Addressing digital equity and the digital divide

An integrative review and internet scan to identify the challenges, practices, and policies.

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Definition of Key Terms

Information and Communication Technology (ICT): Refers to the technology tools and the process that enables those tools to connect, store, create, and exchange information. This is inclusive of computers and the software, middleware, storage, data, and audiovisual supports used with them as well as telecommunications inclusive of devices, telephone lines, and wireless signals.

Digital: Digital refers to the use of computer technologies, such as internet platforms, social media, mobile and other technology devices etc.

Digital Divide: The digital divide refers to the disparity in access to information and information and communication technologies (ICTs) as a result of affordability, accessibility, and digital literacy across different groups of the community.

Digital Equity: Digital equity can be defined as a situation in which all individuals and communities have the necessary access to ICT to enhance participation in cultural and civic activities, employment, access to digital learning, connection to family and friends, and access to essential benefits, services, and commerce.

Digital Literacy: Digital literacy refers to the skills and abilities required to navigate a society where digital technologies, such as internet platforms, social media, mobile devices etc., facilitate communication and access to participation in cultural and civic activities, employment, learning, social networks and essential services.

Digital Normalcy: Digital normalcy is the normalization of digital technologies in all aspects of people's lives.

Broadband Internet: Refers to wide bandwidth data transmissions on multiple signals over a variety of frequencies resulting in fast, reliable, stable internet service. In Canada, the minimum standard speed as set by the Canadian Radio-television and Telecommunication Commission is 50 Mbps download and 10 Mbps upload.

Background

In the modern era, digital technologies have become so deeply embedded in people's lives (OECD, 2019), that a day without information and communication technologies is unimaginable for billions of people across the world (Johnson, 2021). Since its inception, the internet has revolutionized the way people live by breaking down barriers and providing new channels for accessing education, commerce, employment, and entertainment (Chayko, 2014; Haight et al., 2014). Over the last three decades, the continued advancement of digital technologies has resulted in increased e-participation, such as e-government and social connectedness in the techno-social world (Lee, 2010; Chyko, 2014). The importance of digital technology, and subsequently, online accessibility, rose at the outset of the COVID-19 pandemic. Widespread isolation and quarantine requirements caused more people to turn to the internet, social media, and virtual conferencing to maintain social connections and work from home (Guitton, 2020). More importantly, the pandemic triggered online platforms to become the new normal. From shopping to telework to distance learning (Beaunoyer et al., 2020), COVID-19 has ushered in a new world by normalizing digital transformation in all aspects of people's lives.

Its mass availability has allowed digital technology to significantly support people in multiple ways and has proven beneficial for enhanced access to education, commerce, and entertainment (Chayko, 2014; Haight et al., 2014). COVID-19 propelled (Vargo et al., 2021) people and organizations to become adjusted to an enhanced digital environment, as information and communication technologies continue to permeate every sphere of life at a profound rate (De' et al., 2020). Various offline services rapidly shifted to online, which led to growing digital dependence and increased expectations regarding digitalization among customers/clients, businesses, and service providers. Digital normalcy quickly became widespread, and the COVID-19 pandemic has proven that digital access is critical for basic societal functioning, especially during a global crisis (Saeed et al., 2020).

Although the new 'digital normal' benefits people in a variety of ways, many people are unable to enjoy the advantage of digital technology due to a lack of access to digital resources, the inability to afford such resources, or a limited ability to use them. Research has shown that challenges in connecting with digital services are more widely felt by those who are already disadvantaged / marginalized leading to further levels of societal exclusion. This issue may be deeply ingrained in various factors, including socioeconomic, cultural, and global contexts (Beaunoyer et al. 2020). Along with accelerating technology advancement, COVID-19 has accelerated the need to identify vulnerable groups and communities most affected by the digital divide and to understand the reasons that prevent them from participating in the digital world.

The difficulties disadvantaged groups face in the digital world creates concern that equitable access does not currently exist and should be established to fairly distribute the benefits of digitalization across society (Smith et al., 2018). This multi-faceted issue of equity has initiated a paradigm shift related to the conceptualization of the digital divide. The first level of the digital divide was predominately focused on the accessibility to the internet and Information and Communications Technology (ICT). The second-level divide, previously related to digital skills and literacy, is gradually shifting towards a third level indicating an increasingly nuanced understanding of the uneven outcomes and efficiencies resulting from disparities in internet use/skills (Murray, 2021).

As technology increasingly dominates a major portion of our daily lives, the digital divide highlights the importance of digital equity as a critical concept in addressing digital inequity (Yates & Lockley, 2015). Digital equity can be defined as a situation in which all individuals and communities have the necessary ICT capacity to: participate in cultural and civic activities, employment, access to digital learning, informal social networks, essential services (National Digital Inclusion Alliance, 2021) and commerce. Whereas the digital divide refers to gaps in communities' digital inclusion, digital equity means that all residents of a given area have access to information technology and can learn, use, and benefit from ICT. Scholars argue that access to broadband internet, ICT/technology, and digital literacy training represents a fundamental human right (Murray, 2021; City of Casey, 2021; UN-Habitat, 2012). Digital access, affordability, and literacy are essential to navigating and utilizing critical services such as health care, social services, education, etc. (Murray, 2021; City of Casey, 2021; UN-Habitat, 2012). Although digital equity has become a global priority (Baum et al., 2014), bridging the digital divide remains a critical concern for

developed countries. This research paper focused on gaining a better understanding of the digital divide and identifying approaches to achieving digital equity.

A community-engaged research approach to establishing digital equity in the city of Calgary:

The City of Calgary recognized the need for a systematic exploration of the existing research findings, policy recommendations, and practical experiences on the issues associated with digital equity to develop appropriate policy and strategy responses. On this premise, the multidisciplinary research group and The City collaborated to conduct a systematic integrative review of the academic literature and an internet scan for policy and practice-related publications regarding this pressing issue of digital divide/inequity. Following the methodological approach of community-engaged research, the research group and the representatives of The City met on a weekly basis and determined the objectives and specific research activities to achieve those objectives. While The City representatives communicated their current needs and offered their capacity, and future goals regarding digital equity, the researchers provided sound methodological and technical aspects to deliver a foundation for any future policy decisions. Together the group collaborated on a research protocol, which aimed to synthesize insights from existing studies, policies, programs, and initiatives. Initial meetings were held to develop a set of guiding questions that acted as a rudder during this study.

The primary aim of the study:

The primary aim of the study was to gather relevant research findings, policy and strategy recommendations, and individual and collective practical experiences regarding digital equity in an urban environment (resembling Calgary) in developed countries. This research, coupled with community engagement, serves as the knowledge basis upon which The City's Digital Equity strategy will be built. To achieve this primary aim, this study conducted a systematic assessment of existing literature, policy, and practices. The work is divided into the following objectives and associated activities:

Specific Objective 1: Conduct a systematic integrated review to examine the present state of research on digital equity/inequity with the goal of synthesizing understandings of the barriers, facilitators, and potential outcomes of digital inequity. This knowledge will aid in determining and carrying out the next steps in addressing this critical but often overlooked issue.

Specific Objective 2: Conduct an internet scan (I-scan) to unveil the available individual, private, and systemic initiatives, policy recommendations, and practical experiences in addressing digital inequity. This information will be used to learn from previous endeavors, successes, and failures and support the pursuit of practical and solution-oriented research and program activities.

Methods

A. Systematic Integrative Review

The methodological approach suggested by Whittemore and Knafl (2005) was used to synthesize knowledge on digital equity that was gained through academic research activities. An integrative review is an appropriate method to achieve this objective as it allows for generating knowledge from both empirical and theoretical perspectives. A detailed description of the research method and its five steps is provided in Appendix I.

B. Internet scan

As a part of the systematic scan, an internet scan was conducted to capture non-academic publications that encompass policy recommendations, lessons learned, and experiences gained through individual and organizational practices. This systematic search included three major search engines. The details of this method are provided in Appendix I.

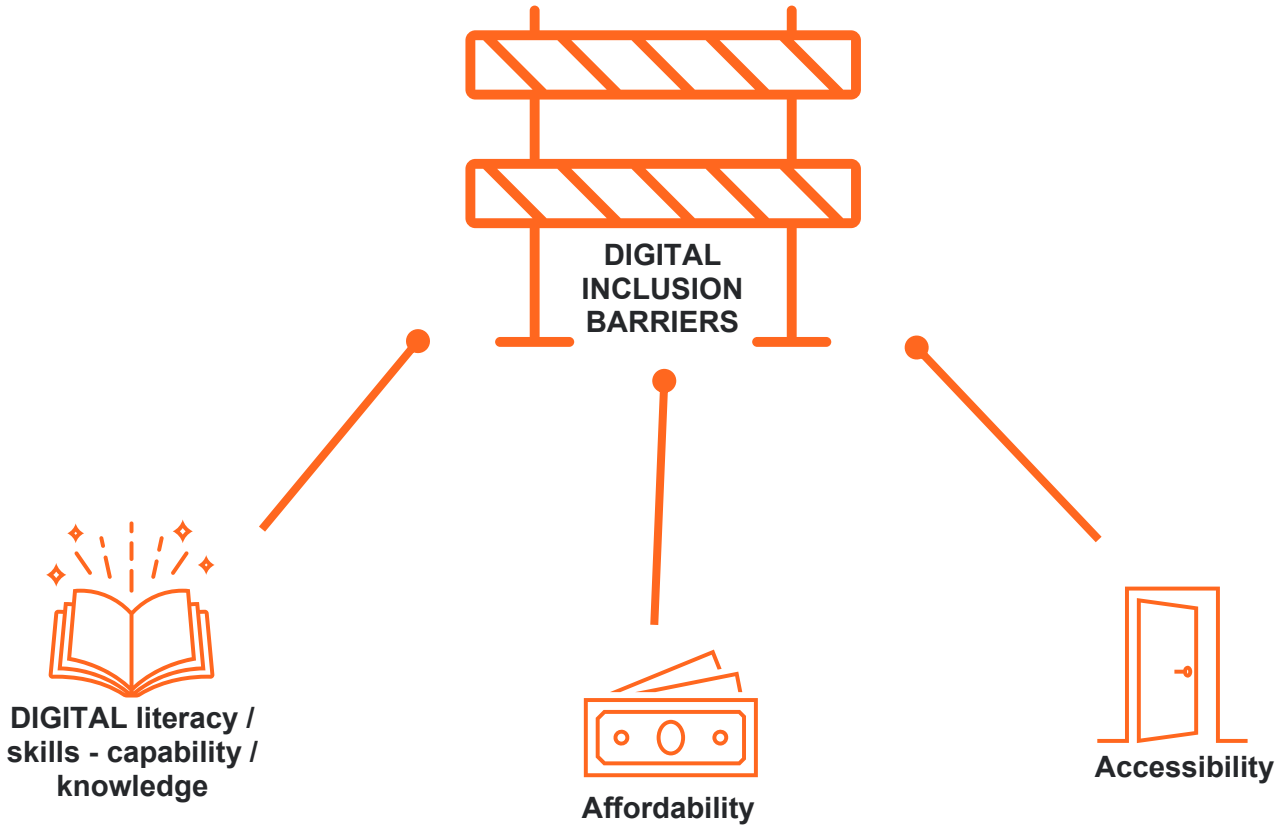
Key Summary of Findings

The findings of the systematic integrative review and the I-scan highlight and explore the key factors and barriers to digital equity, and also reveal how these barriers are embedded in social, economic, and cultural contexts and the way these multi-dimensional issues can lead to systemic injustice, further exacerbate existing or create new digital inclusion/exclusion.

Multiple Dimensions of Digital Equity: Key Barriers / Determinant Factors

There has been a scholarly and practical trend to understand and address the issue of digital inequity from multidimensional perspectives as the digital divide not only refers to the issue of accessibility to ICT but also to underlying (interdependent) socio-economic-cultural factors that shape ICT adoption and usage and amplify vulnerabilities. Most importantly, it focuses on variations in the level of skills/literacy and differentiated needs, perceptions, and user ability of the people. Summaries of the key determinants identified in this review are categorised into the following major themes (Figure 1), which many studies have recommended/highlighted as instrumental factors to bridge the divide.

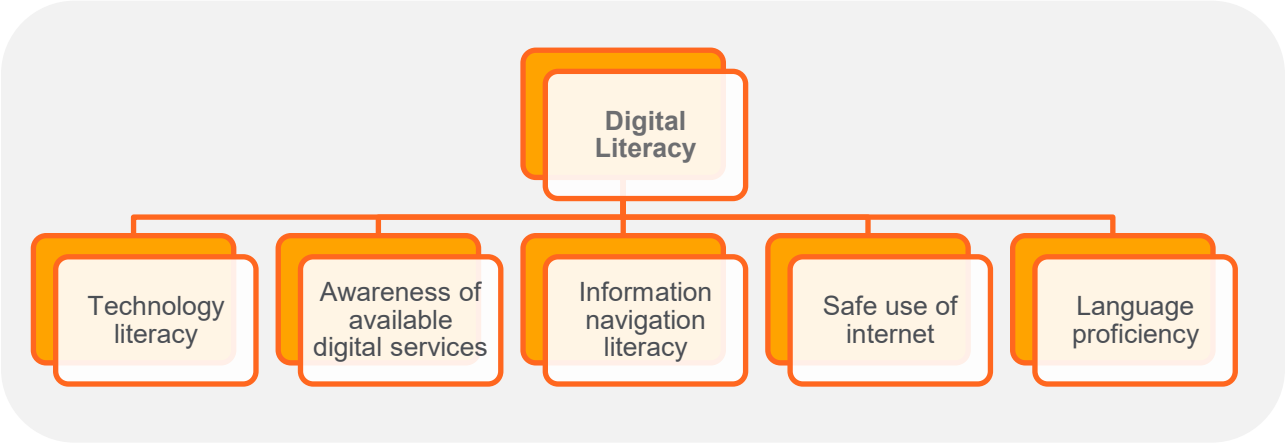
Figure 1. Key barriers to digital inclusion



Digital literacy / Digital skills-capability / Digital knowledge

Individuals' digital skills and literacy of ICT usage are critical factors in the current digital divide. Digital skills refer to the ability to use the internet to obtain information, communicate using digital technologies, and solve software and hardware problems. This also includes the skill of evaluating the validity of information and adapting to norms of online behaviour. The major aspects are shown in Figure 2.

Figure 2. The major components in digital literacy



Technological literacy

Technological literacy refers to individuals' skills and competencies to use, understand, and manage ICT effectively, safely, and responsibly. Knowing how to use hardware/ digital technologies and people's ability to interact with devices and understand how their work can shape digital experience and help overcome the fear of using various tools/electronic equipment.

Awareness of available digital services

Knowledge of existing digital content, subsidized plan/benefits (promotional offerings), and services (ex: location of public Wi-fi, accessing essential or support services online, etc.) are referred to as awareness of available digital services. This skill relates to questions such as how to locate the desired content and gain access to the desired services. A lack of awareness about the benefits of digital technologies may be accompanied by little motivation to access the internet or develop the skills necessary to benefit from internet usage.

Information navigation literacy

Information navigation literacy refers to knowledge about using available digital information, resources and services and the ability to navigate the digital environment. This type of literacy helps people to access and understand IT hardware and software and achieve the desired services. The information navigation hierarchy is often accompanied by a high motivation to access the internet and to develop the skills necessary to benefit from Internet usage.

Safe use of the Internet

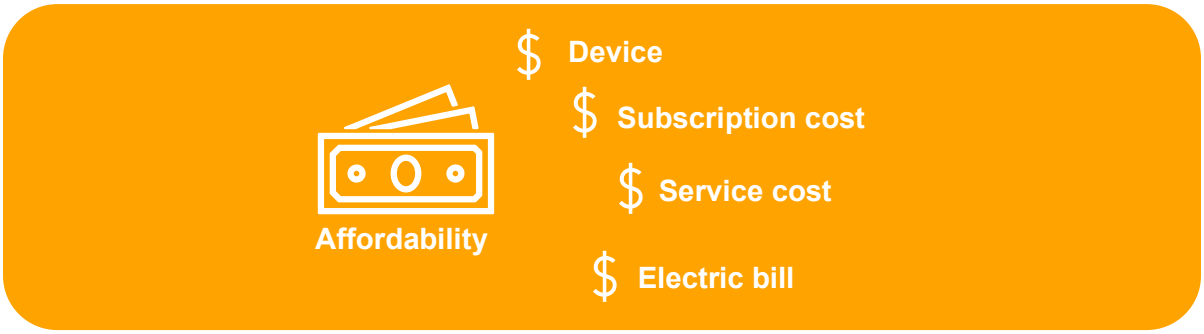
As digital technology becomes more commonplace, people are increasingly aware or concerned about their digital safety and wellbeing. While spamming, identity theft, and fraud activities grow, internet users express concerns and remain sceptical towards the usage of ICT and various digital resources or networks, in part due to safety and privacy concerns. For example, a few studies highlighted that some individuals may perceive peer-to-peer network use as illegal or unethical or not safe, which prompts these users to avoid public/shared networks or Wi-Fi hotspots on personal devices. E-awareness helps to address misconceptions and enables users to make safe technology choices by assessing the risks and benefits of using specific ICTs and making an informed decision about whether to use these applications or to access certain digital content.

Language proficiency

In the context of this report, language proficiency refers to knowledge of the English language, because English-language digital content is most prominent in Canada (notwithstanding the fact that Canada is a bi-lingual country with a major portion of French speakers, particularly in Quebec). In general, non-English speakers may face challenges in accessing or utilizing English language digital content.

Affordability (costs)

Figure 3 shows the major components within affordability.



Device:

This refers to the cost of digital devices, such as mobile phones, laptops, computers, and tablets. Access to appropriate and affordable ICT devices is another key enabling factor for internet usage and gaining access to essential services. Moreover, this dimension of equity is also critical for developing necessary skills/literacy, expanding the breadth of the scope of the personalized digital experience, and, most importantly, utilizing the digital environment/media effectively to transform digital skills into attainable/tangible outcomes. Vulnerable users, especially from low-income groups, often struggle to afford modern ICT devices that are necessary to connect adequately to broadband internet and to effectively access work, education and essential benefits / services. Therefore, the affordability of ICT devices is a very important barrier for disadvantaged groups which influences equal participation in the digital world.

Internet data / usage plans (subscription cost):

Research findings indicate that a lack of access to affordable home broadband internet data plans is a critical barrier exacerbating the digital divide. Despite per MB data usage costs decreasing, the cost of connections meeting the minimum standard of upload/download speeds has not decreased. Additionally, penalties for data overages can be quite steep and there are often few options for low to mid-range data packages. This is conceptualized as “subscription vulnerability”. Low-income users are often unable to afford monthly subscription fees after they account for essential household expenditures making affordability a key concern.

Transmission / service cost:

Transportation or service costs are inclusive of the physical connection from the service provider to the home, the installation fee (often a one-time), and the cost of enabling hardware (such as modems and routers) that are required to be rented or purchased. When coupled with the subscription costs, the cumulative cost of broadband internet plans (even those that offer lower speeds or minimum data), remain out of reach to many low-income households.

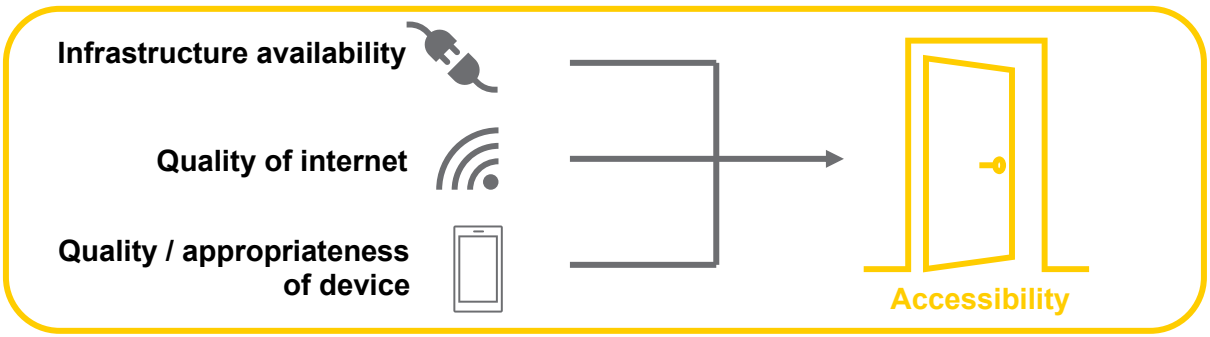
Electricity:

The electricity bill indicates the monthly costs of using electricity at home and forms a part of the household’s utility costs. The cost of electricity can be a significant barrier to digital equity.

Accessibility

Accessibility refers to an individual's overall ability to get the tools and services they need to connect to the virtual world.

Figure 4 shows the major components within accessibility.



Infrastructure Availability

Infrastructure availability refers to broadband internet connections with minimum standards of upload and download speeds. Research has indicated that in some communities there is a limited choice of broadband internet providers or infrastructure only available from a single provider. This phenomenon results in higher fees associated with connectivity.

One aspect about infrastructure availability is electricity. Using digital devices requires access to electricity. Though there might be scenarios where public Wi-Fi can be used, but there are often challenges faced by subgroups of equity deserving people (e.g., dealing with poverty or homelessness) regarding safe and easy access to device charging facilities. Although it appears to be a trivial obstacle, access to electricity for keeping the devices charged to be used can be a significant barrier to some subgroups of people in the community. Also, as more devices are used, electricity usage and in turn costs increase, adding a further cost barrier for households. With the rising costs of utility bills, which include data subscription plans, electricity, heating, water, recycling and other essential services, electricity usage of ICT devices is an important factor to consider.

Quality of Internet

Internet quality refers to the stability and speed of broadband internet and/or Wi-Fi connections as well as uploading and downloading speeds. The quality of broadband internet is also crucial for bringing disadvantaged people into the digital world. As people use more digital services, stable, high-speed connections are required at low costs to ensure equity for all.

Device

Refers to an individual's ability to access the right device for the task at hand. As seen throughout the pandemic, many individuals impacted by the digital divide do not have access to the right device to complete the task they are required to perform online. Overwhelmingly, research references students attending online classes from cellular phones because of a lack of access to laptop computers. Devices can also include hardware or software required by those individuals with a disability such as visual or auditory impairments.

Dynamic impacting digital inclusion

We need to keep in mind that the above-mentioned barriers are not static. We need to appreciate the changing dynamics in factors that influence the extent and impact of the barriers on the community.

Figure 5 depicts the dynamics which influence the digital barriers.

Equity deserving groups: relevant content and services

To make the digital transition inclusive and to close the digital divide between equity-seeking groups, many studies argue that digital content should be available in mother tongues or native languages, which are considerate of cultural norms. Even if individuals can connect digitally, appropriate content, activities, programs, and services tailored to address the differentiated needs and abilities of the equity-seeking groups are critical for digital equity. The increasing sophistication and related requirements to obtain desired content place certain vulnerable groups (such as the elderly and new immigrants) at a disadvantage. Consequently, these groups may lose motivation to learn and engage in the digital environment.

Vulnerable Groups (population sub-groups)

The overarching issues of the digital divide are greatly embedded in pre-existing structural inequities as the dynamics of digital exclusion are highly correlated with intersectionality (race, age, gender, ethnicity, immigrant, disability etc.), socio-economic factors and geographies. Though digital inequity is often amplified and re-produced by other inequities existing within (and across) vulnerable populations, the digital divide is not the outcome of any single barrier. Instead, it is a cumulative effect of multiple factors at play that creates an uneven condition for equity-seeking groups in accessing and utilizing the full benefits of digitization. Vulnerable groups may experience unique forms of marginalization and can be impacted by various dimensions of exclusion based on their exposure and sensitivity to pre-existing factors.

This research has identified key groups which are more likely to experience increased digital exclusion and should be prioritized for targeted action. This list of the vulnerable population is not (entirely) inclusive as there may be significant heterogeneity of situations /experiences, and many digitally excluded people may fall into more than one vulnerable group.

For this research, low-income households have been used as a “benchmark/parameter” to understand/map the context (ground reality) of the existing digital divide and take interventions/programs in a city landscape. This vulnerability has been outlined first to set the stage for other socio-demographic attributes and intersectionality such as sex, gender, age, disability, race, ethnicity etc. and the vulnerabilities specific to those attributes which can act as a threat multiplier within the digital divide.

Low-income people

The digital lives of people with lower and higher incomes remain markedly divided, and a vast majority of literature included in this study highlighted that low-income groups significantly lag in ICT access due to socioeconomic inequalities (Mubarak et al., 2020). Income is highly correlated with a subscription to home quality broadband internet access (with a high-speed plan) (Nielsen et al., 2018). A study in Toronto highlighted that 75% of the low-income households (below 30K) identified monthly costs as a major barrier to broadband internet access (Andrea et al., 2021). Various other studies also highlighted that low-income Canadians (household incomes below 30K) are vulnerable to digital exclusion. The lack of equitable access to affordable broadband internet is a pressing challenge that requires an urgent intervention or policy response (Social Planning Council of Ottawa, 2021).

Another major barrier impacting low-income groups is access to appropriate devices, such as desktop or laptop computers. Many studies identified that ownership of computing devices among lower-income households is comparatively less than in higher-income groups. Families without access to desktop or laptop computers rely heavily on smartphones which impacts their ability to actively participate and interact with many services and uses. Since smartphones lack much of the functionality required for content creation necessary for professional/academic activities, an over-reliance on their use may inhibit low-income

populations from gaining more in-depth online experience and developing transferable digital skills (such as CV building skills, online/job applications, tax return, telehealth, benefit application etc.) (Forman et al., 2020).

In addition, people with low income are often excluded from acquiring necessary digital skills, knowledge, and literacy as affordability constraint creates persistent challenges in accessing appropriate devices along with reliable, high-speed, and affordable internet services required to increase skill levels. Access to devices and reliable high-speed internet often requires a higher proportion of household income to be spent which can lead to the difficult decision to make trade-offs with other basic expenses. Given the multifaceted nature of the digital divide, with a lack of reliable internet at home, low-income people with low education, unemployment, or immigrant/refugee status, may experience additional challenges acquiring the necessary digital skills to participate in the digital world due to a lack of access to tailored digital literacy programs and services.

Older adults

Older adults, are more likely to be impacted by a lack of access to broadband internet (especially those who are in the low-income cohort) (Wilco, 2021; Masoodi, 2021) and perceived lack of relevance or usefulness or interest in digital media/ICT (Nam, 2010). In addition, a lack of digital literacy poses a major challenge and acts as an important barrier to digital inclusion. Older adults are more likely to experience challenges in the acquisition of new digital skills and may be more likely to resist change (Kim Andrew Eugni & Jeong Mi-Kyeng, 2010). This may contribute to further exacerbation of an individual's ability to cope with the rapidly changing digital sphere that often requires constant upgrading of digital literacy skills (Martinovic and Fremian, 2020). This can result in a lack of motivation or fear amongst older adults when it comes to internet use. Inexperience in navigating issues of online safety, security, privacy, and disinformation may also shape their attitudes and confidence towards digital inclusion (Digital New Zealanders, 2017).

Lower literacy among older adults can also be correlated with education and ethnicity, as highlighted in a survey out of Philadelphia which found that Black, Hispanic, or foreign-born older people with low education are more likely to have low digital skills / literacy (City of Philadelphia, 2022). This leads to, the perceived usability of sophisticated digital devices and the availability of device support becoming essential factors influencing older adults' willingness to use digital technologies (Wang et al., 2011). Finally, (physical) health limitations may also present a barrier to enjoying the benefits of digital normalcy (Mubarak et al. 2020), and older adults with mental health issues are also most likely to be a victim of digital exclusion with low motivation, confidence, and adoption / access to online technology (Murray, 2021).

Indigenous groups

Although the internet may appear to be a minor issue compared to other infrastructure issues confronting remote Indigenous communities, a lack of internet access was more likely to impact Indigenous Peoples during COVID-19. (Carson et al., 2021; City of Casey, 2021; Murray et al., 2021) Broadband internet access as a barrier has

made it more difficult for many remote Indigenous communities to achieve essential inclusion in education, health, social interaction, and essential benefits and critical services. Indigenous Peoples are also more likely to be impacted by a lack of digital literacy, skills, and localized online resources (Carson et al., 2021; Murray et al., 2021). Most importantly, a negative or a lack of digital experience may further impact motivation or social acceptability. Motivations/interest in accessing the digital environment may be further impacted due to limited availability of culturally appropriate relevant content and services and the dominance of English language and history content within online spaces.

Racial and Ethnic minorities

Many studies reported that access to the internet for ethnic minorities is much lower than the national average (Digital New Zealanders, 2017; Robinson et al., 2018). Besides a lack of access to devices and subscription vulnerability, some members in this group are also at risk of digital exclusion due to content accessibility. A lack of culturally sensitive and language-appropriate content, that caters to the specific community needs, limits the capacity / ability of those in racial/ethnic minority to navigate the digital sphere/space and may shape or limit their ability to engage in a range of complex online activities

Newcomers / New immigrants and refugees

Newcomers (immigrants) are comprised of heterogeneous groups with diverse abilities and economic situations. Language and literacy barriers to accessing online services are other prominent factors highlighted across the studies. (Bailey & Nyabola, 2021; Cherewka, 2021; Liu et al., 2021; Murray et al., 2021) This poor access may create digital exclusion, negative attitudes, and demotivation towards online services.

Persons with disabilities

People who report a disability are disproportionally impacted by affordability as they may have fewer options for devices (van Deursen & van Dijk, 2019). Persons with disabilities who require assistive technologies (Digital New Zealanders, 2017) could face challenges accessing digital services due to the specific requirements of enabling software/technology (City of Casey, 2021), a need for more developed digital skills, language barriers, and a lack of easy-to-understand accessible digital content (UN-Habitat, 2012). Moreover, studies have identified varying degrees of experience (and exposure) associated with the impacts of disabilities (such as learning, cognitive, hearing, vision, hand-related or physical movement, and health-related issues) and corresponding lack of accessible options to overcome these impacts can result in low internet use and low self-esteem/confidence. This intersecting nature of multiple barriers sometimes makes it difficult for persons with disabilities to navigate online and access critical (government) services and information.

2SLGBTQ+ community

The 2SLGBTQ+ community is more likely to be excluded from a safe and inclusive online experience because of abusive comments, social exclusion on digital platforms, and a lack of tailored information, content, and services targeted to 2SLGBTQ+ communities. For example, digital media representations sometimes promote forms of prejudice which not only diminish motivation to engage but also create a critical barrier to accessing social support, which may impact mental health and overall wellbeing (City of Casey, 2021).

Women

Compared to men, women (and those who identify as women) are marginalized due to various socio-cultural factors (Foteinou, 2010; UN-Habitat, 2012) which are more likely to cause a lack of access to ICT, despite having a connected device(s) in their homes. These factors include: having a caretaker/caregiver role, unpaid domestic work with less time to grow career/learn new skills, household decision-making culture; mothers prioritizing their children's needs, male members occupying the device, etc. Along with limited ownership of the device and a lack of affordable options, some women possess poor technological skills or low digital literacy, which impacts their motivation for online engagement (City of Casey, 2021).

This dimension of the digital divide is not inherent to certain groups rather, the gender-based exclusion is systematically entrenched/embedded. These structural biases/barriers (cultural norms, social expectations, and external factors) may create additional constrain for education (science and ICT-related fields), employment, freedom of career choice, etc., which can further jeopardize women's situation in accessing digital services, learning relevant technical skills and gaining/improving literacy (UN-Habitat, 2012). Additionally, lack of awareness of the potential benefits and lack of gender-sensitive digital platforms and services (designed to meet the specific needs of women) may create barriers to digital adoption and use for women. Moreover, concerns about (sexual) harassment, online safety, and identity fraud incidents were also identified as another factor that inhibits creating a safe digital environment and may impact women disproportionately in comparison to men.

Single parents

Single parents in low-income cohorts are also vulnerable to digital exclusion. The cost of a broadband internet plan is a significant barrier leading to lack of in-home broadband internet services. This dimension of subscription vulnerability may create additional constraints in accessing critical digital services and information (Masoodi et al., 2021). Single parents may be disproportionately affected by digital inequity due to time constraints when in the role of primary caregivers. Therefore, moving beyond the dimension of material access (internet & device), various studies have recommended a careful understanding of their (specific) context (and parenthood lives) to facilitate equitable access to essential services such as government, health care, online education, and online banking.

Examples of Relevant Interventions

Multi-city ConnectHome program in the USA

ConnectHome, a flagship program by the U.S. Department of Housing and Urban Development (HUD) launched in 2017. This initiative, which is based on public-private partnerships provides support to low-income families in 28 communities with school-aged children living in HUD-assisted housing. The program connects residents to free or affordable broadband internet service, a free or affordable computer device, and training to use them.

Source/ For more information about ConnectHome, see: https://connecthomeusa.org/

Federal Government of Canada has also launched a similar project for low-income people called "Connecting Families"

Source: https://www.connecting-families.ca/welcome

Barriers addressed
Connectivity and Affordability (to provide free or low-cost broadband internet access, devices, later expanded to provide digital literacy training).

Targeted group
Low-income Families.

Level/scale of interventions
Federal.

Key actors/stakeholders
U.S. Department of Housing and Urban Development and community leaders, local governments, non-profit organizations, and private industry.

LinkVan, project in Downtown Eastside (DTES) neighborhood of Vancouver

Grounded in participatory technology design and with an aim to create a more inclusive and equitable digital landscape, LinkVan began as a project to create a literacy-friendly online service directory for low-income and homeless citizens. Through interagency collaboration among various stakeholders, such as literacy and education organizations, representatives from community colleges and universities, local libraries (ex: Vancouver public Libraries) and vulnerable communities, this project supports technology-oriented responses to service provisions; to provide better access to services, but also to more equitable distribution of digital resources skills. Some of the key components/steps include:

- *Organizing Community Technology Forum to discuss the key issues and develop possible action plan for LinkVan project.*
- Digital Literacy Education Outreach (creating pop-up tech cafés in shelters, drop-in centers, and other settings).
- *Lesson learning from the LinkVan Project.*

Source: https://dteslit.files.wordpress.com/2018/11/29406-article-text-77929-2-10-20180726.pdf (see page 9-25)

Barriers addressed
Digital Literacy/ capacity for digital technology use; better access to services/ need for literacy-friendly and accessible information about services and resources.

Targeted group
Low-income and homeless citizens.

Level/scale of interventions
Municipal (community-level).

Key actors/stakeholders
University of British Columbia, literacy and education organizations, representatives from community colleges and universities, local libraries (horizontal collaboration).

Digital Wings in New Zealand: A Charitable Trust to Enhance digital opportunities and promote access to digital technologies

Wellington-based computer recycler, Remarkit, established a charitable trust called **Digital Wings** in 2017. The Digital Wings Trust collaborates with socially and ecologically conscious businesses and government agencies to provide high-quality IT equipment to charities and community organizations. They collect devices/hardware/equipment, which is then refurbished, reimaged with Microsoft Charity upgrade licenses, and finally delivered free of charge to community organizations nationwide.

Source: https://www.digitalwings.nz/about.html

https://www.remarkit.co.nz/projects.html

Barriers addressed
Access to device/electronic equipment.

Targeted group
Vulnerable/need-based groups (community organizations).

Level/scale of interventions
Nationwide.

Key actors/stakeholders
Community organizations, donors, business, education and service sectors, etc.

"Community Mesh Network" in Ottawa, Canada

Implemented as a municipally run mesh network in collaboration with other partners, this project intends to investigate the efficacy and acceptability of piloting a community mesh network in high-inequity neighbourhoods. This will provide increased connectivity for low-income residents in the targeted communities. A Community Mesh Network is made up of interconnected routers called "nodes" that distribute broadband internet access throughout a neighbourhood. The community mesh network has boosted community resilience by providing free public Wi-Fi in Ottawa Community Housing buildings and other local communal spaces. This ongoing pilot project is highly appreciated by the advocacy groups to advance of internet equity.
Source: https://www.ncf.ca/en/documents/77/Digital_Equity_Part_3-Community_Mesh_Study_Final_2021.pdf

Barriers addressed
Connectivity (access to broadband internet, affordability, cost).

Targeted group
Low-income families.

Level/scale of interventions
Across the city.

Key actors/stakeholders
Digital Equity Ottawa, National Capital FreeNet, Ottawa Community Housing (OCH), and the Social Planning Council of Ottawa.

The Inter-County Broadband Network (ICBN) in Maryland, USA

Funded partly by the federal Broadband Technology Opportunities Program (BTOP) in the USA, this initiative provides affordable, accessible high-speed internet access to government organizations (such as improved public school system, health care delivery service, etc.), community institutions, businesses, and residents throughout the State of Maryland. The ICBN consortium is comprised of nine Maryland jurisdictions; connects as many as 1,000 community anchor institutions and will expand their network to include under-served urban and rural areas. Through promoting inter-Governmental Resource Sharing, ICBN aims to deliver internet to every county in the state.

Source: https://www.kci.com/projects/inter-county-broadband-network/

Barriers addressed
Connectivity (access to internet, affordability).

Targeted group
Anchor institutions in Central Maryland, K-12 public schools, libraries, public safety agencies, community colleges, and other government institutions.

Level/scale of interventions
Across the state (connected nine cities).

Key actors/stakeholders
A collaborative inter-governmental consortium led by the Maryland Department of Information Technology.

SeniorNet and SeniorHangouts in New Zealand: Fostering Digital Learning and Social Gathering for Older Adults

First established in Wellington in 1992, this project/program brings older adults and technology together in a friendly, fun, and stress-free way. It's aimed towards folks over 50 who want to learn more about technology, what it can do, and how it can benefit them. Learning Centers have their own agendas, but they all offer small, well-organized classes taught by volunteer tutors who are similar in age to their students.

SeniorHangouts is a community learning network that encourages and supports adults to use technology confidently in their daily lives. The Covid-19 Global Pandemic, with its enforced social isolation and 'lockdown periods,' spawned SeniorHangouts. The program is hosted online where seniors can learn from educators while sitting in the comfort of their own homes.

Source: https://seniornet.nz/

Barriers addressed
Digital Literacy, Content, Digital Skills, Social Connectivity/gathering.

Targeted group
Seniors (age 50+).

Level/scale of interventions
Across the country.

Key actors/stakeholders
Public-Private Partnership (Led by The Federation of New Zealand Senior Net Societies and funded by Google, Suzuki, Vodaphone, etc.).

Digital Navigator Programs in Philadelphia, USA

Digital Navigators are trusted guides who assist community members in the digital inclusion process—home connectivity, devices, and digital skills. This is accomplished through repeated interactions. Under this program/model, regional community-based organizations (CBOs) are funded to recruit, train staff, develop call center/service centers, develop inclusion programs, maintain liaison with city officials, and support the community in monitoring and checking. Some of the specific goals are:

- Enroll in or get help with city's initiative/digital services (Ex: subsidy)
- Identify and sign up for a free or affordable internet subscription
- Obtain a free or low-cost device.
- Get basic technical support, troubleshoot, and literacy.
- Find and enroll in a digital literacy program/module.

This program is similar to 'Tech Goes Home" in Boston, USA.

Source: https://km4s.ca/wp-content/uploads/DigitalNavigatorReport.pdf

Barriers addressed
Help individuals find and apply for affordable internet connectivity, obtain low-cost or free computers, complete simple online tasks, and connect to digital literacy training.

Targeted group
Low-income households; households with K-12 students; Older Adults; (Equity) Language support seeking groups (immigrants).

Level/scale of interventions
Across the city.

Key actors/stakeholders
The City of Philadelphia's Digital Literacy Alliance and the Knight Foundation and CBOs (Community Based Organization).

How do we know when we've got there? Measuring success

The Australian Digital Inclusion Index (A Benchmark for measuring progress towards achieving Digital Equity Goals)

It remains important to track digital inclusion's social and geographic distribution across the Australian population. To participate in an increasingly digital economy and society, one will need a mix of technological and financial resources, as well as specific skills and expertise. As a result, the Australian Digital Inclusion Index combines measures of the ability to access the internet, digital devices, and technology, as well as the ability to pay for them and utilize them effectively. The Australian Digital Inclusion Index measures digital inclusion across three dimensions: access, affordability, and digital ability, using data from the Australian Internet Usage Survey.

The ADII dimensions

- **Access (**types of digital connections and devices and how frequently they are used them to get online).
- **Affordability (**measures the percentage of household income required to gain a good quality service with reliable connectivity).
- **Digital Ability (**is about the skill levels, literacy, what individuals are able do online, and the confidence in doing it).

ADII scores range from 0 to 100. The higher the score, the greater the level of digital inclusion. ADII scores are relative: they allow comparisons across different social groups and geographic areas, and over time. Each of the Index dimensions – Access, Affordability and Digital Ability – are equally weighted to derive the total Index score. Total Index scores have been classified into four groups: Highly excluded (45 or below), Excluded (above 45 and below 61), Included (61 and below 80) and highly included (80 and above).

Level/Scale of Interventions: Across the Country.

Key Actors/Stakeholders: The Australian Bureau of Statistics; The Australian Communications and Media Authority.

Source: https://www.digitalinclusionindex.org.au/

Policy Recommendations: A Roadmap for Actions

This systematic integrative review and I-scan highlight the key challenges and barriers to digital equity, which is a multi-faceted problem with multi-dimensional issues. Solving this problem requires short and (long) term strategic planning, inclusive approaches with targeted actions, and inter-sectoral and multiagency/-stakeholder collaboration. Building on the summary of various digital inclusion initiatives in developed countries, the following recommendations may serve as a roadmap for The City of Calgary to understand the contextual socio-economic dynamics of existing barriers that create uneven/unequal digital landscapes. Moreover, it will help The City develop guiding principles and collaboratively identify important actions to overcome/address these challenges to work towards achieving a baseline of digital equity across the city over the next five years. The specific policy recommendations are organized into three categories (Figure 6). However, this report primarily details the immediate priorities as navigating mid-and-long term strategies is mainly contingent upon the successful accomplishment of this crucial first step.

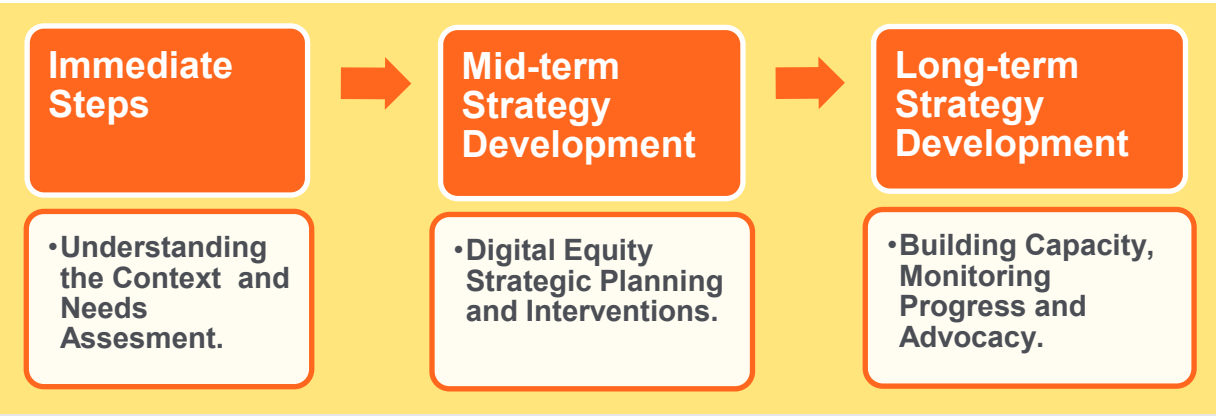


Figure 6: Roadmap for Action Towards Achieving/Materializing Digital Equity

Immediate Next Steps for The City of Calgary

Stage 1: Understanding the Context of the Digital Divide in City Landscape

While transforming into smart cities under this global wave of digitization has opened enormous opportunities, it has also created systematic exclusion and differentiated impacts on citizens across intersectional groups (previously outlined) and geographies. Based on these findings, it is recommended The City takes immediate steps to fully understand the digital divide, explore the factors and barriers, and identify the underlying root causes that shape Calgary's digital reality/ecosystem and further exacerbate the pre-existing inequality. Most specifically, to comprehend the disparities in connectivity, unequal access, and the dimension of digital skill/literacy/ability across the socio-economic and demographic groups, and geographies / spatialities.

- The City of Calgary may want to establish a digital equity office (and advisory board) to provide guided direction, (seek and) manage funding, and foster/ensure accountability.

- The next most crucial step is to conduct a citywide digital divide survey to gain an updated understanding of the current status/map the gap and identify the vulnerable groups/ digitally excluded communities.

    - To gather and utilize timely and relevant data, the city may want to conduct a "Household Internet Assessment Survey" to assess/identify the barriers to technology usage/adoption and access, affordable connectivity, and digital literacy/skills.

    - A multi-method online and phone survey/ telephone interviews (using Interactive Voice Response) with a random/cluster sample of 2000-2500 Calgary residents could be a useful (and timesaving) method to unravel the background context of this complex issue.

Stage 2: Community Consultation and Needs Assessment

The initial survey will provide a robust quantitative picture of the digital landscape/divide in the city domain and offer a critical benchmark for developing a smart city vision and goals. However, this type of survey is likely to miss some of those in vulnerable subpopulation groups who are without stable housing or reliable means of communication. To better grasp the needs of diverse vulnerable/equity-seeking groups, it is recommended The City of Calgary undergo inclusive and meaningful community engagement (Turin et al., 2021a) that is inclusive of:

- Focus groups, one-on-one conversations / workshops, community fairs, and city hall dialogues to help understand how residents are navigating the impacts of the digital divide, their priorities, needs, and suggestions for solutions.

- In-depth community conversations from relevant stakeholder groups, including grassroots organizations.

- Directly involving representatives from identified vulnerable groups (from the survey), community-based organizations (CBOs), internet service providers (ISPs), technology companies, disability centers, public libraries, community centers, social service centers, and other relevant stakeholder organizations.

- Building a process that involves organizations who support citizens across different levels of needs (Turin et al., 2022).

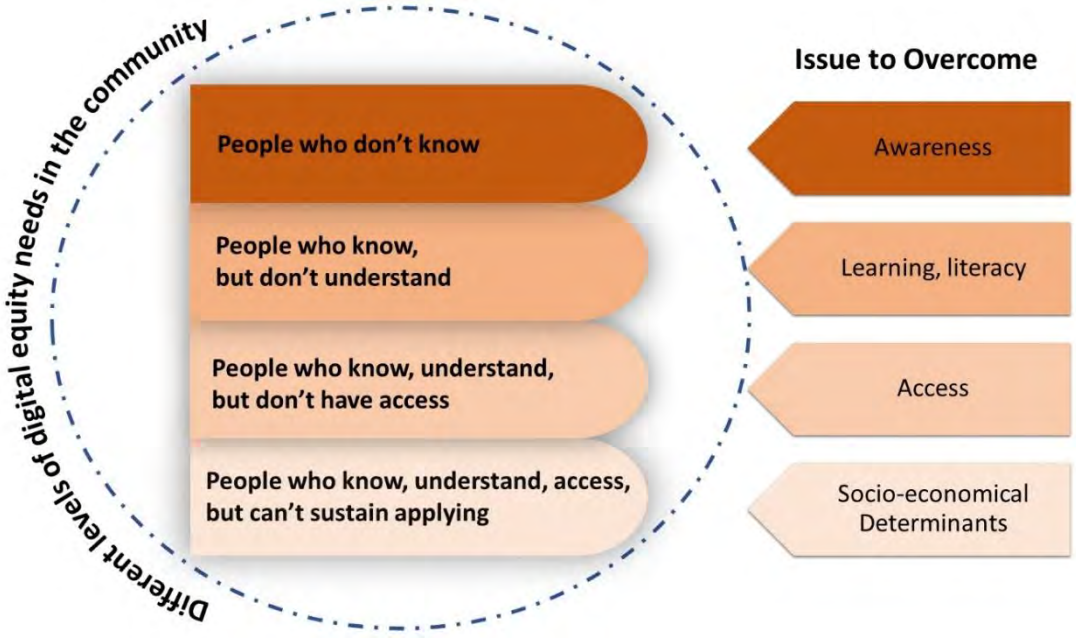
- "Digital Equity Summits / Fairs" or "Open Dialogues / Citizen Forums" to disseminate findings from the survey and in-depth consultations and encourage deliberate participation and community involvement and feedback (Turin et al., 2021b).

- Publishing key findings on the organization's (City) website, which will also help generate ideas or possible strategies/solutions in response to gaps/barriers and potential guiding principles/goals for inclusion in the long-term strategic plan.

Understanding levels of need in our community

While exploring the digital equity barriers in the community, The City must remain considerate that different levels of needs will exist simultaneously in the community. There may be a segment within the community who do not know about the issue and therefore require more information prior to giving input. There may also be those who know about the issue but lack the ability to understand the details or require access to a support to provide input. Lastly, there may be those who know about the issue and require no additional information or support prior to providing input. As such, solution-oriented work needs to be multi-dimensional in nature.

Figure 7 depicts different levels of digital equity need in the grassroots community.



Stage 3: Targeted Pilot Projects and Community-led Solutions / Innovation / Interventions

Followed by the city-wide survey, in-depth needs assessment, and stakeholder consultation carried out in the previous phases, the next suggested steps for Calgary are to create a platform for multi-stakeholder engagement and initiate community-led interventions/pilot projects to find practical *(de facto)* solutions to address various barriers/challenges. In this stage, a starting point could be to review the case studies/interventions undertaken by other countries to advance digital inclusion goals and bridge the existing divide. This would also help identify whether any of these interventions/projects/programs/case studies identified in this report could suit Calgary's specific circumstances and meet the needs of vulnerable groups. Other tasks under this stage are:

- Vertical and horizontal collaboration: The City should consider active collaboration among various government agencies (along the hierarchy/different levels) and private/corporate organizations to share resources and responsibilities. It should also encourage deliberate participation and engagement of vulnerable groups, community-based organizations, non-profit organizations, volunteers, education sectors, social services, charitable foundations, faith-based organizations, and civil society organizations across the horizontal network/levels of the cityscape in designing and implementation of interventions.

- Community-driven innovation program/interventions: It is essential to take a city-wide coordinated approach that focuses on community-based design, implementation, and delivery models to test new programs or adopt solutions from case studies. Solutions should be contextualized to specific circumstances and evaluated on progress/outcomes. With explicit focus on addressing the major dimensions of digital inequity (affordable subscription vulnerability, access gap, digital literacy/skills, and lack of culturally appropriate content), The City should introduce/encourage new community-driven innovation programs, start-ups, or small-scale pilot interventions in partnership with non-city/government stakeholders to develop innovative, effective, and scalable approaches for digital equity. The City would benefit from trials of new or untested ideas and by engaging residents/citizens and other organizations. This process of co-learning and allowing citizens to work on the issues shaping their lives may help to develop capacity, empower the community, foster a sense of ownership, and voice the concerns of the marginalized group. Lesson-learning from existing interventions could also benefit/guide the city to move forward determining how best efforts/interventions can be upscaled in the next stage while a long-term strategic plan and vision to address the digital divide and provide sustained solutions is being developed.

Mid-term Development: Strategic Planning and Overcoming Barriers through Upscaled Interventions

- Developing Digital Equity Strategic Plan (at least a five-year plan with deliverable goals, action strategies to achieve these goals, and a mechanism for tracking progress).
- Establish and promote/upscale best practices across the city.
- Encourage public-private partnerships and involvement of NGO and volunteer organizations. Take a multi-stakeholder approach (with cross-sectoral collaboration) to digital transformation.
- Best use of the available resources and existing infrastructure.
- Building capacity of other non-city stakeholders (across and within).
- Launching a pilot digital navigator program (tech volunteer, one-on-one digital support tutorials, etc.) to assist vulnerable groups with accessing essential services, literacy training and digital skills development.
- Equip public libraries with necessary tools/devices/staff and provide training opportunities to enhance digital literacy/services.
- Establish consistent benchmarking/baseline guidance (for example, Digital Inclusion Index) and continuous data collection at a temporal scale to inform/adjust strategic planning.
- Encourage digital equity collaboration across sectors and actors (for example, non-profit and social service agencies collaborate): to share ideas, develop partnership opportunities, and provide input on proposed programs or policy questions with strong community engagement.

Long-term Development: Building Capacity, Monitoring Progress, Advocacy, and Sustained Solutions

- Build the capacity of municipal government to advance digital equity (for example, including a digital equity component in all aspects of City planning).
- Advocacy for stable federal funding (federal engagement, public-private partnerships, etc.).
- Track provincial /federal programs and align with City goals/strategy.

- Inter-provincial / inter-sectoral collaboration with long-term Investments.
- A mix of demand (digital literacy/skill-building, more social educational program or awareness campaigns, accessibility of digital services etc.) vs. supply-side interventions (facilitate to increase the availability of broadband internet infrastructure such as, fiber, or mobile networks, investment/funding, etc.).
- Develop digital stewardship models and empower community members/organizations through community organizing.
- Demonstrate effectiveness: especially whether existing/ongoing digital inclusion initiatives/projects have addressed the barriers and contributed to better socio-economic outcomes.
- Create a unifying framework to align the efforts across the scale of governance and actors/sectors (for example, how does city intervention/plan complement provincial and federal goals).
- Continuous feedback loop/lesson learned, follow an adaptive (flexible) model to foster resiliency/sustainability.
- Develop a Digital Equity Scorecard and Annual Reporting (performance monitoring and benchmarking).

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Appendix I – Methods Expanded

A. Systematic Integrative Review

To capture the knowledge on digital equity in academic literature, a systematic integrative review following Whittemore and Knafl's (2005) method was undertaken. The five-step process began with the clear identification of the problem through a series of discussions between the researchers and City representatives. To identify the relevant literature, a set of inclusion criteria were developed using the 'Population-Concept-Context (PCC)' framework (Robinson et al., 2018). Taking into account the multicultural fabric of Calgary, we included studies on any aspects of digital inequity, division, and exclusions affecting Indigenous people, immigrants, refugees, seniors, low-income groups, and other population subgroups in the urban context. A total of 9,976 articles were identified from different academic databases (e.g., Web of Science, Scopus, Canadian Research Index, SocIndex with FullText, etc.) through a systematic search. Following a two-step screening process (title-abstract and full-text screening), 32 peer-reviewed articles were selected to be included in this review. The eligible articles were screened by both reviewers and study characteristics were extracted such as population size, study location, objectives, methods, etc. Key findings relevant to the research questions were also extracted. Using the framework for thematic analysis by Braun and Clarke (2006), the data was iteratively compared, collated, and discussed to generate key themes and subthemes. The themes and subthemes were then interpreted and contextualized to the research settings and the City of Calgary's perspectives.

Step 1: Identification of the problem

The problem was identified based on the collaborative discussion between the researchers and City representatives. To highlight the problem, specific guiding questions were developed to create the protocol for the subsequent literature search.

Step 2: Literature search

A set of criteria was developed using the 'Population-Concept-Context (PCC)' framework (Robinson et al., 2018) to include studies that are relevant to the objectives.

Population:

Studies conducted among the urban population of developed countries, especially those that resemble the multicultural population fabric of Calgary were included in this search. Different subgroups of an urban population have been identified as most impacted by the digital divide, including Indigenous peoples, immigrants, refugees, seniors, low-income groups, and others.

Concept:

The terms “digital equity”, “equality”, and “inclusion” (and similar terms) have been accepted and describe the concepts of having access to and the ability to use ICT for the benefit of all individuals and communities. Digital inequity, inequality, division, exclusion, or gaps were used to describe any disturbances to this idea, such as particular individuals or communities being unable to access the internet or employ existing digital technology.

Context:

Digital equity can be considered in a variety of contexts, including healthcare access, law and order, social support, employment, economic issues, etc. In any of these scenarios, we incorporated studies on digital equity.

Search Strategy:

A strategy has been developed to capture peer-reviewed journal articles as well as grey literature (literature not formally published) from a variety of disciplines, including social sciences and humanities, computer science and technology, and health sciences. The search was limited to information post-2010. Appendix Table 1 lists the academic and grey literature databases.

Step 3: Data extraction

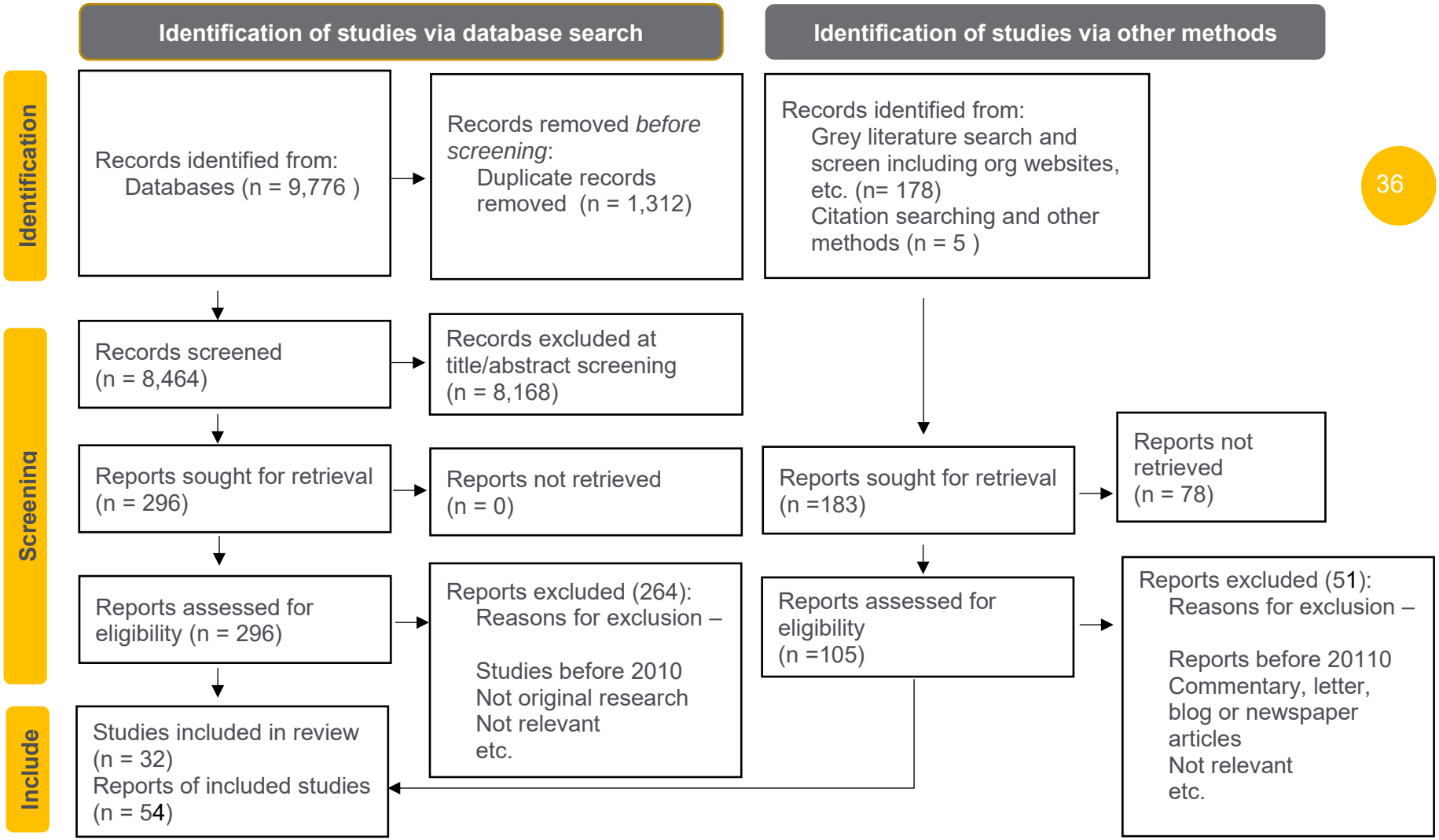
With the help of a systematic review tool, Covidence, two reviewers screened each article in two phases, title-abstract screening followed by a full-text screening. Each step of the selection of the studies is reported using an adapted version of the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) flow diagram (Appendix Figure 1).

Appendix Table 1: Academic and grey literature databases searched

Academic articles	Grey literature
• Web of Science • Scopus • Academic Search Complete • Canadian Research Index • MEDLINE • SocIndex with FullText • Communication & Mass Media Complete • IEEE Xplore digital library: Standards	• Google Scholar • ProQuest (theses and dissertations) • OAISter (WorldCat) • National Digital Inclusion Alliance • Canadian Radio-television and Telecommunications Commission

Appendix Figure 1: Flow diagram of search and selection process for the systematic integrative review (adapted from diagram for systematic review)

Appendix Figure 1: Flow diagram of search and selection process for the systematic integrative review (adapted from diagram for systematic review)



Step 4: Data analysis

The data from the eligible articles were charted and collated by two independent reviewers to identify codes and emerging themes. Study characteristics were extracted such as population size, study location, objectives, methods, etc. and key findings relevant to the objectives. The framework for thematic analysis by Braun and Clarke was followed at this stage (Braun and Clarke, 2006).

Step 5: Presentation of the results

The extracted data was iteratively compared, scrutinized, and discussed between the research team to generate key themes and sub-themes by which to organize the results. The themes have been interpreted and contextualized, through a community-engaged approach which included formal and informal conversations with social impact organizations and community groups around barriers and challenges to connecting with those impacted by the digital divide. Potential scopes of future research were also pointed out at this phase.

B. Internet Scan

As a part of the systematic scan, an internet scan was conducted to capture non-academic publications that encompass policy recommendations, lessons learned, and experiences gained through individual and organizational practices. A systematic search of the three big search engines, namely Google, Bing, and Yahoo!, identified organizational web posts, annual and other reports, newsletters, presentations, videos, podcasts, commentary, online news, blog and community forum articles, and others. This also identified many initiatives, programs, and activities to improve digital equity taken by governmental, private, or non-profit organizations, which were not published in conventional peer-reviewed journals. The internet scan was adapted using a guideline by the Canadian Institute of Health Information and the Canadian Agency for Drugs and Technologies in Health (CADTH). AACODS (Authority, Accuracy, Coverage, Objectivity, Date, and Significance) checklist was applied to ensure the credibility and validity of the information from each data source.

Web pages have been screened at two-levels. Initially, the landing page (the first page of a website that is referred to in the search results by the search engines) was screened for eligibility, followed by exploring all other pages of an eligible website. The website metadata such as web page address, page title, etc. and any description of activities, opinions, policies, recommendations, and experiences regarding digital equity were extracted. All collected data were collated and processed to generate themes. Few relevant exemplary practices with regards to key barriers have been showcased within this document (see page 9).

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