internet and equipment access is present, without additional training and support, not everyone is equipped with the literacy and numeracy, English fluency, confidence, or navigation skills to self-teach. For people with disabilities, devices, websites and teaching tools may not be fully accessible.

The map on the following page shows the availability of broadband internet service that is at or above the CRTC’s universal target speeds for internet access in Canada (five megabits per second download and one megabit per second upload).⁴¹ While work is being done to expand internet service, the largest remaining gaps in coverage and high-speed availability tend to be in remote, rural, and Indigenous communities. While this seems to affect the North more than other regions of Canada, large gaps in coverage are also present in provinces such as Prince Edward Island and Newfoundland and Labrador.⁴²



Mapping Broadband Internet Service Coverage in Canada



Source: CRTC, BII+E Analysis

Types of internet service reflected on this map

Fibre: A technology that delivers connection to the internet via fibre-optic cables. Fibre offers the fastest speeds but is currently the least available as fibre-optic networks are expensive to build.

Digital subscriber line (DSL): A data communications technology that provides data transmission through telephone lines (although unlike dial-up, it does not require users to connect each time they want to use the internet). Internet speeds through DSL are slower for users who are located further from internet service provider offices.

Cable: A communications technology that provides data transmission via copper coaxial cable. Internet speeds provided through cable are not substantially affected by distance from internet service provider offices.

Fixed wireless: A wireless network that uses mobile network technology to provide communications services (voice and/or data), where the service is intended to be used in a fixed location.⁴³

“Not every child comes to school with the same personal or technology experience. Not everyone has equal access to early math or literacy, and certainly our children do not have equal access to technology... I’m deeply concerned about the disparity that we are continuing to perpetuate in society if all Canadians do not have equal access to deep, meaningful learning, early learning experiences, and, of course, to technology.”

—Dr. Gina Cherkowski, Founder and CEO,
STEM Learning Lab

“If you are lacking a computer in the household you are lacking the ability to do school work, apply for jobs... access to basic services via the internet, access to completion of education, employment, and entrepreneurship opportunities... To have a complete digital learning experience, you need three parts: computers, competencies, and connectivity.”

—Toby Harper-Merrett, Executive Director,
Computers for Success Canada

“One of the current gaps that we have now that we can partially fill is hardware. A lot of students don’t have a computer or a computer that can support the software needed for the training. [Our] Complete to Keep program is working to provide funds so that students have access to quality hardware. What happens after you complete three months of training and you go home and you don’t have hardware? You can’t continue to develop or apply your skills or learn.” —First Nations Technology Council

2017 Federal Budget Commitments on Access to Technology

Developing Assistive Technology: \$22.3 million over five years to establish the new Accessible Technology Development program, co-funding innovative projects with private sector firms, non-profit organizations, and research institutes to develop new assistive technology devices that will make it easier for people with disabilities living in Canada to more fully participate in the digital economy. These technologies include screen readers and alternative keyboards.

Affordable Access Program: \$13.2 million over five years to help internet service providers offer low-cost home internet packages to low-income families, and a target of 50,000 refurbished computers through the existing Computers for Success Canada program.

Access to education + training

Despite significant government investments in digital literacy and coding, alongside a growth in program offerings, interviewees reported that access to education and training remains a barrier, particularly outside of major urban centres and for learners with low income levels. A number of interviewees called for increasing access to in-person programs within a reasonable commute, providing high-speed internet to enable access to online programs and video streaming, and enhancing financial aid to cover tuition and course fees. Some interviewees noted that students were travelling hours to their program location, even for evening classes, and that low-income adult learners are cobbling together training from drop-ins at the library and social service centres, which are often volunteer-taught and equipped with older desktop computers. Learners with disabilities can be faced with a lack of closed-captioning in online training and in classrooms, physically inaccessible educational spaces, and other barriers.

Across the country, programs are seeking to improve access by providing wraparound or complementary supports. Dames Making Games, located in downtown Toronto, offers transit tokens, childcare, and food if the program goes over the dinner hour to facilitate access to those living further away. Others are meeting learners where they live. Canada Learning Code's Code Mobile program is expanding to a permanent fleet of 13 vans, operating year-round across the country. The program will bring free beginner and customizable coding education programs to youth and educators in most provinces and territories (including bilingual programming in Quebec, New Brunswick, and Prince Edward Island) and provide all equipment needed for both live coding and unplugged activities. Many online programs, including for-fee programs such as [Lynda.com](#) and [Udacity](#), free programs such as [Code.org](#), and apps such as [Grasshopper](#) by Google offer asynchronous programming (i.e., accessible at any time of day, not just during set class hours) allowing learners to access curriculum around their work schedules and across time zones.

For some prospective learners, returning to a structured educational environment poses its own challenges. Some non-profit programs noted that their participants struggled in full-time programs and in maintaining structured time for study between classes. They emphasized the need for flexible program designs that engage learners with different learning styles, capabilities, and schedules. Mid-career workers who are at risk of job displacement or seeing the relevance of their skills decline as the labour market shifts, are likely to be under increasing pressure to upgrade their skills to work alongside technology or in digital environments. In this context, some are seeking learning opportunities that allow them to continue working while learning, and that fit with family responsibilities and other commitments.⁴⁴

"It's important to look closely at the communities you're working in. With digital skills, you can't come up with a one fits all toolkit; it has to be adaptable. I work with marginalized people in the Downtown Eastside; they don't go into institutions or organizations but they still need the skills so our approach to that and how we do it is different from our work with a group of refugees in a training program somewhere ... It has to be community-based and geared towards the communities you are working with. 'One size fits all' doesn't work, particularly with digital literacy." —Dionne Pelan, Coordinator, Computer and Drop-In Programs, University of British Columbia

"We need to decentralize the digital knowledge that is getting built up in big cities. It will create an even wider gap with small cities that don't have the density to support technology-first businesses that are driving the tech economy." — Jason Field, Founder and CEO, BrainStation

"[There is] a general digital divide that most people can understand (e.g., people who have computers and internet at home and people that don't). Lowest income: 65 percent of households are online. Middle income: 84 percent are online. You can address that gap by getting people online. But the reason that people aren't online isn't always about affordability, it's also about knowledge, competency, and infrastructure issues in which rural and remote communities are more excluded." —Toby Harper-Merrett, Executive Director, Computers for Success Canada

2017 Federal Funding Commitments for Access to Training

The [2017 federal budget](#) announced several major funding commitments for digital literacy education and training:

[CanCode](#): \$50 million over two years to support initiatives providing educational opportunities for coding and digital skills development in K–12.

[Digital Literacy Exchange](#): \$29.5 million over five years to support non-profit organizations implementing initiatives that teach basic digital skills to vulnerable groups such as low-income individuals and families, and seniors.

[PromoScience](#): \$10.8 million over five years to support STEM learning for youth who are underrepresented in these fields.

Seeing yourself reflected in the field

A number of interviewees reported that, for visible minorities, women, and other underrepresented groups in tech, not seeing themselves reflected in the sector can pose both psychological and practical barriers. These barriers range from difficulty finding mentors who understand their experiences and needs, to facing discrimination in the classroom, on the job market, and in the workplace.

According to [findings from ICTC](#), participation of women in ICT professions has averaged about 25 percent for more than ten years, with a 3 to 1 ratio of men to women employed in ICT positions. Indigenous people are also underrepresented in the ICT sector in Canada, with only 0.2 percent of ICT roles being held by Indigenous people from 2007–2014, increasing slightly to 0.3 percent in 2015.⁴⁵

We heard from programs across Canada that are working to improve diversity in the tech sector, through training and mentorship programs taught

by and for certain identities and demographics (e.g., Centre for Young Black Professionals, Dames Making Games, Ladies/Girls Learning Code, NextBillion, Pixelles, TXDL (Techsdale), and The Chic Geek) and conferences and networking venues such as [Shopify’s Beyond the Code](#) and [Venture Out](#).

“It’s a psychological barrier; not having role models in the industry that look like you, not having a black Bill Gates. It’s one of those things where once you get your hands on it and you know what it can do, you feel invincible, you feel emboldened ... We’re like unicorns in that when you look around the room, not everyone looks like us. We’re trying to show that it’s a matter of exposure, not a matter of aptitude. Once these youth have the exposure to tech and to training, they find out they have the aptitude for it and they can pursue careers in the industry.” — Richard Barrett, Executive Director, TXDL (Techsdale)

“[There are] barriers to convincing people to teach workshops, especially when you want traditionally marginalized people to learn from traditionally marginalized instructors, in particular getting people to teach more intermediate and advanced courses.”

—Izzie Colpitts-Campbell, Programming Director, Dames Making Games

“We want to find a strong network of trainers who are ideally Indigenous, or people who have worked with communities and are invested in the outcomes of this project, to create digital skills learning programs and support students. How do we create a strong, supportive learning environment? As we work with industry partners to create internships for students and look for diverse companies, how do we make sure that this is a safe, supportive, and diverse environment for Indigenous innovators?”

—First Nations Technology Council

“People in lower income brackets [tend to face the most barriers] ... They’re usually in environments where there is no computer or communities, where there is no mentor or champion present. It is so much harder to understand what engineering is, to think it’s something that’s possible for you. We found that there was real excitement of students in these areas to talk to a real engineer and have that mentorship. Certain groups are discouraged because there aren’t a lot of mentors that look like you. [We see it as building a] pipeline versus a leaky pipeline—we want to not only encouraging girls to be engineers—we want to make sure we help girls to become engineers.” — Deborah Raji, Founder, Project Include

“With the 40-something person looking for a new job after a change in their organization or the 95-year-old grandmother who just got an iPad from her child, I see them coming in and they’ll be afraid to touch the buttons, they’ll say ‘I haven’t even taken it out of the box, I’ll break it and it will be horrible, I need to know exactly what to do.’ [We need to] erase that fear, that hesitation to just try something, make mistakes, and learn something.” —Kelley Rojas, Computer Course Coordinator, Atwater Library

“All of us are women in tech. Every career we work in is going to become integrated in technology and for some reason that’s not clicking yet. Women aren’t realizing that they are already working in tech and that they’ll need to update their technology skills to stay relevant in their careers. There’s a fear of making mistakes and not being perfect at it the first time, and this can make technology intimidating.” —Kylie Woods, Founder and Executive Director, Chic Geek

“You have members who are interested in digital tech and they’ve always wanted to do it, but are worried they don’t have enough technical experience to actually do the work.” —Horace Spence, Program Facilitator, CEE Centre for Young Black Professionals

Intimidation/Fear of failure

A number of interviewees talked about how intimidating learning digital literacy can be—even more so for those who, as described above, do not have regular digital access, cannot afford to pay for advanced or personalized training, or do not see themselves reflected in the sector. Program leads described beginner students who were afraid they would break the hardware if they did not use it properly or who got easily frustrated if they did not get it right. For low-income individuals using computers to apply for jobs and social services, “not getting it right” can have far-reaching consequences.⁴⁶ Some interviewees called for digital literacy curriculum across the board in elementary schools, to get learners comfortable early and ensure broader access to future career pipelines and training.

Lack of intermediate-level programs

Some interviewees noted that there is a lack of programming that bridges the gap between introductory programs for adults with low levels of digital literacy and more intensive advanced training. Organizations working with individuals who face barriers in the labour market or are returning to school noted that many of their participants are not ready for full-time intensive bootcamps, but they are comfortable operating computers and using software and want to move

from being digital consumers to producers. Others noted a lack of intermediate programming for people who want to develop digital skills within professions that fall outside the traditional ICT sector. Demand for intermediate-level programs is likely to grow as more people who are not formally educated or employed in digitally-intensive fields seek to transition from consumers to producers, from baseline to workforce, or to develop their professional digital skills.

“There’s this gap between intro classes that will teach you what a variable is and what Python is and [more advanced, professional classes] ... they’re like, ‘Great, we’ve taught a woman to code, go home now.’” —Izzie Colpitts-Campbell, Programming Director, Dames Making Games

“[There are] not a lot of people on our caseload who are ready for bootcamps. So what’s the in-between step [to] develop their levels of literacy and aptitude for IT work? What’s the transition piece between career exploration and discovery and bootcamps? We need high-quality training and education that exists somewhere between self-study and bootcamps. Bootcamps can be daunting for somebody because that’s a major time and financial commitment.” —Jennifer Posthumus, Manager, Employment and Social Services, City of Toronto

CHALLENGES THAT TEACHERS + ORGANIZATIONS FACE

In interviews with K–12 teachers, school boards, professors teaching digital content, academics researching education, and external organizations offering curriculum and professional development programs for teachers, we heard that the quality and approach to teaching digital literacy and incorporating digital technology into curriculum varies significantly between classrooms. Despite forward-thinking provincial policies and new curriculum and pedagogical approaches, some teachers and organizations are struggling with

implementation. The challenges they face include: fear of failure; insufficient professional development opportunities for teachers, particularly in the formal education system; the need to iteratively update curriculum; and difficulty securing sustainable funding.

Intimidation/Fear of failure

Just as learners can face intimidation and a fear of failure in improving their digital literacy and interfacing with technology, some K–12 and post-secondary teachers face the same fears, struggling to simultaneously learn new technology and integrate it effectively into the classroom. Some interviewees noted that teachers felt that they had to master a skill before they could teach it, rather than learning alongside their students and incorporating trial and error into the learning approach, and that teachers with lower levels of digital literacy themselves were struggling to adopt it in the classroom.

“A lot of teachers are fearful of some aspects of digital literacy and coding because they don’t know anything about it and they are uncomfortable in bringing it to students to learn with them. This presents an opportunity for teachers to try something new. Support for educators to have their own transformation is one way to move from pockets of innovation to a global transformation.” —Non-Profit Program Lead

“Often teachers are uncomfortable with the content. There are similar issues with math education. Often teachers feel really uncomfortable with math [and] that their content knowledge is lacking. If you integrate coding with math they start to see it and think about it differently. It helps build confidence with math as well as coding. They have a lot of ‘aha’ moments.” —Lisa Floyd, Director of Research and Inquiry, Fair Chance Learning

“We focus on mastery; a lot of teachers internalize it and feel like they have to master it before they can share something with their class. It takes a very brave teacher to say, ‘It’s ok for the children to know I don’t know everything’ and to allow that freedom in the class ... That’s what we’re trying to get across to our teachers as well: you can’t master everything, you can try, but don’t let that stop you from bringing in technology because every day there is a new thing.” —Clarke Hagan, Director of Information Systems, Louis Riel School Board

Professional development for teachers

The [Social Sciences and Humanities Research Council’s](#) (SSHRC) “Leveraging Knowledge for 21st-Century Teaching and Learning” initiative concluded that professional development for teachers was critical to building technological capacity and competencies.⁴⁷ We heard from teachers, school boards, and other actors in the system that there was a need to revamp pre-service teacher education, offer more practicum opportunities for teachers with computer science as a teachable, and provide better support for teachers throughout their professional development, both to teach them the technology and to teach them how to teach technology. Beyond technological mastery, teachers need to understand new ways of teaching digital skills, as well as issues raised by learning and working in digital environments, such as online collaboration, data privacy, and algorithmic bias, across subject areas.⁴⁸ At the post-secondary, interviewees noted that many institutions require instructors to have graduate degrees and are not yet recognizing other professional credentials or experiential learning in the field, imposing barriers for digital professionals who want to teach at this level.

Professional development programs, offered by teachers’ associations and external organizations, are seeking to improve teachers’ capacity to

understand, apply, and teach digital skills. In the informal education sector, representatives of many programs, particularly for-fee programs, said they looked for technology experts first, and pedagogical experts second; they prioritized seeking enthusiastic, patient practitioners working in the field who could inspire learners and be trained in curriculum development and instruction.

“Teachers are coming into the system from the Faculty of Education and they may not have the pedagogy of how to infuse ICT into their teaching. We work with the Faculties of Education to encourage that, but it comes down to the Faculty to decide how they will fulfill their mandate.” —Director, Provincial Education Ministry

“Computer science is a teachable but there are not enough course offerings for teachers to find work. Even if someone has enough computer science classes to teach it, there’s not enough opportunities for people to get qualified.” —Lisa Floyd, Director of Research and Inquiry, Fair Chance Learning

“Teacher preparedness is critical to make this work. Once they see the pedagogical purpose of the technology, even the most seasoned teachers, the ‘digital immigrants,’ begin to see the value of it. ... Early on, [teachers] have to build technological resiliency and free themselves up to get students’ help to resolve them. Rather than struggling with the technical issue, it becomes an opportunity to learn with their students.” —Policymaker, Ministry of Education

“A lot of faculty members didn’t grow up with it, so there’s a lot of views of this kind of thing as flash in the pan. The ones who really embrace it are trying things, making videos with high production value, and that’s what’s needed, but there’s very few professors who have the skill or vision to do it because they’re not trained to do that.” —Dr. Richard Lachman, Director of Zone Learning, Ryerson University

Iteratively updating curriculum

Interviewees from both the formal and informal education systems talked about the need to iteratively update curriculum, adapting to new and updated programming languages; software, devices, and digital interfaces; social media platforms and digital social norms; and fields of practice and applications. Many interviewees leading informal educational programs saw formal institutions as too slow to adapt. While we heard from innovative educators at both the K–12 and post-secondary level about initiatives to build new digital curriculum, they pointed to challenges to scaling these approaches effectively across institutions, school boards, or at the provincial/territorial level, particularly in ways that would maintain agility.

“Technology always changes, and unlike some faculties where they have their tried-and-true curriculum they can reuse every year, we don’t have that luxury. It’s always about being on top of technology. I’m a graduate of the program I now coordinate and one thing that hasn’t changed much is designing for the user, ensuring there is a sound interface, interface design, but the technology, the platforms have certainly evolved.” —Andrew Hladkyj, Coordinator, Web Design Program, Sheridan College

“Our educational model began as more of a concept, ‘agile learning,’ which we rolled out as a minimum viable product. We didn’t build a campus first; we took an approach similar to a software company, starting with two-hour events and workshops to validate our content and methods within the Toronto community. Technology evolves so quickly, I don’t know exactly what we’ll be teaching in five years, but I can guarantee that because of our ‘agile learning’ approach, BrainStation’s students will be at the forefront of their industries.” —Jason Field, Founder and CEO, BrainStation

Funding

For some people living in Canada, their only access to digital technology and training is through public support for infrastructure and training. A number of interviewees called for additional government support to ensure equal access to digital skills training across the country, including in rural and remote communities, in both official languages, and at all skill levels.

Many programs that depend on government grants and offer reduced or free tuition to learners reported that they struggled to fit what their students needed into existing funding structures, often tweaking programming year-to-year in order to meet funder expectations for new or innovative programs—in one case even setting themselves up as a SSHRC-funded action research site in part to ensure multi-year support. Some noted that short-term funding horizons pose challenges to developing long-term, stable programs and that there is a lack of funds to offer sufficient wraparound and support programs including hardware and software, transportation, and childcare. A few non-profit programs reported that learners who would have qualified for government funding (e.g., refugees seeking retraining and upskilling or employment insurance and welfare recipients) were having difficulty accessing it and turned to the programs themselves for financial aid. Many noted that the reporting burden for receiving funding is high, tending to focus on output metrics and not effectiveness, and that there is insufficient investment in measuring what works or in taking successful approaches to scale. Beyond training, funding for high-speed internet, hardware, and software is also important, reflecting the foundational role of digital access.

“The lack of stable funding is a challenge ... Our need in terms of people clamouring for digital literacy instruction is constant, so over the next period we will probably see the waiting list grow. If we can get interns in the winter, we can reduce that wait. Not knowing when or if we will have funding for interns is a challenge.” —Non-Profit Program Lead

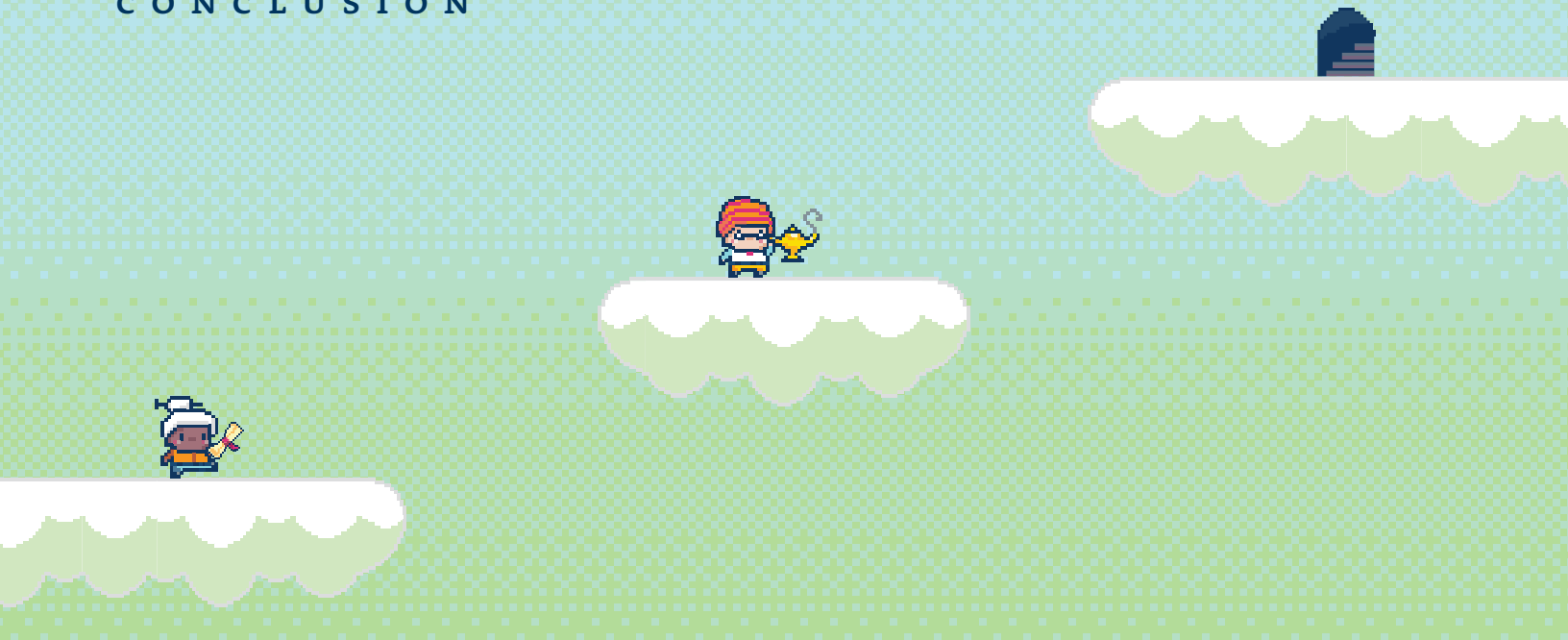
“The negotiation and reporting burden that’s put on and attached to those funds impacts the amount of work you can actually complete. We’ve been negotiating this contract for months but we can’t spend any money or get the project going ... A vast majority of our staff time is spent creating a document that will guide the project.” —Non-Profit Program Lead

“It is ridiculous that we have to keep proposing a new project under these funding structures. And they’re really hard on us; they’ll say, ‘this looks like a program you already did.’ We’re constantly being a startup and having to develop new programming. We’re always having to compete to do something new. You could have an amazing program that everyone thinks should continue but we can’t redo it.” — Non-Profit Program Lead

“It’s sometimes hard to explain what we do because we don’t teach Learn to Code. And as much as we can change how we market ourselves to funders, it’s hard to explain how a six-week program for making a game would lead to me working at Shopify as a UX designer, but it’s a very real trajectory. This helps, and it helps in really different ways than a coding bootcamp.” —Non-Profit Program Lead

“It’s hard to find funding for digital literacy if it’s not tied to a school program [i.e., for community organizations]. The metrics and promises that granters are looking for are really difficult to qualify in terms of digital skills: X number of people achieve Y skill and go on to get a job. With digital literacy, it’s much harder to quantify those skill sets because it’s so individual and people come in with such different skills.” — Professor, Faculty of Education

SAVE + CONTINUE: CONCLUSION



Demand for digital skills across the economy is growing, both in the tech sector and outside it. However, there is no one path to gaining these skills, and individual learners start in different places, face different barriers, and have different goals. A dynamic landscape of digital literacy policies and programs is emerging but navigating through it is complicated even for the most digitally savvy learners. To ensure a robust digital talent pipeline for an increasingly digital economy—and one in which all of Canada has opportunities for economic, civic, and social participation—policymakers from all orders of government, educators, and employers will need to collectively take action.

The challenge facing Canada is to build a system that supports all learners throughout their journeys, irrespective of their starting point or end goal. Below, we outline some areas where action is needed:

- + Targeted programming and support is needed for groups that are currently underrepresented in the tech sector and that face barriers to

digital access and developing and maintaining digital literacy.

- + More programs are needed that bridge the gap for learners looking to move from beginner to advanced and intensive courses, including programs designed for mid-career retraining, for evolving tech sector jobs, and for jobs outside the tech sector that engage with digital technologies.
- + To help learners navigate the complex landscape of digital literacy education, training, and skills demands, better pathways and pipelines are needed. This includes wayfinding support for learners to identify their skills gaps and choose between programs, support for students moving between programs and sectors, and some coordination of training and curriculum.
- + Additional training and support is needed for teachers at all levels of the formal education system, including training in how to use, build, and teach digital technology and how to infuse technology into the curriculum.

- + There is a need for sustainable, long-term commitments to funding digital literacy at all levels, including funding for evaluating and scaling successful pilots; wraparound supports for learners; tuition subsidies for programs; and funding for hardware, software, and internet access across Canada to bridge the digital divide.
- + Across the landscape, rigorous evaluation of what works is needed, including tracking student outcomes and pathways through the landscape of digital literacy education and training programs, and assessing the digital skills that different demographic groups have, that learners are gaining, and that employers are seeking.

This report has aimed to map the landscape of digital literacy policies and programs across Canada. While it did not set out to make specific recommendations, the authors hope that the strategic directions identified will help to guide the design of policies and programs aimed at broadening access to a more coordinated and labour-market relevant system of digital skill development. The Brookfield Institute plans to continue to work with stakeholders across the digital literacy education and training landscape to build on this initial high-level strategy.

APPENDIX A: CASE STUDIES

As a companion piece to this report, we have developed ten case studies to highlight a small swath of the diversity of digital literacy education and training in Canada, the complex pathways and barriers that learners face, and local models and approaches with the potential to scale or be adopted and adapted elsewhere. Pulled from 10 of 90 interviews

with digital literacy and education programs, policymakers, academics, and industry experts from across Canada, these case studies were selected to reflect a broad range of program models and pedagogy, sectors, skills taught, student demographics, and geography. [Read the full case studies here.](#)

ORGANIZATIONS PROFILED:



LifeLiteracyCanada

ABC Internet Matters



The Atwater Library and Computer Centre



Code, Create, Teach



DAMES MAKING GAMES

Dames Making Games



EID 100: Digital Skill and Innovation for the Global Economy

FIRESIDE ANALYTICS INC
@FIRESIDE_INFO

Fireside Analytics Inc.



First Nations
Technology Council

Foundations & Futures in Innovation and
Technology (FiIT) program



Les Labs Inc.



NEXTBILLION.ORG

NextBillion



Learning Lab

STEM Learning Lab Inc.

APPENDIX B: DIGITAL LITERACY PRIORITIES + TERMINOLOGY IN K-12 EDUCATION



To highlight the range of definitions, terminology, and approaches across provinces and territories, we collected language from each province and territory from official policy documents, interviews with provincial representatives, and publicly available curriculum materials. However, these approaches

are continuing to change; even in the course of research for this report, new programs and policies have been launched and terminology has shifted. Priorities span from coding as a major area of focus, to the infusion of technology with literacy and other subjects, to increased technology use in the classroom.

ALBERTA

Student-Centred Learning

“Technology is used to support student-centred, personalized, authentic learning for all students.”

In Student-Centred Learning with technology, the focus is on how students create and share knowledge instead of just focusing on technology as a way for teachers to present information. Technology also offers teachers an opportunity to ensure that students have flexibility in how they access content and demonstrate their learning.⁵⁰

access, manage, integrate, analyze, and evaluate information, construct new knowledge, and create and communicate with others.

MANITOBA

Literacy with ICT

Literacy with information and communication technology means thinking critically and creatively, about information and about communication, as citizens of the global community, while using ICT safely, responsibly, and ethically.⁵¹

BRITISH COLUMBIA

Digital literacy

Digital literacy is the interest, attitude, and ability of individuals to use digital technology and communication tools appropriately to

NEW BRUNSWICK

Technological fluency

Learners are expected to use and apply technology to collaborate, communicate, create, innovate, and solve problems. They use technology in a legal,

safe, and ethically responsible manner to support and enhance learning.

Learners are expected to be able to:

- + recognize technology encompasses a range of learning tools and contexts;
- + use and interact with technology to create new knowledge;
- + apply digital technology to gather, filter, organize, evaluate, use, adapt, create, and share information;
- + select and use technology to create and innovate;
- + analyze how technology and society impact and advance one another; and
- + adopt, adapt, and apply technology efficiently, effectively, and productively.⁵²

NEWFOUNDLAND AND LABRADOR

Learning Skills for Generation Next

“Generation Next is the group of students who have not known a world without personal computers, cell phones, and the internet. They were born into this technology. They are digital natives. Learning Skills for Generation Next encompasses three broad areas: Learning and Innovation Skills, Literacy (including ICT literacy and numeracy) and Life and Career Skills.”⁵³

NORTHWEST TERRITORIES

Literacy with ICT

21st Century citizens need a broader literacy that guides the use of these tools and applications. This “literacy with ICT” includes “learning about and choosing ICT to critically, creatively, and ethically use, produce, and communicate meaning.”⁵⁴

NOVA SCOTIA

Information and communication technology/ Coding integration

Essential learning outcomes and performance indicators include digital citizenship, productivity (using digital tools to explore, create, and represent learning), communication, technology operations and concepts, and research, innovation, problem-solving, and decision-making.⁵⁵

NUNAVUT

Science and Technology

“Technology includes much more than the knowledge, skills, and attitudes related to computers, electronics, and their applications. Technology is both a form of knowledge and application that uses concepts and skills from many disciplines and cultures to design and construct useful ‘tools’ that meet an identified need or solve a specific problem. The methods used to develop technology consist of inventing or modifying devices, structures, systems, or processes to meet a human need and transcend cultural, geographic, and linguistic differences. Students are expected to design, explain, and make modifications to devices to improve their functionality through experimentation and experiential learning.”

“Technologies, historical and present, are also ‘a way of knowing’ and a process of exploration, experimentation, and refinement. Technological investigation involves the application of methods known as design processes, which in turn involve the use of concepts and procedures such as the identification of a need or problem and the selection of a best solution and refinement. This process transcends all cultural and historical perspectives.”⁵⁶

ONTARIO

Blended learning

Blended learning is instruction and student learning that incorporates digital resources in the face-to-face classroom. Through the use of digital resources, educators can differentiate learning to meet student needs and preferences.⁵⁷

PRINCE EDWARD ISLAND

Technological competence

“The ability to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems independently. Individuals competent in information and communication technologies have specialized knowledge and skills that enable them to use technology to access, gather, process, and share information.”

Technological literacy

“Technological literacy encompasses technological competence but refers to a higher level of understanding of technology. Individuals literate in the area of ICT think critically about information gained through the use of technology, the application of specific technologies, and the impact of technology on individuals and society when formulating decisions, opinions, and courses of action. These individuals apply problem-solving strategies and creative thinking skills to independently learn how to use new technologies, or circumvent problems associated with older technologies. CIT literate individuals demonstrate confidence and a positive attitude as they adapt and use technologies for a beneficial purpose.”⁵⁸

QUEBEC

Compétences digitales (digital skills)

“Digital skills are the ability to identify, organize, understand, evaluate, create, and disseminate information using digital technology. They cover a range of aspects, such as ICT skills, social and collaborative skills, as well as cognitive skills. This also includes learning ethical and responsible behaviour. Digital skills are linked to civic obligations that are legally defined by various privacy, copyright and intellectual property laws, and also by the Criminal Code.”

(Translated email response, Ministère de l'Éducation et de l'Enseignement supérieur)

SASKATCHEWAN

Digital fluency

Digital fluency is the ability to use digital technology effectively. All students should be able to use digital technology to learn, to work, and to play through the use of real-world tools and processes.⁵⁹

YUKON

Digital literacy

“Students today need to know how, where, and when to locate information from a variety of media, and they must possess skills to access, evaluate, synthesize, create and present new knowledge in a variety of forms. New technologies are changing the way we think, learn, work and communicate. The 21st century learners in Yukon have access to a multitude of technologies and resources that will help prepare them with the skills to thrive in their chosen fields and to continue to ‘learn how to learn’ throughout their lifetimes.”⁶⁰

APPENDIX C: INTERVIEWEES + EXPERTS CONSULTED



The Brookfield Institute would like to thank the following individuals, as well as representatives from Ministries of Education in all provinces and territories, for contributing their time, expertise, and insights to this project.

**Titles and organizations reflect individual affiliation at the time of their interview*

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ENDNOTES

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