State of Digital Inclusion in Singapore
A Landscape Review

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Executive Summary

We live in an era of rapid transformation brought about by fast-evolving digital technologies. For those who are digitally disconnected (or less connected), the global pandemic has further exacerbated their existing socio-economic challenges. In these times, digital access is no longer a luxury but a basic need for participation in the global digital society.

The current report focuses on the state of digital inclusion in Singapore. For this report, we conducted a literature review that synthesised academic research, consultancy reports, policy research, intergovernmental research, press releases, and news publications. We also conducted four in-depth interviews with domain experts from around the world, on their thoughts about improving digital inclusion. They are Jan van Dijk (University of Twente), Johannes Bauer (Michigan State University), Eszter Hargittai (University of Zurich), and Anett Numa (e-Estonia).

The report is made up of two parts. The first half is a primer on the “problem” of digital inclusion. It includes the theories and frameworks for understanding digital divides and discusses the various components of digital inclusion. Each section ends with a discussion of the risk factors of digital exclusion in Singapore.

The second half of the report focuses on the “solutions” for digital inclusion through an analysis of global indices for digital inclusion, international and local strategies, frameworks, policies, and programmes. In this “applied” half of the report, we attempt to answer questions on the best practices that Singapore can learn and adapt to the local context, and how digital readiness and literacy programmes can evolve. This second half is intended for practitioners and policymakers.

Unpacking the digital divide(s) problem

The Digital Future Society defines digital inclusion as the elimination of the digital divide by ensuring those who do not have the skills and ability needed to access and use digital devices and content can do so confidently, safely, and effectively (Digital Future Society, 2019). The digital divide in question is actually made up of many divides. Digital divide scholars specify four types of digital divides — *motivation, access, skills, and usage*. These dimensions are interconnected in complex ways, and based on existing research, digital access is necessary but insufficient for digital use.

Digital divide is especially acute in low-income economies, where digital infrastructure and systems are oftentimes entirely missing in the most rural communities. For such nations, increasing physical access to digital devices is the crucial first step to closing the digital divide between the “haves”, the “have-nots” and the “have-less”.

The situation in Singapore is exceptional. As one of the most digitally advanced economies in the world, Singapore is often ranked among the top of global benchmarks for digital inclusion. Many countries look to Singapore’s digital inclusion efforts as a model for policy

action. In particular, Singapore performs consistently well in the areas of material access, reporting one of the most affordable broadband rates in the world along with the fastest download speeds.

Digital divides exist even in Singapore. Existing studies in digital inclusion have identified several factors that predict groups of people who tend to be digitally excluded. The most significant personal categories affecting digital access observed in research are age, gender, and ethnicity or race. In Singapore, the two key access gaps are age and socio-economic status — older and lower-income individuals face physical and economic difficulties that hinder their basic digital access. Often, the unequal digital access in age and income groups are compounded, highlighting the complexities in addressing the digital divide in access even in a digitally advanced country such as Singapore.

The divide is also manifested in skills. Digital skills can be classified into two types — operational and content skills. Beyond basic skills necessary for operating digital devices, there is a fuller range of skills that are required for full participation in the digital society such as communication, collaborative, and creative skills. For content-related skills, researchers have observed that being good in one dimension does not mean being good in another, making digital skills a lifelong learning endeavour. Attitudes and motivational gaps should be a key consideration in any digital inclusion policies and interventions addressing digital skills.

Scholars refer to the third level of the digital divide as the participation gap. This divide relates to technology adoption and use that can be measured in time and frequency, diversity and quality of applications used, or the benefits derived from the usage of technology. In Singapore, the digital use divide has been observed across the categories of age, socio-economic status, occupation, and education level. This suggests that a tailored approach which takes into account both the existing socio-economic divides and their relationships with digital use is necessary to address the participation gap.

To improve digital inclusion, short-term policy recommendations include: investing in public spaces to hold digital literacy classes; ensuring flexible and private all-day access; identifying and training more community leaders and seniors; and co-designing programmes with target groups. Mid-term policy recommendations include: introducing “low-tech” solutions like audio information systems to assist low-literacy groups; improving accessibility standards for persons with disabilities; and producing more multicultural and inclusive content. Longer-term recommendations include: revising Singapore’s Digital and Media Literacy Framework; systematic evaluation of digital literacy programmes; and institutionalising vocational curriculum. Policymakers should also look into improving trust in digital tools and ecosystem, better articulating the value of digitalisation, providing periodic updates of digital inclusion indicators, and designing locally recognised evaluative tools for learners to gauge their skill level and progress in digital learning journeys.

PART I

1 State of digital inclusion in Singapore

Singapore has come far in increasing digital inclusion but how well do citizens fare?

We live in an era of rapid transformation and accelerating change brought about by digital technologies. The rapidity at which technologies have changed has thrown the traditional information and media landscape into chaos, upended the business of businesses, and revolutionised how people interact with information, with one another, with their governments, and with the world.

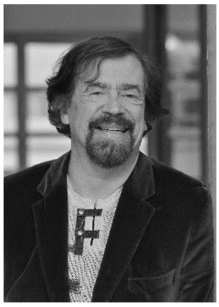
In this milieu of rapid technological change, it is increasingly challenging for policy to keep pace with the developments. In fact, the High-level Panel on Digital Cooperation appointed by the United Nations (UN) Secretary-General observed that the "divergent approaches and ad hoc responses threaten to fragment the interconnectedness that defines the digital age, leading to competing standards and approaches, lessening trust and discouraging cooperation." It urged nations to work together to address the social, ethical, legal and economic impact of digital technologies in order to maximise their benefits and minimise their harm. This is the backdrop for this series of policy reviews.

1.1 Methodology

For this report, we conducted a literature review that synthesised about 220 secondary sources[1] comprising academic research, consultancy reports, policy research, intergovernmental research, press releases, and news publications. Key search terms that were used included "digital divide", "digital inclusion", "digital literacy", "digital participation", "digital initiatives", and other related terms specific to each section. This review was conducted online from May to November 2021. Current, Singapore-based and diverse sources were included wherever possible.

As part of this landscape review, we also conducted in-depth interviews with domain experts from around the world on their thoughts about improving digital inclusion. The four domain experts comprised three professors who are the thought leaders in the field and a digital transformation adviser from Estonia, a country that is widely recognised as a world leader in digitalisation. They are:

[1] More than 220 sources were reviewed and only the publications used were included in this count.



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The interviews were conducted online in July 2021. Each interview was recorded with consent and lasted on average one hour. The interview guide can be found in the appendix. Direct quotes from the interviews can be found throughout the review where we thought they were most relevant.

The current review — the first of four — focuses on building an inclusive digital society for Singapore. The review comprises two parts. The first half of the review is a primer on the "problem" of digital inclusion. It includes the theories and frameworks for understanding different types of digital divides and discusses the components of digital inclusion and the risk factors of digital exclusion. Each section ends with a discussion of the digital divides and inequalities in Singapore.

The second half of the review focuses on "solutions" for digital inclusion through an examination of global indices for digital inclusion, international and local strategies, frameworks, policies, and programmes. In this "application-focused" half, we attempted to answer questions on the best practices that Singapore can learn from and adapt for the local context, and how digital readiness and literacy programmes should evolve.

In writing this review, we attempted to cover as much ground as practically possible. We do not intend for the review to be read from cover to cover and suggest for readers to choose the sections that are of personal interest to them. For policymakers looking for our recommendations, a summary of suggestions and insights from global experts is included at the end of the review and in the accompanying policy brief. We begin with approaches to define digital inclusion.

1.2 Digital inclusion defined

There are broadly two approaches to define digital inclusion. The more common approach takes on an inclusivity frame that enables people to access and use the Internet. For example, the UK government defines digital inclusion (Government Digital Inclusion Strategy, 2014) in terms of:

- **Connectivity** — access to the Internet. People need the right infrastructure but that is only the start.
- **Digital skills** — being able to use computers and the Internet. This is important, but a lack of digital skills is not necessarily the only, or the biggest, barrier people face.
- **Accessibility** — services should be designed to meet all users' needs, including those dependent on assistive technology to access digital services. Accessibility is a barrier for many people, but digital inclusion is broader.

In a recent report on improving digital inclusion in Southeast Asia, Roland Berger, a global consultancy, defined digital inclusion as "the empowerment of individuals and societies to effectively use information and communication technologies (ICT), enabling them to contribute to and benefit from today's digitalised economies and societies" (J. Low et al., 2021, p. 2). Likewise, the US Institute of Museum and Library Services defines digital inclusion as "the ability of individuals and groups to access and use information and communication technologies. It encompasses not only access to the Internet but also the availability of hardware and software; relevant content and services; and training for the digital literacy skills required for effective use of information and communication technologies" (Becker, et al., 2012, p. 1).

The other approach to defining digital inclusion is the elimination of the digital divide or digital exclusion. For instance, the Digital Future Society (p. 13) defines digital inclusion as the elimination of the digital divide by ensuring those who do not have the skills and ability needed to access and use digital devices and content can do so confidently, safely and effectively. In Singapore, Ng and colleagues (2021) frame the problem of digital exclusion as the lack of or suboptimal access to the Internet, be it due to the (i) inability to acquire and maintain appropriate devices; (ii) inability to link to Internet connections; (iii) not having essential online skills; or (iv) a combination of any or all these factors.

The concept of the digital divide is often discussed with issues of digital inclusion and its definitions can also be classified into two categories (see Table 1):

Table 1. Definitions of the digital divide

Definition	Source
Definitions that focus on converting the "have-nots" to "haves"	
Early research concerning the digital divide primarily considered a twofold classification: "haves" versus "have-nots"; a division between people who have access and use of digital media and those who do not.	van Deursen & Mossberger, 2018; van Dijk, 2019
Digital divide depicts the gap separating those who have access to new forms of information technology from those who do not.	Inegbedion, 2021

Digital divide refers to the distinction between those who have Internet access and are able to make use of new services offered on the World Wide Web, and those who are excluded from these services.	UNESCO
"The gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ICTs and to their use of the Internet for a wide variety of activities"	OECD, 2001
Definitions that focus on equal/unequal access to the benefits of a digital society	
The digital divide is generally defined as information access inequality, and includes not only literal access to the Internet, but also access to devices and the knowledge needed to access information. Such inequality is presumed to prevent those without access from enjoying the benefits of a digital world.	Hilbert, 2013; DiMaggio et al., 2004; Hsieh et al., 2011
The digital divide refers to unequal patterns of material access to, usage capabilities of, and benefits from computer-based information and communication technologies that are caused by certain stratification processes that produce classes of winners and losers of the information society, and of participation in institutions governing ICTs and society.	Fuchs, 2009

Two common threads cut across the myriad definitions for digital inclusion, digital exclusion, and the digital divide. The first consensus is the normative tenet that unequal access to an important resource is preventing many individuals from thriving in the modern world. The role of digital inclusion policies is to ensure that access to these resources is more equal so that the benefits can be enjoyed by all. The second consensus is that digital inclusion is multi-dimensional and needs to be addressed for not just connectivity, but also skills and use. Ensuring digital inclusivity is the endeavour to overcome the summation of challenges in these different facets.

> [Jan van Dijk on the importance of the digital medium] "Digital medium is a powerful instrument when you're able to get onto it, when you are able to use it, when you can use it in a good application for you, when you get a career or a better school or a better work, then it means that it will strengthen your position… **The problem is that some people do and others do not**."

1.3 Macro and micro perspectives of digital inclusion

Digital inclusion can be approached from either a macro or micro perspective. The macro perspective typically focuses on environmental factors and is directed at policymakers and policies. The micro perspective focuses on individuals. At the macro level, the Digital Future Society (p. 8) identified four key dimensions of digital inclusivity:

1. Access to electricity, the Internet, devices, and quality of that access;
2. Traditional and digital skills including critical thinking, literacy, and entrepreneurship;
3. Use of technology, public and private digital services, digital products and content, various types of work, social and civic engagement activities, as well as places of

access to measure actual value creation and digital inclusion of marginalised communities; and
4. A supportive environment, particularly in terms of affordability, legally valid identification, financial inclusion, trust and security.

These dimensions are further explained later in this report.

At the micro level, van Dijk's appropriation of digital technology model (2019) specifies four dimensions of digital inclusion for individuals:

1. Motivational — object-specific and primarily determined by attitudes towards technology;
2. Material — includes physical connection (e.g., infrastructure, speed), as well as the costs associated with being connected (e.g., hardware, software, and service provision);
3. Skills — the ability to use technological hardware and software, as well as navigate and use the information available online; and
4. Usage — the final stage of appropriation (a dependent factor), typically defined in terms of frequency, or the type of online behaviours.

Both macro and micro perspectives emphasise material access, digital skills and use of technology. The dimension specific to the macro level is the creation of a supportive environment and an enabling ecosystem. The dimension specific to the micro level is an individual's motivation to adopt and use technology and this is an important consideration in the implementation of community programmes and initiatives.

2 Deep dives into dimensions of digital inclusion

2.1 Unpacking access

In Singapore, there has been continued growth of household Internet and broadband access over the years. According to the Infocomm Media Development Authority (IMDA) "Statistics on Telecom Services for 2021" (Statistic on Telecom Service for 2021 Jan - Jun, 2021), the residential wired broadband household penetration rate stood at 91.8 per cent in July. Mobile cellular subscriptions were 157 per 100 people in the same month. By global standards, Singapore has one of the highest Internet access rates but even the notion of access to the Internet is not a simple dichotomy between "haves" and "have-nots". Scholars such as van Dijk (2019, p. 48) make a distinction between three types of access:

1. **Physical access** is the opportunity to use digital media by obtaining them privately in homes or publicly in collective settings (schools, libraries, community centres, Internet cafés, and other places).
2. **Material access** is broader than physical access. It can be defined as all means needed to maintain the use of digital media over time, including subscriptions, peripheral equipment, electricity, software and print necessities (e.g., ink and paper).
3. **Conditional access** can be defined as the provisory entry to particular applications, programmes or contents of computers and networks. The conditions are payment or

a particular position, membership or allowance that is required at the workplace or schools and for membership of organisations or activities.

2.2 Physical access

Scholars have emphasised that the distinction between modes of physical access is important as different devices offer different functionalities or affordances (Reisdorf et al., 2020; Pearce & Rice, 2013; Donner et al., 2011). Both mobiles and desktop computers support basic communication tasks such as texting and emails, and entertainment activities such as gaming, listening to music, and watching videos. PC-based Internet seems to better support some activities such as work-related activities and using search engines where the larger keyboard and display, high processing power, access to associated files and functions, and printing allow for a more optimal user experience (Pearce & Rice, 2013; van Dijk, 2019). On the other hand, the advantages of mobile-based Internet are that it is more accessible and affordable but requires users to compromise on other functionalities such as less advanced applications and hardware conveniences (van Dijk, 2019).

Research has suggested that over-dependence on either mobile-based Internet or PC-based Internet only can also have negative consequences. Mobile-based users have been found to be less engaged in potentially capital-enhancing online activities and as such, may not gain as much economic, material, or cultural benefits from the Internet (Hampton et al., 2021). Mobile-based usage is deemed less effective for immersive Internet work such as working on a school project, or information seeking. In fact, the participants of the study thought that there was an advantage to having home Internet access and using the Internet on a laptop or computer as compared with a mobile phone when doing homework. This was also evidenced through higher rates of homework completion and interest in school. On the other hand, other studies have pointed out that over-dependence on PC-based Internet can result in relatively few opportunities for continuous communication, entertainment, and location-based activities (Reisdorf et al., 2020).

Based on the findings of the existing research, an over-dependence on mobile-based Internet can have both short- and long-term negative impact for the users. There is also the growing trend of transitions from fixed home broadband connections to mobile connections with people exchanging desktops for tablets and smart phones (Perrin & Duggan, 2015). It follows that digital inclusion policies need to go beyond simple notions of dichotomous access (i.e., being connected or not) and look into the availability of multiple modalities for connecting to the Internet. Where practical, multiple modes of access should be offered as it provides a fuller range of online opportunities when compared with a single mode of access.

2.3 Material access

Material access is related to ongoing economic costs such as payment of monthly Internet subscriptions (Gonzales, 2016; Goedhart et al., 2019) and availability of hardware, software, applications, networks, and the usability of ICT devices and applications (Fuchs, 2009).

According to the UN Broadband Commission on Sustainable Development's Target 2 for 2025, entry-level broadband service in developing countries should not cost more than 2 per cent of monthly Gross National Income (GNI) per capita. Specifically, Internet affordability is

defined as “1 for 2” — that is, 1GB of mobile broadband costing no more than two per cent of the average monthly income. The UN target is for the world to reach 75 per cent broadband Internet penetration by 2025 and have it cost no more than two per cent of earnings.

Singapore has achieved both criteria based on the ICT Development Index 2018 by the International Telecommunications Union (ITU) which noted that Asia and the Pacific is home to some of the operators offering most value for money to their customers for entry-level fixed-broadband plans (*Measuring the Information Society Report 2018 – Volume 1*, 2018, pp. 129–130). In Singapore, Singtel offered the lowest price per Mbps worldwide (*Measuring the Information Society Report 2018 – Volume 1*, 2018, p. 144). More recent statistics put mobile broadband affordability in Singapore at 0.37 per cent of GNI per capita (US$17.94, 23.89 PPP[2]) and fixed broadband affordability at 0.74 per cent of GNI per capita (US$35.81, 47.69 PPP). Both are well below the UN target of below two per cent of earnings. For those prices, Singaporeans also have access to the fastest average fixed broadband speeds in the world (Statista, 2021).[3]

The affordances of different hardware used for Internet access discussed earlier in physical access also apply to material access in terms of download speeds. Despite the increasing trend of using smartphones for Internet access, it is believed that a major constraint to increased usage of mobile Internet subscription has been the relatively slower download speed[4] of smartphones for videos and large files (Inegbedion, 2021). Mobile broadband is often slower, less reliable, and unable to support bandwidth-intensive transactional usages of the Internet (UNESCAP, 2021). Case in point, Schradie (2011) found that people who have Internet access at home were also more likely to produce online content. Research on middle school students in China indicated that students who have home Internet access score significantly higher in the areas of technology self-efficacy, interest in technology, perceived importance of the Internet, and perceived impact of the Internet of learning, which suggests that the quality of access has a clear effect on the subsequent levels of the digital divide (Lei & Zhou, 2012).

Challenges to material access are not just limited to the cost of the Internet subscription and the speed of the connection. The plethora of hardware and software applications that have proliferated in recent years also raises the question of the quality and capability of different technologies for users. Questions about who can fully tap the full range of opportunities offered by multiple devices and who can afford the maintenance and replacement costs of newer devices are all important considerations in material access.

2.4 Personal categories that affect access

[2] Purchasing power parity (PPP) is a money conversion rate used to express the purchasing powers of different currencies in common units. This rate expresses the ratio between the quantity of monetary units required in different countries to purchase the same "basket" of goods and services.
[3] In a ranking of 176 countries, Singapore had the fastest download speed at 247 Mbps.
[4] Even in higher-income economies, such as the US or European markets, 10 per cent of the broadband subscribers still get speeds below 10Mbps and close to 30 per cent below 30Mbps. The World Economic Forum recommends that speeds above these levels would enable a more enhanced usage of connectivity, better simultaneous virtual communication for work and school, and an overall improved user experience.

Existing studies in digital inclusion have identified several factors that predict groups of people who tend to be digitally excluded (Table 2). The most frequent personal categories affecting digital access observed in research are age, gender, and ethnicity or race.

Table 2. Demographic predictors of access

Factor	Description	Source
Income	People with high income, far-reaching and influential social relationships, good education, and high skills are much more likely to have access to ICTs, to be capable of using them, to benefit from this usage, and to be supported in political participation by ICTs than people who are endowed with only a little amount of economic, political, or cultural capital.	Fuchs, 2009; Soysal et al., 2019
Social class	In general, lower levels of social-economic status (SES) significantly reduce the odds of using the Internet, due to poor access. Furthermore, a longitudinal study provides evidence that in Britain, Internet use has an effect on social class mobility, controlling for age, gender, education, health, and previous social class membership suggesting that Internet use is now important for maintaining or improving class position.	Eynon et al., 2018; Ritzhaupt et al., 2013
Education	Whether people use the Internet varies widely by level of education. Internet use (including smartphone ownership) is particularly rare among people with a lower level of completed education in Nigeria, where only 13 per cent of people say they use the Internet, compared with 73 per cent of those with more education in that country. Differences in reported Internet use between those with lower educational attainment and those with more education can be greater than 30 percentage points.	van Deursen & van Dijk, 2015; Siddiq et al., 2017; van Ingen & Matzat, 2018
Age	There are wide gaps in social media use between the youngest and oldest age groups. In some countries, this difference can exceed 50 percentage points. In Lithuania, nearly all young people (95 per cent) say they use social media, compared with only 28 per cent of those 50 and older. In some countries, like South Korea, Israel and Lebanon, social media use is more prevalent across all age groups.	Schumacher & Kent, 2020
Gender	Globally, the gender gap in developing countries is much wider than that in the developed world. Existing research shows that women tend to possess lower digital literacy skills than their male counterparts, especially among older and low-income adults. According to a study from Taiwan, the gender Internet usage divide is primarily exacerbated by “higher opportunity costs” incurred by women in patriarchal societies.	van Dijk, 2019; Hargittai & Dobransky, 2017; Jiang & Luh, 2017

Disability	Studies have found an independent effect of disability on digital access. In general, disabled people are less likely to go on the Internet due to personal mobility and device accessibility issues. Different kinds and levels of disability also affect Internet usage. In Sweden, students with intellectual disabilities report having the lowest proportion of digital access for educational purposes. In Singapore, a lack of disability-friendly courses and digital support remains an ongoing problem.	Dobransky & Hargittai, 2016; van Dijk, 2019; Goh, 2021; Johansson et al., 2021
Race/ Ethnicity	Race and ethnicity are closely tied to language proficiency and socio-economic status. In the United States, African American, Latino, and Asian populations report substantially lower odds of using the Internet as compared with Caucasians. This effect is compounded if the same users have limited English proficiency and/or come from lower-income backgrounds.	Tsatsou, 2021; Yoon et al., 2020

3 Physical and material access gaps in Singapore

In Singapore, the two key access gaps are *age* and *socio-economic status*:

3.1 Access gaps by age

The access gap by age is observed across nations. Within countries, older individuals generally have lower rates of Internet adoption. For Singapore residents between 50 and 59 years old, 95 per cent have Internet access in 2019, up from 88 per cent in 2018; but for residents who are 60 years old and above, only 58 per cent have Internet access in 2019. This is a stark contrast to the almost 100 per cent access among residents aged 7 to 49 and the 89 per cent of total residents. In other contexts, researchers found that among older seniors, the relation between age and Internet use is exponential rather than linear. In Belgrade, only 4.9 per cent of the seniors in the age group of 85 and above were using the Internet regularly and for every five-year cohort that were younger, this proportion approximately doubled (9.4 per cent for the 80–84 age group, 19.7 per cent for the 75–79 age group, and 40.0 per cent for the 70–74 age group) (Gazibara et al., 2016).

There are several reasons for the access gap in age. First, the basic literacy rates of Singaporeans aged 65 and older is about 86 per cent, compared with 99.9 per cent for those aged 15 to 25 years old (Law et al., 2018). Traditional literacy skills like reading and numeracy are foundational skills for the acquisition of digital literacy skills. The relative lack of basic literacy skills among older Singaporeans is a significant barrier for older Singaporeans to access the Internet.

Another major factor underlying the access gap by age is that people enter other disadvantaged statuses in society as they age (Hargittai & Dobransky, 2017; Srivastava & Panigrahi, 2019). Full-time employees are typically required to keep up with their skills or learn new ones to cope with the demands of their jobs. When seniors enter retirement, the need to learn Internet skills is reduced. Moreover, their income levels decline and they have “fewer financial resources to devote to technologies” (Hargittai & Dobransky, 2017, p. 198).

Researchers also pointed out that one of the most significant barriers to Internet adoption among seniors is the decline in cognitive and physical capability that comes with old age (Loos & Bergstrom, 2014; Dobransky & Hargittai, 2016). With advanced age, chronic illnesses become more common, and physical and mental functioning deteriorate, impeding the seniors' adoption and use of technologies. Compounding this is the increased complexity of smart phone functionalities that require a basic level of dexterity and good understanding of multi-layered menu structures to operate (Hänninen et al., 2021). A study of about 4,000 older Singaporeans (aged 60 years and above) found that one in 15 respondents faced difficulties in using the Internet due to poor health (Ang et al., 2020). This suggests the importance of identifying and addressing age-related problems that hinder Internet use in bridging the digital divide among older populations. A common recommendation to address operational problems for seniors and persons with disabilities is the simplification of current digital resources to enhance "readability", both in terms of its appearance and operation (Yang & Chen, 2015).

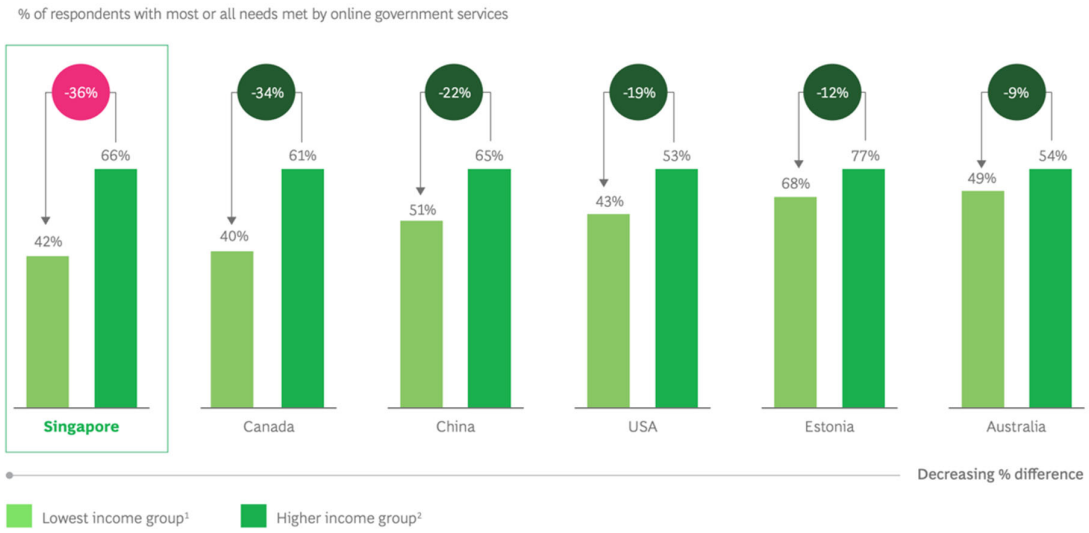
3.2 Access gaps by socio-economic status (SES)

The other key access gap in Singapore is SES. Taking housing types as an indicator of SES, nearly all (98 per cent) of households living in private condominiums and other apartments have Internet access, compared with 86 per cent who live in public housing. The gap is widest for households residing in one- and two-room public flats: only 45 per cent of households residing in one- and two-room Housing Development Board (HDB) flats have Internet access which means that more than half the households living in one-and two-room HDB flats have no Internet access. Among these households, only 31 per cent have a personal computer, in contrast with 95 per cent of households in private condominiums and other apartments.

By household income, 69 per cent of households in the lowest 20th percentile have Internet subscription/access, compared with an average of 87 per cent across all income groups (SingStat, 2019a, Table 49). Just 58 per cent of households in the lowest 20th income percentile have a personal computer, compared with an average of 81 per cent across all income groups.

In fact, Singapore's digital divide by household income was observed to be wider than its global counterparts, according to Boston Consulting Group's *Bridging Singapore's Digital Divide in Government Services* 2021 report (Tan et al. 2021; see Figure 1). The report pointed out that only 42 per cent of Singapore's lowest-income households (below the 10th percentile) have their needs met by online government services, despite having the lowest expectations (Tan et al. 2021).

Figure 1. Digital divide for income in Singapore wider than global peers



For lower-income households, the choice to pay for an Internet subscription may entail giving up other essential spending; and even when they choose to connect, they might not be able to afford the best connection both in terms of speed and data usage (Dobransky & Hargittai, 2016). In interviews with nine low-income households in Singapore, CNA (Channel NewsAsia) reported that none of them had broadband Internet subscriptions at home, and few subscribed to a mobile data plan (Oh, 2019).

According to the Household Expenditure Survey 2017/2018, expenditure on communication was $57.30 per household member in the lowest income quintile with an average monthly expenditure of $942.50. In the highest income quintile, expenditure on communication was $110.70 per household member with an average monthly expenditure of $2,945 (SingStat, 2019a, Table 23). This works out to be 6 per cent expenditure of the household expenditure for the lowest income households, and 4 per cent expenditure for the highest income households. For the average household, communications expenses are about 5 per cent of the household expenditure.

While the difference of 1 per cent is small, it bears noting that an average household in the lowest income quintile is already likely to face a shortfall of $335 each month even after regular social transfers such as Workfare, a government wage supplement scheme (SingStat, 2019a; see Table 3). Having multiple modes of physical access or even just higher quality access is economically untenable for low-income households in Singapore.

Table 3. Average monthly household income and expenditure across five income quintiles

Income Quintile	Average Monthly Household Income	Average Monthly Household Expenditure	Difference
1**st** – 20**th**	$2,235	$2,570	–$335
21**st** – 40**th**	$5,981	$3,753	$2,228
41**st** – 60**th**	$9,678	$4,812	$4,866
61**st** – 80**th**	$14,407	$5,826	$8,581
81**st** – 100**th**	$26,587	$7,573	$19,014

On the supply side, Singapore Internet Service Providers (ISPs) charge $40 to $50 per month for Internet connection. Routers, installation, and other fees add around another $200 to the cost. A new laptop that will last at least three years costs over $2,000, plus another $500 for warranty. Fibre installation can cost $500. For an ordinary household, connecting to the Internet and getting a laptop adds up to a once-off cost of over $3,000, with ongoing subscription payments (MoneySmart, 2021). This is well over the monthly average income for the lowest-income households (see Table 4).

Table 4. Best fibre broadband plans in Singapore 2021 (MoneySmart, 2021)

ISP	Price/month	Registration fee	Service activation fee	Total cost of two-year contract
WhizComms	$34.90	Free	Free	$894.31
M1	$39.90	Free	Waived up to $90 on weekdays 9am to 6pm	$1,073.16
StarHub	$45.90	Free	$56.71	$1,020.61 (first three months free)
ViewQwest	$36.90	Free	$56.71	$942.31
MyRepublic	$38.99	Free	$53.50	$1,045.97
Singtel	$44.90	Free	Free	$1,134.31

> [Johannes Bauer on better access] “You have the two components — lack of access and lack of affordability — and again, this is linked back to income. **Being low income may actually constrain users [whether] they can afford the technology.** And it's not just access that we noticed, it's also having the right device in place.”

3.3 Compounding access gaps

To complicate the issue, the unequal digital access in age and income groups do not occur independently and are often compounded. In Singapore, over a third (36.7 per cent) of the low-income households were headed by persons aged 65 years and over in 2017/18 (SingStat, 2019b). Households in the lowest 20 per cent income group were the only group whose expenditure growth (3.0 per cent per annum) outpaced income growth in nominal terms (2.8 per cent per annum). The low-income households who are headed by seniors are doubly disadvantaged in a digital society.

This compounding effect is not unique to Singapore. In Australia, non-users of the Internet tend to be the oldest, and they were also least likely to have a tertiary qualification and more likely to be low-income earners (Borg & Smith, 2018). They were predominantly retirees and included the largest group of people who identified as disabled or who lived outside major cities. Non-users of the Internet were almost six times less likely to agree that the Internet is beneficial. They also felt that their digital self-efficacy was poor and were more likely to have no Internet access at home.

The compounding effect is not just between old age and low income. In Singapore, mobile-based Internet is increasingly the top equipment of choice for accessing Internet at home while the use of computers continued to drop (IMDA, 2019) and in less affluent homes, computers are less of a priority than mobile phones (Ng & Lim, 2020). Youth from low-income households who only connect to the Internet using mobile devices are more likely to develop a limited repertoire of Internet skills confined to the mobile devices, compared with their counterparts who have access to both PC-based and mobile-based Internet (Lim, 2018). Their limited familiarity and experience with the full digital opportunities offered by PC-based Internet can have serious downstream consequences in the range of economic activities that they can participate in.

These observations highlight the complexities of closing the digital divide in access even in one of the more connected countries in the world. As van Dijk (2005) argues in his theory of resources and appropriation, “categorical inequalities in society produce an unequal distribution of resources and that an unequal distribution of resources causes unequal access to the Internet” (p. 15). The differences in Internet access reinforce inequalities of participation in society and this effect therefore reflects on greater inequalities between persons, positions, and resources. This is why structural and generational effects continue to be evident in the access dimension of digital inclusion (van Dijk, 2019).

The preceding sections highlighted two key demographic variables that influence digital access in Singapore. Two other topical issues relating to access in Singapore are discussed in the following sections. The first is on the sufficiency of devices for households with school-going children that became particularly salient during the COVID-19 pandemic, and the second is on the limitations of public access points in closing the digital divide.

3.4 Households with school-going children

According to the *Annual Survey on Infocomm Usage in Households and by Individuals 2019*, about 98 per cent of households with school-going children had computer access at home (Ong, 2019). This is higher than the percentage for resident households without school-

going children, at 83 per cent. For households with school-going children, Internet and broadband access rates were both near 100 per cent in 2019, about two percentage points higher than in 2017.

Despite the near universal connectivity reported in households with school-going children, 8 per cent of families who lived in rental units did not have a connection and 44 per cent lacked a computer or a laptop at home, based on a study of over 5,000 children aged six years and below (Ng & Lim, 2020). When the Ministry of Education (MOE) had to implement home-based learning during the periods of heightened COVID-19 alerts, 3,300 primary school pupils and 700 secondary school students returned to school daily because of parents' requests, the need for alternative care-giving arrangements, and lack of digital devices or Internet access at home (Teng, 2020).

The urgency to close the access gap for households with school-going children is evident to eliminate the "homework gap" between those who can access the Internet to support their schoolwork at home, and those who cannot (Beaunoyer et al., 2020). This is when individual and social dimensions, such as whether a household can afford connections or hardware needed to access the Internet at home, or whether householders see the personal need to subscribe to high-speed access, play a significant role in shaping uptake.

As a stopgap measure, the MOE loaned about 12,500 laptops or tablets, as well as 1,200 Internet-enabling devices such as dongles to students who did not have enough devices at home for home-based learning (Lee & Yeo, 2020). Even with these stopgap measures, there have been many reports of students from low-income families sharing devices on loan and experiencing connectivity issues because they did not have Wi-Fi subscription or updated devices (Yip, 2020a; J. Ang, 2020; Goh, 2020; Ng & Lim, 2020).

In the short term and for practical reasons, any connectivity and any device are better than no connectivity. In the longer term, policy interventions need to take into consideration the quality of the technology provided for young people in low-income households. Lower quality devices that are second-hand and cheap are also more prone to malfunctions and unstable connections (Goedhart et al., 2019). When devices break down, additional expenses may have to be incurred to repair the hardware or to update the software. These negative experiences associated with low-quality access can lead to other problems such as decreased motivation to engage with the Internet and acquire Internet skills (Gonzales, 2016). On the other hand, providing young people with high quality access will enable greater autonomy over using technology and amount of experience of being online and in turn have a positive influence on their level of digital skills (Hargittai, 2010).

This trifecta of connectivity, device sufficiency, and quality of access are key considerations in a more permanent solution to close the access gap especially for low-income families with school-going children (S. S. Lim, 2020; Parliament of Singapore, 2020). And as discussed earlier, the solutions may not be straightforward because the structural effects are often compounded for low-income families struggling both to cope with home-based learning and at the same time, deal with economic challenges such as finding work during the pandemic (Yip, 2020b).

3.5 Limitations of public access

Providing free public access can be an effective way to connect those who are digitally disadvantaged. In Singapore, those without Internet access at home can be connected at public libraries, Internet cafés, and community centres or through public Wi-Fi hotspots offered by the Wireless@SG programme.

Our review did not turn up any research specific to the quality of public access in Singapore, but other existing studies generally point to two key limitations for the deployment of public access points to close the digital divide — autonomy of use and privacy. Those who can access the technologies from home expectedly reported higher ease of use of technologies compared to those who need to access them from public spaces such as schools, libraries or Wi-Fi hot spots at coffee shops (Gonzales, 2016). Eynon and Geniets (2016) also found that users of public access locations often attributed poor quality of access to the limited range of websites they had access to. Where quality of access was reported to be poor, users often spent less time online and explained their low use in terms of difficulties of access and lack of interest (Livingstone & Helsper, 2007).

The autonomy of use, which is not afforded by public access points, can also limit the users' likelihood of producing online content (Schradie, 2011). When users have autonomy on where, when, and on what devices they use to access the Internet, they have better control over the production process, and can produce more content. They are also more likely to use the Internet for a greater variety of activities (Hargittai, 2010).

> [Eszter Hargittai on autonomy of use] "What's been very consistent in research [is] autonomy of use, [which is] defined as the freedom to use the technology when and where one wants. *In many of the analyses, it's clear that people who have Internet access at home on mobile, tablet, laptop and desktop do more online."*

Finally, users accessing public computers reported that they are not the perfect solution as they feel uncomfortable from having to use the Internet in public spaces (Eynon & Geniets, 2016) and because those public places lack privacy and they feel "unsafe" (Goedhart et al., 2019).

4 Unpacking digital skills

The review of digital skills inclusion in this section will subsequently lead to the conclusion that there is no international consensus about its definition, unlike access which has generally agreed-upon definitions and standards for measurement, such as physical and material access.

Hatlevik, Ottestad, and Throndsen (2015) suggested that technological skills are generally conceptualised in two parts — a domain part (e.g., computer, ICT, Internet, multimedia) that is defined in combination with a specific knowledge perspective (e.g., competence, literacy, skills). These components would include a basic set of skills in using computers or Internet technology, such as turning off the computer, opening a folder and saving a file. Søby (2003) noted that these skills are a basic component of digital literacy that include foundational

knowledge of hardware, software, applications, networks, and elements of digital technology.

These basic technical skills are also known as operational skills (van Dijk, 2005) or technical competence to operate a computerised or electronic device (Mossberger et al., 2003). van Deursen, Helsper, and Eynon (2014) referred to them as “button knowledge” (p. 3).

van Deursen and Helsper (2017) further identified a subset of basic technical skills, which they called medium-related skills. These skills relate to understanding the hypermedia structure of the Internet, which requires the skills of navigation and orientation (van Deursen & van Dijk, 2009a; 2010); and information-navigation skills related to searching for information, including the ability to find, select, and evaluate sources of information on the Internet (van Deursen et al., 2016). The suite of information-navigation skills include:

- Operating an Internet browser:
  - Opening websites by entering the URL in the browser’s location bar;
  - Navigating forward and backward between pages using the browser buttons;
  - Saving files on the hard disk;
  - Opening various common file formats (e.g., PDFs);
  - Bookmarking websites.
- Operating Internet-based search engines:
  - Entering keywords in the proper field;
  - Executing the search operation;
  - Opening search results in the search result lists.
- Operating Internet-based forms:
  - Using the different types of fields and buttons;
  - Submitting a form.

Beyond these basic skills, there is a wider range of skills that are required for full participation in the digital society — such as communication, collaborative and creative skills. The set of digital skills identified by van Dijk, van Deursen (2009b; 2010) and colleagues (van Deursen et al., 2016) are compiled in Table 5 below. van Dijk and van Deursen (2014, p. 42) classified these skills according to medium-related and content-related skills:

Table 5. Framework of medium- and content-related digital skills (various sources)

Operational skills	Basic technical skills required to use the Internet, often referred to as "button knowledge"	Medium-related
Formal Internet skills	These relate to the hypermedia structure of the Internet which requires the skills of navigation and orientation	
Information Internet skills	Searching for information, including the ability to find, select, and evaluate sources of information on the Internet	Content-related
Communication skills	Mailing, contacting, creating online identities, attracting attention online; profiling; and the social ability to pool knowledge and to exchange meaning.	
Content-creation skills	Skills needed to create content of acceptable quality to be published or shared with others on the Internet	
Strategic skills	These are the capacity to use the Internet as a means of reaching particular goals and for the general goal of improving one's position in society. The emphasis lies on the procedure through which decision-makers can reach an optimal solution as efficiently as possible.	

> [Jan van Dijk on skills] "And talking about skills, you also see differences of skills that might be easier for people to learn, such as the operational skills…but not the content related skills, like information skills, communication skills. You need to use the Internet."

Internationally, the UNESCO Institute for Statistics and the Global Alliance to Monitor Learning (Law et al., 2018, p. 6) defines digital literacy as:

> … the ability to define, access, manage, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies and networked devices for participation in economic and social life. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy, data literacy and media literacy.

The European Union (EU) uses a similar (multi-dimensional) definition of digital literacy that is encapsulated in the Digital Competences Framework (DigComp). The framework comprises five key components (Carretero et al., 2017, p. 11):

Information and data literacy:

1.1. To articulate information needs, to locate and retrieve digital data, information, and content

1.2. To judge the relevance of the source and its content

1.3. To store, manage, and organise digital data, information, and content

Communication and collaboration:

2.1. To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity

2.2. To participate in society through public and private digital services and participatory citizenship

2.3. To manage one's digital identity and reputation

Digital content creation:

3.1. To create and edit digital content

3.2. To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences are to be applied

3.3. To know how to give understandable instructions for a computer system

Safety:

4.1. To protect devices, content, personal data, and privacy in digital environments

4.2. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion

4.3. To be aware of the environmental impact of digital technologies and their use

Problem solving:

5.1. To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments

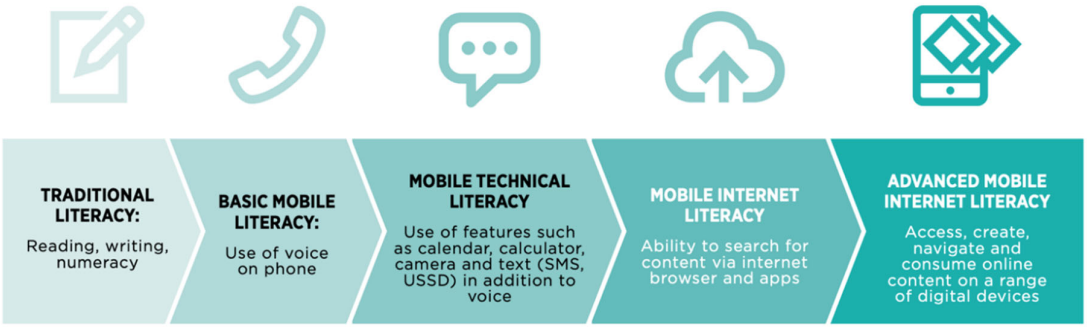
5.2. To use digital tools to innovate processes and products

5.3. To keep up to date with the digital evolution

The digital skills frameworks listed above are not exhaustive. Besides the frameworks that cover general Internet skills, there are others that are specific to hardware, such as the digital literacy for using a mobile device mentioned by the GSMA intelligence digital inclusion report 2014 (see Figure 2) or those required for new developments such as Artificial Intelligence (AI) (UNESCO, 2021).

The authors of this policy review have also conducted a review of different digital literacy frameworks which can be found here: "Towards a United Framework for Digital Framework in Singapore." Both the paper and the current review are not exhaustive, due to the sheer volume of different frameworks for different skillsets and different technologies.

Figure 2. Stages of digital literacy using a mobile device[5]



Basic mobile literacy: The ability to use the phone to make voice calls

Mobile technical literacy: The ability to use a mobile phone and its non-voice and core functions such as SMS, the calculator, alarm clock, time and date, contact menu, and camera. People who are technically illiterate are less likely to use these core functions effectively, if at all

Mobile internet literacy: The ability to access the internet using a mobile device internet browser and or application to find resources, and the capability to critically evaluate and create information

Advanced mobile internet literacy: The ability to find, evaluate, utilise, share, and create content using information technologies and the internet using a mobile phone or a computer. Advanced skills are achieved via five interdependent stages

4.1 Implications for a surfeit of frameworks

The plethora of frameworks available for understanding digital skills also means that there are multiple dimensions and benchmarks for being a skilled user of the Internet: *being good in one dimension does not mean being good in another* (Hargittai & Micheli, 2019). The researchers gave the example of how some users are very skilled in sharing content but may not know how to go about protecting their own privacy or managing information overload. It is important then to recognise that users are unlikely to have mastery in all the different dimensions of digital media and being digitally skilled is a constant work-in-progress.

As an illustration of the multi-dimensional and lifelong learning orientation of digital frameworks, the EU offers a self-evaluation digital competence tool for citizens (see Figure 3). The purpose of the Digital Competence Wheel is "to provide an overview of which digital competences exist and should be improved, as well as concrete inspiration for how to improve the most relevant digital competences" (*The Digital Competence Wheel, n.d.,* para. 1). Figure 4 shows a screenshot of an individual's test scores with tailored recommendations on how a digital competence can be strengthened.

[5] USSD (Unstructured Supplementary Service Data) is a Global System for Mobile Communications protocol that is used to send text messages. USSD is similar to Short Message Service (SMS).

Figure 3. DigComp self-evaluation digital competence wheel

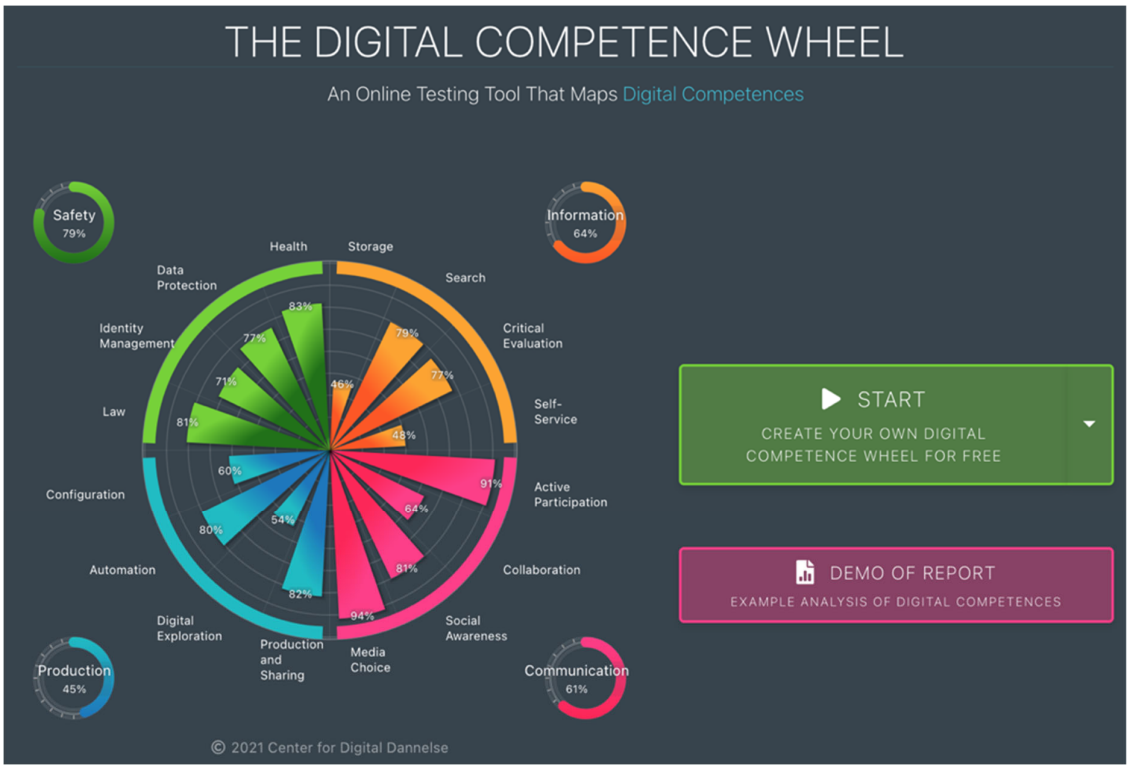
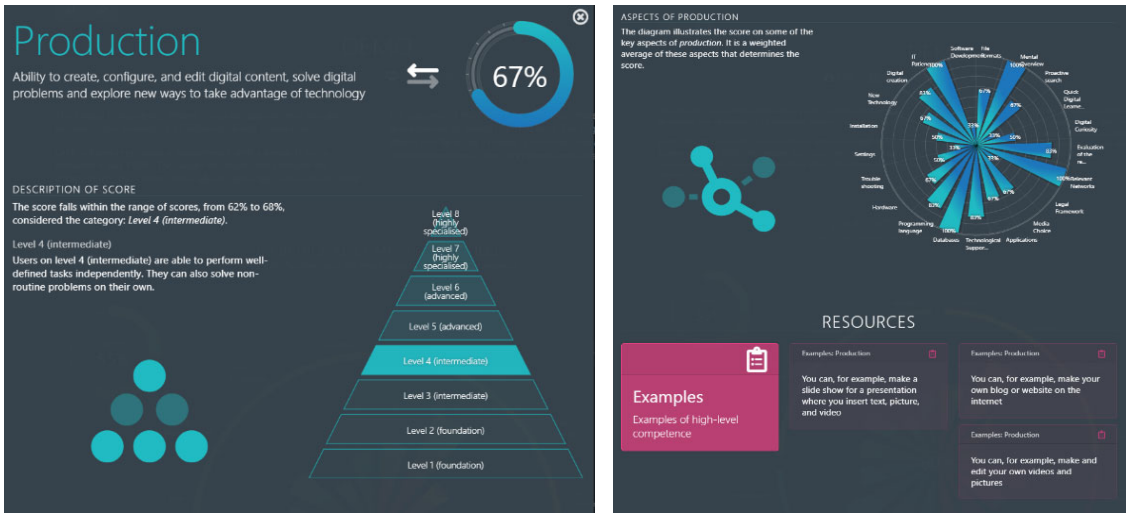


Figure 4. Example of individual test scores and tailored recommendations



There are other examples of how mastery of digital skills can vary widely depending on the dimension or framework being used as the benchmark. In the Netherlands, van Dijk (2019) noted that the majority of the population (98 per cent) has Internet access and most have sufficient technical or medium-related skills; but the more advanced strategic skills are mastered by only about 20 per cent of the population (van Deursen, 2010; van Deursen & van Dijk, 2015a). The World Economic Forum (WEF) estimates basic workplace digital skills mastery (defined as the ability to copy or move a file or send e-mails) to be at 62 per cent on average in higher-income economies; this drops to 44 per cent if standard skills (i.e., defined

as the ability to use basic formula in a spreadsheet or create electronic presentations) are considered. In lower-income economies, it is estimated that only 32 per cent of the population has basic digital skills for the workplace (Orduña, 2020).

4.2 Personal categories that affect competency in digital skills

Digital skills gaps by education

The most significant factor in predicting digital skills competence is educational attainment. Research has found that education attainment is significant for competency in Internet skills (Siddiq et al., 2017; van Ingen & Matzat, 2018). In their research on the role of education on digital skills and capital-enhancing usage, van Ingen and Matzat (2018) observed that educational differences translate most strongly into inequality in skills. Those with higher levels of education tended to have greater Internet awareness, better training, higher capabilities, and greater abilities to evaluate online content (van Deursen et al., 2014). Hargittai and Dobransky (2017) have also found that users with a high school education or less were significantly less skilled than those with a college education.

Hargittai (2010) has even found an inter-generational effect for educational attainment. In the study, parental education explained the variation in user skill even when respondents' education level was held constant. Those from families with at least one parent holding a graduate degree exhibited significantly higher-level know-how about the web than others, even when other background characteristics were held constant. This observation was also supported by Siddiq, Gochyyev, and Wilson (2017). When accounting for differences in students' socio-economic backgrounds on ICT literacy, findings revealed that students with high SES (i.e., father with higher education) scored higher on the literacy assessment test than students with low SES (i.e., father with no or lower education), which points towards the varied effects of household SES on education and digital literacy.

Educational attainment is also particularly important for information digital skills, which are defined as the "ability to find, evaluate, and effectively use information online" (Kiliç-Çakmak, 2010; Kurbanoglu et al., 2006). According to the American Library Association (2000), an information-literate person is ''able to recognise when information is needed and has the ability to locate, evaluate and use the needed information effectively" (p. 2). In today's world, these skills to assess information by sorting out misinformation, fake news, and biased information have become a key issue in training people to become critical thinkers and consumers of information (Eshet-Alkalai & Amichai-Hamburger, 2004).

One key challenge in closing the second-level digital divide in skills is that digital skills have been found to have a sequential and conditional nature — a person who lacks one type of skill is also likely to lack another (van Laar et al., 2019). Without informational and communications skills, users are less likely to develop collaboration and creative digital skills and consequently, less likely to have strong problem-solving digital skills. And this sequence is premised on educational attainment. The scientific evidence points to the practical limitations of digital skills interventions for population segments with lower education. Without sufficient traditional literacy skills, people will be constrained in the type of digital skills that they can acquire and are less likely to gain mastery in the more advanced skills such as creative digital skills.

Digital skills gaps by age

Age has been found to predict digital access — seniors are more likely to be digitally excluded in terms of physical access (Internet connectivity) and material access (such as the ability to afford high quality broadband). Age has also been found to predict digital skills competency and not in a wholly exclusionary way.

Unsurprisingly, the older generation perform worse than the younger generation in operational skills (i.e., button skills and navigational skills; van Deursen & van Dijk, 2009a). Recent intergenerational digital divide research found that in general, high school students had higher ICT literacy and better information acquisition skills than their parents and teachers (Soysal et al., 2019). In the Netherlands, older users lagged younger users in the skills to operate digital media as well as skills to handle the formal structures of the Internet, such as menus and hyperlinks (van Deursen & van Dijk, 2015b). The use of ICT devices requires physical dexterity, and the older generation can find menu navigation, keystrokes, and mouse clicks challenging to execute (Tan & Chan, 2018). However, one of the experts pointed out that the assumption that young people do not need help is flawed:

> [Eszter Hargittai on skills for youth] "I actually think it's a huge problem when we assume that younger people don't need help and training, because we're short-changing that generation. And then we're short-changing everyone, and that includes employers and companies that hire young people who don't actually know what they're doing. **It is a very, very bad thing to assume that just because they grew up with technology, they know everything about technology.**"

Furthermore, older users do not always perform worse than the younger generation in other aspects of digital skills. According to van Deursen and van Dijk (2011), while the younger generation may perform better on operational skills, they may not fare as well on information and strategic skills. These "content-related skills" are skills to seek and evaluate information, and problem-solving online in the most optimal and efficient way (Helsper & van Deursen, 2017). Researchers have found that as long as seniors have sufficient fundamental operational skills, they can be better at content-related tasks than their younger counterparts. Their searches are more relevant and are more specific to the task at hand. Scientists attribute this to the higher stock of mental resources such as knowledge of technological and societal affairs, and critical thinking skills that the older generation possess (van Dijk, 2019). This is supported by recent research on the effect of age on ICT skills among library personnel, which found that the age of respondents had a significant positive effect on task performance (Oyedipe & Popoola, 2019). All things being equal — like educational attainment and socio-economic status — being older does not always mean having inferior digital skills.

4.3 Digital skills gaps in Singapore

As part of the tracking for Singapore's progress towards the UN Sustainable Development Goals (SDGs), the Singapore Department of Statistics reported that the proportion of youth and adults with ICT skills was approximately 76 per cent in 2020 (SingStat, 2021; see Figure 5). The gender gap in ICT use was about 4.3 per cent. Consistent with existing studies, age was a major differentiating factor. Only 25 per cent of Singaporeans aged 75 years and

above had ICT skills compared to 75 per cent and above having ICT skills for the younger age cohorts (SingStat, 2021; see Figure 6).

This indicator is defined as the percentage of individuals that have undertaken certain ICT-related activities in the last three months (Law et al., 2020). Computer-related activities to measure ICT skills are as follows:

- Copying or moving a file or folder;
- Using copy and paste tools to duplicate or move information within a document;
- Sending e-mails with attached files (e.g., document, picture, video);
- Using basic arithmetic formulas in a spreadsheet;
- Connecting and installing new devices (e.g., a modem, camera, printer);
- Finding, downloading, installing, and configuring software;
- Creating electronic presentations with presentation software (including images, sound, video, or charts);
- Transferring files between a computer and other devices; and
- Writing a computer programme using a specialised programming language.

Figure 5. Proportion of youth and adults with ICT skills by age group

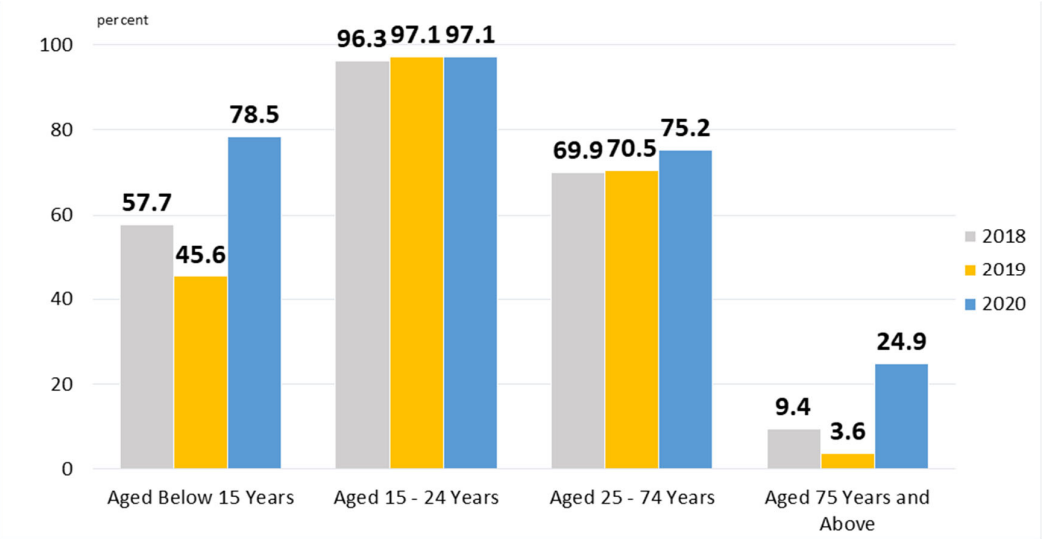
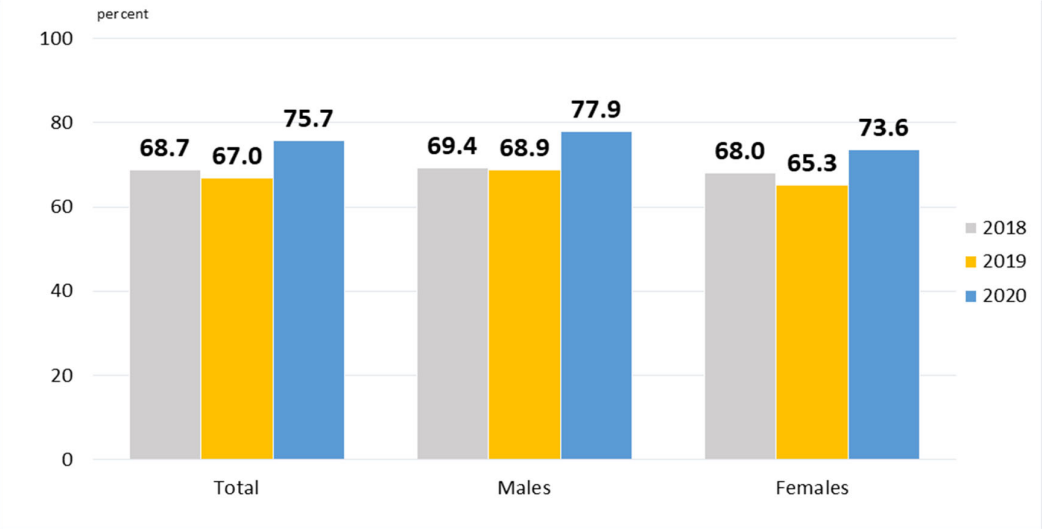


Figure 6. Proportion of youth and adults with ICT skills by sex



While the indicator suggests that Singaporeans are on average highly skilled digitally, there are two considerations for interpreting these statistics. First, the indicator is based on the proportion of Singaporeans who have undertaken any of the computer skills on the list. These range from very simple tasks such as connecting and installing new devices to very complex tasks such as writing a computer programme using a specialised programming language. The actual proportion when disaggregated by the different skills would be significantly lower for the more advanced digital skills (see Table 6). In Table 6 (IMDA, 2019, p. 16), only one in four residents were creating content, compared with almost ubiquitous use for communications and leisure activities.

Table 6. Primary activities of Internet users in Singapore, 2017–2019

Primary Internet Activity Group	Residents aged 7 and above		
	2017	2018	2019
Communication	94%	95%	96%
Leisure Activities	90%	91%	92%
Getting Information	84%	85%	85%
Purchasing or ordering goods or services	55%	60%	66%
Online Banking	59%	60%	62%
Dealing with government organisations / public authorities	44%	45%	46%
Education or learning activities	24%	26%	27%
Creating Content	26%	26%	24%

Base: Internet users aged 7 and above who had used the internet in the past 3 months

Second, the SDG Target 4.4.1 statistic is based on self-reports, which have been found to be usually higher than if actual digital skills were assessed. For instance, in ECDL Foundation's *Perception & Reality: Measuring Digital Skills Gaps in Europe, India and Singapore*, in Singapore, 88.5 per cent of the study participants rated their digital skills as "fair" to "excellent", but when their digital skills were assessed, the average score was only 55 per cent (ECDL Foundation, 2018; Figure 7).

In short, the need for skills specificity in evaluating competency in digital skills and the disparity between self-reported and assessed efficacies are two key considerations for formulating policy interventions and initiatives to close the digital skills gap in Singapore.

In Singapore, the top reasons overall for not having computer and Internet access from 2017 to 2019 were the lack of skills (38 per cent in 2019) and the perception that there is no need to use the Internet (Tables 7 & 8). According to *Annual Survey on Infocomm Usage in Households and by Individuals 2019*, households without home Internet access cited "lack of interest/no need to use" and "lack of knowledge/skills/confidence" as the main two reasons for not using the Internet (Ong, 2019, p. 11).

Figure 7. Self-assessed digital scores vs. actual skills

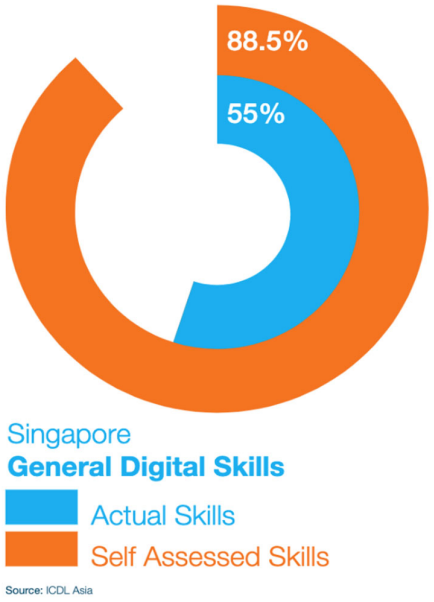


Table 7. Main reasons for not having access to a computer at home, 2017–2019

No.	Main Reason	2017	2018	2019
1	Lack of skills	23%	41%	38%
2	No need to use	33%	29%	35%
3	Old age is a barrier to learn computer skills	17%	9%	7%
4	Usually use mobile phone to access Internet	10%	11%	8%
5	Too costly to purchase a computer	9%	8%	10%

Table 8. Main reasons for not having Internet access at home, 2017–2019

No.	Main Reason	2017	2018	2019
1	Lack of interest/No need to use	64%	62%	68%
2	Lack of knowledge/skills/confidence	16%	27%	23%
3	Costly equipment costs	5%	5%	4%
4	Have access to Internet elsewhere	9%	1%	2%
5	Subscription to the Internet is too costly	3%	1%	2%

These statistics pose an interesting policy conundrum in terms of prioritising interventions. Which of the following should take precedence: public campaigns to generate interest for technology adoption, or provision of home access to create opportunities for citizens to learn about the usefulness of technology, or focus on improving digital skills to drive demand for technology adoption? In her interview, Eszter Hargittai suggested that "lack of interest" is first and foremost a skills problem that can be solved by helping non-users realise the potential of the Internet:

> "There are surveys that show that people who are not online are not online because they're not interested, or they don't think there's anything relevant. That's actually a skill story, because if you're not interested, it's because you don't realise what you can do with [the Internet]. You can have any hobby, you can find like-minded people online, you can write anything you're interested in. *And so anyone who says they're not interested — it's only because they don't actually understand what they can do."*

Motivation is also one of the primary digital divides, according to van Dijk. *Based on the existing literature, the attitudes and motivational gap should be the priority in any digital inclusion gap policies and interventions.*

5 Unpacking use

Having motivation, physical access, and digital skills are necessary, but not sufficient conditions for digital use and participation (van Dijk, 2019). Maceviciute and Wilson (2018) referred to closing gaps in digital use and participation as the third level digital divide. This divide relates to technology appropriation and use that can be measured in terms of time spent and frequency of use, the diversity and quality of applications used, and the benefits derived from the usage of technology. As this definition suggests, the typologies for determining digital use are at least as diverse as the typologies of digital skills.

A common way of defining use is in terms of time spent and functions used. Borg and Smith's 2018 study of Internet users in Australia supported a five-typology structure based on respondent's self-reported behavioural preferences, as measured by "percentage of use". The five types of users are: "non-users" (9 per cent); "sporadic users" (17 per cent); "social media & entertainment users" (18 per cent); "instrumental users" (25 per cent); and "advanced users" (31 per cent). Brandtzæg, Heim, and Karahasanović defined sporadic users as those "characterised by occasional and infrequent use of Internet services", including e-mail and other specific tasks (2011, p. 129). At the top end of the spectrum, "advanced users" generally possessed high competencies across all Internet variables, exhibiting a "very varied and broad Internet behaviour".

Use can also be defined according to motives. Kalmus, Realo, and Siibak (2011) identified two primary motives for Internet use: "social media and entertainment-related" and "work and information-related" using an exploratory factor analysis (see Table 9). On the other hand, van Deursen and van Dijk (2014) identified seven types of usage activities: personal development, leisure, commercial transaction, social interaction, information, news, and gaming.

Table 9. Typology of Internet use domains, activities, and applications

Use domains	Activities	Internet applications
Work, study/ information use	Work	Professional applications
	Consumption	E-shopping and marketplaces
	Finance	Internet banking
	Citizenship	E-government services
	Learning/study	Online courses and training
	Career development	Personal development/independent learning sources
	Searching for Information	Search engines/personal assistants and encyclopaedias
	Searching for news	News services/blogs
Leisure/social use	Communicating	E-mail/messaging services
	Networking	Social-networking services
	Community-building	Community sites and forums

	Sharing	Music, video (sharing) sites
	Entertainment	Online broadcasting and video
	Gaming	Online gaming
	Exploring	Browsing

Source: Derived from Kalmus et al. (2011)

Yet others have suggested that use can be defined as being capital-enhancing or consumptive in nature (Pearce & Rice, 2013). Internet for work, online news, and blogs are more capital-enhancing, while Internet for leisure and social uses such games, music, and videos are more consumptive in nature.

5.1 Significance of parsing difference types of digital use

Research has been converging on the observation of the "Matthew effect" (Merton, 1968), i.e., "the rich get richer and poor get poorer", on different types of digital use. Hargittai (2010) found that those who were already more privileged in society tended to have more digital resources, more online experiences, higher levels of digital competencies, and were engaged in more diverse types of uses than those who were less privileged. She further argued that it was precisely the less privileged group who had more to benefit from the more capital-enhancing online activities if they were more active in them.

This observation was also made by van Deursen, van Dijk, and ten Klooster (2015) who found that most capital-enhancing online activities were favoured by males, younger people, people with a higher education, and people with higher incomes. In comparison, non-capital-enhancing online activities were more common among people with lower education levels and below-average incomes. Borg and Smith (2018) found that those with higher levels of income and education tended to engage in more instrumental uses of the Internet associated with practical, capital-enhancing behaviours. Tsetsi and Rains (2017) also found that users who are already less advantaged were more likely to be smartphone-dependent and used their devices for more social activities, while those from more advantaged groups used their devices more for news and information.

Extant studies, several of which are cited here, all suggest that the nature of digital activities is closely associated with the societal positions that people occupy. Those who are privileged are engaging more in capital-enhancing activities while the disadvantaged tend to engage more in consumptive activities. The implication for stakeholders and policymakers is that all three levels of the digital divide — access, skills, and use — need to be part of the overarching national plans and frameworks for digital inclusion. Meaningful digital inclusion does not stop with closing access gaps; the gaps in skills and use also need to be part of the overarching plan.

> [Jan van Dijk on use] "And most challenging is of course digital skills and usage because you can provide physical access if you've got the money…. But then the problem is how people can work with it, and do it for good opportunities, and not only for disinformation and for hate speech."

5.2 Factors that influence use

Access to digital tools

Studies have shown that when users own the tools of digital production and have the information to use the new technology, they tend to create more online content (Schradie, 2011). Hargittai and Dobransky (2017) also found that the autonomy of use (defined as the number of locations users can access the Internet without restrictions) and digital skills are linked to capital-enhancing types of activities. This relationship holds true even after accounting for the effects of age. Regardless of age, people are more likely to use the Internet for capital-enhancing activities as long as they have easy access and the skills to navigate it.

Digital skills

Internet skills are also closely associated with diverse types of uses. A lack of skills and motivation is found to be a key barrier to adoption, both in terms of residential subscription and individual use (Galperin, 2017). Hoffmann, Lutz, and Meckel (2015) found that online self-efficacy had a strong positive effect on content creation and that younger, educated, and male users tended to be more active creators of online content. Similarly, Hargittai (2010) found that those with higher-level knowledge engaged in more online activities than those who understand the web less. Regarding motivations and attitudes, Reisdorf and Groselj (2017) noted that positive attitudes towards digital technologies were strong predictors for differentiation of all types of uses and for differentiating between non-users and low users.

Time spent with technology

The amount of time that people spend with technology also predicts the amount of instrumental use. Beaunoyer, Dupéré, and Guitton (2020) highlighted that time was important for people to be familiar enough with the technology to extract benefits from its use. Livingstone and Helsper (2007) found that children and young people who were online for longer and who used the Internet more often tended to take up more online opportunities, such as creating a website or contributing to a discussion forum. On the other hand, new adopters of technology and those who lacked confidence in their online skills tended to spend their limited time on the Internet primarily on entertainment and leisure activities. A similar observation has also been made by van Deursen and van Dijk (2014) who found that people who used the Internet for longer periods of time were more likely to use the Internet for news and information-seeking. All in all, research suggests that familiarity with technology is closely related to the type of online activities — capital-enhancing or consumption — that people engage in.

5.3 Personal categories that affect digital use

Education

Across the studies reviewed, educational attainment is one of the most consistent and significant predictors of the disparity in digital use. For instance, education has been found to be associated with more productive activities (Schradie, 2011) and more practical, capital-enhancing behaviours (Borg & Smith, 2018). Hoffmann, Lutz, and Meckel (2015) found that those with higher educational attainment were more likely to be involved in the production of social and entertainment and skilled content, regardless of age.

Higher educational qualifications are also the strongest predictor for differentiating broad level Internet users from low-level users (Scheerder et al., 2019). Scheerder and colleagues (2019) also showed that users with high educational attainment adopted behaviours that could be described as “studious leisure”, such as consciously exploring possibilities and benefits that the Internet had to offer. Higher educated people also made more use of the Internet for personal development and information. Those with lower educational attainment adopted behaviours that the researchers described as “keeping up with the crowd” (p. 2114). They made less use of the Internet for information and more for gaming and social interaction (van Deursen & van Dijk, 2014).

Socio-economic status

Research has shown that those with higher SES tend to be more knowledgeable and participate in more numerous and diverse activities than those who with lower SES. Those from socio-economically disadvantaged backgrounds were less likely to be online; and among those who were online, those from less fortunate backgrounds used it less and for fewer activities (Reisdorf & Groselj, 2017). On the other hand, those with higher SES were more likely to use online news and use digital media especially when it came to following political news and quality online news media (Ohlsson et al., 2017; Thorson et al., 2018; Wei & Hindman, 2011). This potentially translates to those who are already advantaged in their SES being heard more and their interests more frequently considered in policymaking (Dalton, 2017). Other studies have confirmed that middle-class children took up more online opportunities such as seeking information or creating content than working-class children (Livingstone & Helsper, 2007).

Occupational type

A person’s occupational type has also been found to determine how frequently they use digital media, how diverse that usage is, and whether it is active or passive. When examining Internet use patterns across Finland, the UK and Greece, Lindblom and Räsänen (2017) observed that in all three countries, occupational class had a clear effect on frequent Internet access. The study observed that higher occupational classes were found to exhibit a higher frequency of Internet use for cultural purposes in the UK and Greece, where “high” culture and “elitist” Internet usage was predominant. Most research shows that it is the professionals and managers who make greater use of computers than people with executive, manual and physical jobs. Students were more likely to use the Internet for information, personal development, social interaction, and leisure than the employed (van Deursen & van Dijk, 2014).

Age

Age, which has been an important category that affects access and skills, predictably affects digital use. For instance, Hoffmann, Lutz, and Meckel (2015) showed in their study that the participation divide was largely caused by an age gap in online content creation. They found that younger users gravitated towards interactive, social, and entertainment uses of the Internet, and they reported significantly higher levels of online participation.

5.4 Digital use gaps in Singapore

In Singapore, the digital use gaps mirror the access gaps by age (IMDA, 2019). Only 22 per cent of those 60 and above used the Internet to transfer funds, compared with 54 per cent

overall and 83 per cent of those between 25 and 34 years old (see Table 10). The top three primary Internet activities of Internet users (see Table 11) were related to communication, leisure activities and getting information. Capital enhancing activities such as online content creation and learning activities were the lowest ranked in 2019.

Table 10. Top 10 Internet activities on mobile equipment by age group in 2019

Activity	7-14 years	15-24 years	25-34 years	35-49 years	50-59 years	60 years & above	All age groups
Instant messaging	71%	97%	96%	95%	90%	80%	90%
Social networks	53%	89%	85%	86%	85%	51%	78%
Getting information or general Web browsing	65%	87%	91%	85%	71%	51%	77%
For purchasing or ordering goods or services	12%	81%	95%	84%	54%	29%	66%
Sending or receiving emails	31%	82%	86%	78%	54%	38%	66%
Downloading or watching movies, short films or images	68%	79%	73%	64%	58%	51%	65%
Telephoning over the Internet (VoIP) - Voice	50%	72%	69%	66%	54%	49%	61%
Checking account information	3%	72%	89%	77%	49%	30%	60%
Reading online news	28%	60%	69%	63%	50%	40%	55%
Transferring of funds	2%	63%	83%	71%	43%	22%	54%

Base: Residents aged 7 and above who had used mobile equipment in the past 3 months

Table 11. Primary Internet activity groups of Internet users, 2017–2019

Primary Internet Activity Group	Residents aged 7 and above		
	2017	2018	2019
Communication	94%	95%	96%
Leisure Activities	90%	91%	92%
Getting Information	84%	85%	85%
Purchasing or ordering goods or services	55%	60%	66%
Online Banking	59%	60%	62%
Dealing with government organisations / public authorities	44%	45%	46%
Education or learning activities	24%	26%	27%
Creating Content	26%	26%	24%

Base: Internet users aged 7 and above who had used the internet in the past 3 months

According to the *Visa Digital Inclusion Study 2018*[6] (*Visa and People's Association Partner to Strengthen Digital Inclusion for Senior Citizens in Singapore*, 2018), 84 per cent of Singapore seniors aged 50 to 80 years owned a smartphone, of whom 93 per cent reported using their smartphones regularly. However, while awareness of various mobile apps was high among seniors, the numbers dropped significantly when it came to the actual usage of digital applications such as mobile banking and ride-hailing (see Table 12).

Table 12. Percentage of seniors who are aware of and use mobile apps in 2018

Apps	Social Messaging	Ride-hailing	Food Delivery	Mobile Banking	Online Shopping
Awareness	90	81	73	74	–
Usage	–	29	–	31	22

Source: *Visa Digital Inclusion Study 2018*

More seniors (52 per cent) also reported cash as their preferred mode of payment, and most do not own credit or debit cards. Seniors who were already using the Internet were well-versed in the functions of digital apps. Of the seniors who had mobile banking apps, all of them knew how to check their balances, and 78 per cent had used such apps to transfer money between accounts.

Recent years have revealed an encouraging trend of Singapore seniors using digital apps more widely. According to the *Visa Digital Inclusion Research 2021* (*Digital Payments and Online Shopping on the Rise among Seniors in Singapore*, 2021), more than one-third of seniors (36 per cent) shopped online in the past 12 months, a 14-percentage point increase from 2018 in just three years.

The study also reported that most seniors in Singapore are aware of a variety of digital payment methods, particularly contactless card payments, QR code payments, and mobile contactless payments. For contactless cards, high awareness (and ease of use) also translated to high usage (see Table 13).

Table 13. Percentage of seniors who are aware of and use digital payment methods (2021)

Payment Methods	Contactless Card	QR Code	Mobile Contactless
Awareness	90	67	56
Usage	68	22	31

Source: *Visa Digital Inclusion Research 2021*

As evidenced in earlier sections, usage is contingent on access and literacy. This could suggest why contactless cards, which do not require additional knowledge to operate, is the

[6] The *Visa Digital Inclusion Study 2018* was conducted on 200 senior citizens in Singapore aged 50 to 80 years of age using face-to-face interviews.

preferred alternative payment method among Singapore seniors despite awareness of other digital payment methods.

PART II

The first half of this policy review focused on understanding the "problem" of digital inclusion by unpacking its components and identifying the risk factors of digital exclusion in Singapore. As one of our domain experts, Johannes Bauer, remarked: "Access is a necessary condition to achieve an outcome, but not sufficient. You need to combine [it] with skills and the right types of users." This sums up the current thinking about the multi-dimensional and contingencies of the "problem" of digital inclusion.

The second half of the review focuses on the "solutions" for digital inclusion through an examination of global indices for digital inclusion, international and local strategies, frameworks, policies, and programmes. This second half of the review concludes with a set of bite-sized policy recommendations based on the review and insights from the four domain experts on digital inclusion.

For this second half of the review, we included the frameworks and policies in their entirety as far as possible so that readers have easy access to the fuller versions. To the review of these strategies, policies, and programmes, we added three annotations based on our assessment of their priority for Singapore: "prioritisation recommended", "progress on track" and "may not apply to local context".

6 Global benchmarks and indicators for digital inclusion

To assess the state of digital inclusion in Singapore, we located the country's performance on existing benchmarks and global indicators. As one of the most digitally advanced economies in the world, Singapore is often ranked among the top of these benchmarks (see Table 14). Where data is available, we highlighted the performance of two other digitally advanced nations — South Korea and Estonia, on the same indices for comparison. The following eight indices were selected for their currency and global standing. The purpose of this meta review is to identify indicators that Singapore has done consistently well in and those that have more room for improvement:

Table 14. Global digital indicators and benchmarks (arranged in alphabetical order)

Index	Organisation	Singapore	South Korea	Estonia
Digital Inclusion Index 2020	Roland Berger	1	7	11
Global Connectivity Index	Huawei	2	13	24
Global Digital Readiness Index 2019	Cisco	1	8	19
GSMA Intelligence's Digital Society Index 2020	GSMA Intelligence	2	1	–
IMD World Digital Competitiveness Ranking 2020	Institute for Management Development (IMD)	2	8	21
Inclusive Internet Index (3i) 2021	Economist Intelligence Unit (EIU)	12	11	30
Network Readiness Index 2020	World Economic Forum	3	14	23
United Nations E-Government Survey 2020	United Nations	11	2	3

6.1 Indices on which Singapore performed well

Singapore topped digital inclusiveness among 82 countries around the world on the Roland Berger's *Digital Inclusion Index 2020* (J. Low et al., 2021; see Table 15). South Korea was 7th and Estonia was 11th in the same ranking. The Roland Berger's *Digital Inclusion Index* (RB DII) measures the level of digital inclusion in countries based on four criteria:

1. Accessibility: The availability of digital access to an individual. Digital access is the most important requirement for digital inclusion.
2. Affordability: The financial capability to pay for digital access. As hardware and software is required for digital access, investments must be made to increase digital inclusion.
3. Ability: Digital literacy regarding the use and knowledge of ICT as part of digital readiness. Only by harnessing its tools can an individual be digitally included.

4. Attitude: The trust and enthusiasm to harness ICT. The complexity of digital tools can deter many from adopting them, necessitating a carefully thought-out approach to digital inclusion

In 2020, Singapore made gains on accessibility, affordability, and ability but scores on attitude (trust and enthusiasm towards ICT) dropped from 85 out of 100 in 2017, to 82 in 2020. This was attributed to the rise of Internet scams and concerns over personal data security.

Table 15. Overall positions and scores for SEA countries on the RB DII

	Ranking			Overall Score			Accessibility			Affordability			Ability			Attitude		
	2020	2017	Change	2020	2017	Change	2020	2017	Change	2020	2017	Change	2020	2017	Change	2020	2017	Change
Singapore	1	1	—	86	83	↑	86	80	↑	88	87	↑	84	83	↑	82	85	↓
Malaysia	21	21	—	76	71	↑	68	58	↑↑	81	78	↑	80	80	—	87	90	↓
Brunei	38	37	↓	65	63	↑	49	47	↑	86	84	↑	65	63	↑	69	68	↑
Thailand	38	40	↓	64	61	↑	64	55	↑	62	59	↑	60	68	↓	79	83	↓
Vietnam	44	49	↑	64	54	↑↑	61	45	↑↑	64	56	↑	61	63	↓	76	64	↑↑
Philippines	45	42	↓	63	59	↑	60	54	↑	59	56	↑	72	71	↑	67	68	↓
Indonesia	49	48	↓	61	55	↑	53	46	↑	60	57	↑	67	61	↑	81	71	↑↑
Myanmar	55	68	↑↑	53	42	↑↑	58	38	↑↑	53	48	↑	37	32	↑	66	63	↑
Cambodia	57	62	↑	52	45	↑	48	36	↑↑	58	55	↑	51	48	↑	50	45	↑
Laos	69	67	↓	46	43	↑	36	31	↑	54	51	↑	48	48	—	59	52	↑

Top performer · Bottom performer · ↑ Improved · — Unchanged · ↓ Degraded

Source: RB index on GSMA, ITU, World Bank, UNESCO, UNDP, Euromonitor, Ookla

Singapore was also ranked first out of 141 countries on the *Cisco Global Digital Readiness Index 2019* (*Cisco Digital Readiness Index 2019*, 2019). In the sub-indices, Singapore ranked 1st for business and government investment, 1st for human capital, 2nd for basic needs (such as electricity and water) and start-up environment, 4th for ease of doing business and technology adoption, and 5th for technology infrastructure. The Singapore government's strong hand in nudging different sectors towards digitalisation is evident in its policies stemming from early days of the IT2000 Masterplan in the 1990s and, more recently, its Industry Digital Plans for small-medium enterprises. The government has also allocated more than $500 million to support the digital transformation of businesses during the COVID-19 pandemic (H. M. Ang, 2020).

Singapore ranked 2nd globally on the *IMD World Digital Competitiveness Ranking 2020*. Singapore's achievements were attributed to its performance in the knowledge and technology factors. In particular, Singapore topped the rankings in talent, and in the

regulatory and technological frameworks. In training and education, employee training rose from the 28th place to the 16th. In addition, in scientific concentration, the scientific and technical employment indicator shows improvement. There was a fall in the future readiness ranking from 2016 to 2020, from 4th to 12th. Korea's future readiness ranking improved from 25th to 3rd in the same period.

Singapore was placed 2nd on Huawei's *Global Connectivity Index*, behind the US. Singapore scored well in broadband technology but trailed the US in cloud technology, the Internet of Things, and Artificial Intelligence.

Singapore was also 2nd on the GSMA Intelligence's *Digital Society Index 2020* and South Korea was 1st (Advancing Digital Societies in Asia Pacific: A Whole-of-Government Approach, 2020). Singapore trailed South Korea in the domains of digital identity — the existence of formal identity systems and digital identities, digital citizenship — the provision of public services through digital channels, and digital commerce. Singapore led in connectivity and was on par for digital lifestyle scores.

The *Network Readiness Index 2020* by the WEF (see Table 16) ranked Singapore 3rd out of 134 countries and first in the Asia Pacific region ahead of Australia (12) and South Korea (14). Estonia was ranked 23rd overall. In the technology pillar, Singapore trailed the leading countries in content, which refer to the content and applications that can be deployed locally. In the governance pillar, Singapore trailed the leading countries in trust and regulation. Trust pertains to an environment conducive to trust in the network economy and the trusting behaviour of the population. Regulation refers to the extent to which the government promotes participation in the network economy through regulation.

Table 16. Top five countries on Network Readiness Index 2020

Country	NRI Rank	NRI Score	Technology	People	Governance	Impact
Sweden	1	82.75	2	4	4	3
Denmark	2	82.19	5	1	2	5
Singapore	3	81.39	10	5	13	1
Netherlands	4	81.37	3	9	3	4
Switzerland	5	80.41	1	13	10	2

6.2 Two benchmarks where Singapore placed out of the top 10

Singapore was ranked 11th on the E-Government Development Index (EGDI) measured in the *UN E-Government Survey 2020*. South Korea was 2nd and Estonia 3rd (Denmark was 1st, see Table 17). The EGDI assesses e-government development at the national level and is a composite index based on the weighted average of three normalised indices:

- Telecommunications Infrastructure Index (TII): includes indices such as active mobile broadband subscription, fixed broadband internet subscriptions, fixed telephone lines, percentage of internet users, and mobile telephone subscriptions.
- Human Capital Index (HCI): includes education-related indices such as learning-adjusted years of school, expected years of school, harmonised test scores, etc.
- Online Service Index (OSI): measures the evolution of e-government services (smart services) in terms of availability, quality, connectivity and diversity of channels and the use by the public of these services.

South Korea is the global leader in OSI and is the top EGDI performer in Asia, followed by Singapore and Japan.

Table 17. Leading countries in e-government development in 2020[7]

Country	Rating class	Region	OSI value	HCI value	TII value	EGDI value (2020)	EGDI value (2018)
Denmark	VH	Europe	0.9706	0.9588	0.9979	0.9758	0.9150
South Korea	VH	Asia	1.0000	0.8997	0.9684	0.9560	0.9010
Estonia	VH	Europe	0.9941	0.9266	0.9212	0.9473	0.8486
Finland	VH	Europe	0.9706	0.9549	0.9101	0.9452	0.8815
Australia	VH	Oceania	0.9471	1.0000	0.8825	0.9432	0.9053
Sweden	VH	Europe	0.9000	0.9471	0.9625	0.9365	0.8882
United Kingdom of Great Britain and Northern Ireland	VH	Europe	0.9588	0.9292	0.9195	0.9358	0.8999
New Zealand	VH	Oceania	0.9294	0.9516	0.9207	0.9339	0.8806
United States of America	VH	Americas	0.9471	0.9239	0.9182	0.9297	0.8769
Netherlands	VH	Europe	0.9059	0.9349	0.9276	0.9228	0.8757
Singapore	VH	Asia	0.9647	0.8904	0.8899	0.9150	0.8812
Iceland	VH	Europe	0.7941	0.9525	0.9838	0.9101	0.8316
Norway	VH	Europe	0.8765	0.9392	0.9034	0.9064	0.8557
Japan	VH	Asia	0.9059	0.8684	0.9223	0.8989	0.8783

On the TII, Singapore trailed index leaders Denmark and South Korea in the percentage of individuals using the Internet and the number of fixed (i.e., wired) broadband subscriptions per 100 inhabitants (Table 18).

[7] VH = very high (rating class). VH is the highest of all rating classes.

Table 18. Selected countries in the Telecommunication Infrastructure Index (TII)

Country	Telecommunication Infrastructure Index (TII)	Mobile cellular telephone subscriptions per 100 inhabitants	Percentage of Individuals using the Internet	Fixed (wired) broadband subscriptions per 100 inhabitants	Active mobile broadband subscriptions per 100 inhabitants
Denmark	0.9979	120	97.32	44.06	120
South Korea	0.9684	120	96.02	41.6	113.62
Singapore	0.8899	120	88.17	27.97	120

On the HCI, Singapore trailed index leader Denmark in adult literacy, expected years of schooling, and mean year of schooling (Table 19).

Table 19. Selected countries in the Human Capital Index (HCI)

Country	Human Capital Index (HCI)	Adult Literacy (per cent)	Gross Enrolment Ratio	Expected Years of Schooling	Mean Years of Schooling
Denmark	0.9588	99	100	19.1	12.87
South Korea	0.8997	99	97.48	16.4	12.2
Singapore	0.8904	97.34	100	16.3	11.62

The E-Participation Index (EPI) is derived as a supplementary index to the *UN E-Government Survey*. It focuses on the government use of online services in providing information to its citizens or “e-information sharing”, interacting with stakeholders or “e-consultation”, and engaging in decision-making processes or “e-decision-making”. Estonia, South Korea, and US each have an EPI value of 1.0, which means that all of the e-participation features assessed in the survey are present in these countries. Japan and New Zealand are both ranked 4th, and Austria, Singapore, the United Kingdom, and Northern Ireland were ranked 6th. The eight countries ranked highest in the 2020 EPI are listed in Table 20:

Table 20. Countries ranked highest in the 2020 E-Participation Index

EPI rank in 2020	Country	EPI value in 2020	EPI rank in 2018	Change in EPI rank from 2018 to 2020
1	Estonia	1.000	27	+26
1	South Korea	1.000	1	0
1	United States of America	1.000	5	+4
4	Japan	0.988	5	+1
4	New Zealand	0.988	5	+1
6	Austria	0.976	45	+39
6	Singapore	0.976	13	+7
6	United Kingdom of Great Britain and Northern Ireland	0.976	5	-1

Singapore was ranked 12th on the *Inclusive Internet Index* (3i) 2021 by the EIU. Sweden was ranked first followed by the US and Spain, South Korea is 11th, and Estonia 30th. The overall index score is based on the scores of availability, affordability, readiness, and relevance categories (see Table 21):

Table 21. Inclusive Internet Index domains

Availability	Affordability	Readiness	Relevance
Usage Quality Infrastructure Electricity	Price Competitive environment	Literacy Trust & safety Policy	Local content Relevant content

Availability

The availability category examines the quality and breadth of available infrastructure required for access and levels of Internet usage. Singapore was ranked 1st, South Korea was ranked 2nd, and Estonia was ranked 37th. Although Singapore topped the ranking in this domain, it was ranked 36th in fixed-line broadband subscribers and 48th in gender gap in Internet access.

Affordability

The affordability category examines the cost of access relative to income and the level of competition in the Internet marketplace. South Korea was ranked 21st, Singapore was ranked 27th, and Estonia was ranked 36th. In this domain, Singapore was ranked 1st on the price of Internet access relative to income but trailed the leading countries in having a competitive environment (due to the size of the country and market).

Readiness

The readiness category examines the capacity to access the Internet, including skills, cultural acceptance, and supporting policy. South Korea was ranked 7th, Estonia was ranked 17th, and Singapore was ranked 29th. Within the domain of readiness, Singapore ranked 30th in literacy, 33rd in trust and safety, and 54th in policy. Singapore has high trust in government websites and apps and *low trust in non-government websites and apps*. Singapore was ranked 47th in national female e-inclusion policies. Another reason why

Singapore ranked low in this domain is because the government of Singapore does not currently have government programmes with incentives or subsidies for broadband buildout in underserved areas, unlike South Korea and Sweden.

Relevance

The relevance category examines the existence and extent of local language content and relevant content. Estonia was ranked 2nd on relevance, Singapore was ranked 41st, and South Korea was ranked 59th. "Local" measures the availability of Internet content in the local language(s). Within this domain, Singapore topped the ranking for the availability of local news in local languages and the availability of e-government services in the local language. It was ranked 73rd in the concentration of websites using country-level domains (only one to two websites out of the top 25 most visited websites were local sites). "Relevant content" measures the availability of news, finance, health, entertainment, and business information. Singapore scored 49th in the value of e-finance information, 41st in the value of e-health information, and 106th in e-Entertainment usage.

In terms of data trends, the *Digital Riser Report 2021* published by the European Center for Digital Competitiveness noted that the progress of digitally established countries like Singapore and South Korea have been stagnating over the last three years. Across East Asia and the Pacific, growing economies like Vietnam (1st) and Cambodia (3rd) consistently outperformed developed economies including Japan (17th), New Zealand (14th), and Singapore (8th) in the main dimensions of digital ecosystem and mindset (Meissner et al., 2021).[8]

7 Insights from review of existing benchmarks and indicators for digital inclusion

Across the different global benchmarks and indicators, Singapore consistently ranks as one of the leading countries in availability and access to the Internet, and the quality of high-speed Internet. It also has some of the most affordable broadband rates in the world. Regarding material access pertaining to digital inclusion, the indices suggest there is not much room for improvement. To improve digital inclusion, Singapore can bring the remaining 10 per cent of its people onto the Internet (90 per cent are currently using the Internet, compared with close to 100 per cent in the leading countries).

The other areas for improvement in access would include policies that promote the safe and widespread use of the Internet for women by way of national female e-inclusion policies, increasing the number of female researchers (Singapore was ranked 47th in national female e-inclusion policies on the EGDI) and improving the web accessibility of government websites for persons with disabilities. According to EIU and the European Internet Inclusion Initiative (EIII), http://www.gov.sg failed 31 tests and passed 361 tests conducted by an automated web accessibility checker.

[8] The *Digital Riser Report 2021* analyses and ranks the changes that countries around the globe have seen in their digital competitiveness between 2018 and 2020. A country's digital competitiveness is defined in two main dimensions: its ecosystem and its mindset. For both dimensions, report includes five items from the *Global Competitiveness Report* (Schwab, 2019).

Several of the indices suggest that the people's *attitudes and trust towards a digital economy* are a key area for improvement. Even on the Roland Berger's *Digital Inclusion Index* where Singapore was ranked 1st, trust and enthusiasm towards ICT declined in 2020 due to the rise of Internet scams and concerns over personal data security. On the EIU's Inclusive Internet Index, Singapore ranked 96th in trust in online privacy with less than half the people (41 per cent) being "somewhat" or "very confident" that their activity online was private. Only 22 per cent trusted the information they received from non-government websites that were based in Singapore. This relatively lower ranking is noteworthy especially since the country has a national data privacy regulation and there is high trust in government websites and apps. For this area for improvement, focused efforts are necessary to understand the specific ground conditions required to improve the people's generalised trust towards a digital economy.

Local content creation is a clear area for improvement arising from the global indicators. Both the *Network Readiness Index* by the WEF and *Inclusive Internet Index* by the EIU suggest that Singapore falls short on locally created content and apps that deliver useful e-health information, e-finance information, and e-entertainment. The seeming dearth of locally relevant content may be the result of a less vibrant creative industry, a lack of digital content creation skills, or it could be the result of actual demand where people prefer international content to local content. So, while the indices suggest that this is a key area for improvement, further efforts should be calibrated against the actual demand and the supply for these contents in Singapore.

The purpose of the current review of global indicators is not a self-aggrandising exercise for Singapore to show how far it has come in ensuring digital inclusion. Neither does the review suggest that the country should unthinkingly pursue higher rankings on these indicators by highlighting the key areas for improvement. The primary purpose of this review is to provide a springboard for subsequent deep dives into the local conditions that will inform policy considerations for digital inclusion in Singapore.

The researchers for the *UN E-Government Survey* make a strong case in point for both a qualitative and quantitative assessment of these indices. In the case of the e-participation index, the EGDI noted that:

> "while e-participation platforms have continued to spread in more countries, there is a trend towards multi-function participation platforms, such as ideation forums, consultations and/or e-petitions on new policies, opinion surveys, complaint system, reports of corruption and generation of ideas and innovations."

However,

> "it is not always clear that the multiplication of electronic platforms has translated into broader or deeper participation. In many cases, the take-up of e-participation remains low. Beyond reasons related to technology access and digital skills, **a lack of understanding of motivations to participate online and the reluctance of public institutions to share agenda setting and decision-making power** seem to

play an important role in the observed limited progress, among many other factors" (p. 1).

Having examined the existing literature on digital inclusion and the key trends from Singapore's performance on the global indicators, we turn to the practicalities of advancing digital inclusion in the country through a review of international strategies, policies, and programmes.

8 Roadmaps and high-level strategies for digital inclusion

The global call to action on digital inclusion has grown increasingly urgent especially during the pandemic. There is the mounting evidence that digital inequalities are exacerbating existing social inequalities (Robinson et al., 2020). The rallying calls are unanimous in their emphasis on cooperation and collaboration, with many calling for a whole-of-society and whole-of-government approach, more public-private partnerships (PPPs), and collective action. Below, we included a selection of these higher-level strategies and recommendations from a variety of domains:

8.1 UN Secretary-General's Roadmap for Digital Cooperation (June 2020)

Based on recommendations from the Secretary-General's High-level Panel for Digital Cooperation convened from 2018 to 2019, the *United Nations Secretary-General's Roadmap for Digital Cooperation* sets out eight sets of actions for "ensuring digital inclusion for all" and guides all stakeholders to build a safer and more equitable digital world. They are organised below according to the access, skills, and use categories discussed in the first half of this policy review as well as the actions needed for a conducive ecosystem.

		Prioritisation recommended	Progress on track
Access	Achieving universal connectivity by 2030		x
	Ensuring digital inclusion for all, including the most vulnerable		x
Skills	Strengthening digital capacity-building	x	
Use	Promoting digital public goods for a more equitable world	x	
Ecosystem	Promoting trust and security in the digital environment	x	
	Supporting global cooperation on AI		x
	Building a more effective architecture for digital cooperation		x
	Ensuring the protection of human rights in the digital era		x

The three actions recommended for prioritisation in Singapore were previously highlighted in the first half of this review as areas for improvement:

1. Although basic digital skills for communication and leisure activities are almost ubiquitous among Singapore residents, competence in the more advanced digital skills, such as e-learning, is significantly lower and there is room to further strengthen digital capacity. The authors of this review have also observed that the national digital skills framework currently emphasises the importance of digital consumption skills over digital production skills (Chew & Soon, 2021).

2. Singapore can also do more to create digital public goods as it is currently falling short on both the Network Readiness Index by the WEF and Inclusive Internet Index by the EIU in this indicator. Specifically, Singapore can aim to increase the availability of locally created content and apps that deliver useful e-health information, e-finance information, and e-entertainment.

3. The third priority area is digital trust and security. Singapore residents have high trust in government websites and apps but ranks 96th in trust in online privacy on the EIU's *Inclusive Internet Index* and there is considerable room to improve general trust towards digital activities.

8.2 ITU x UNESCO *State of Broadband* Report 2020

With the release of the *State of Broadband* report 2020, the ITU and UNESCO jointly put up a set of 26 policy recommendations for a decade of action to bridge the digital divide (Garrity, 2020). The priority areas are similarly annotated below:

Policy recommendations by the Broadband Commission for "the decade of action"

		Prioritisation recommended	Progress on track
Access	Use of Universal Service Funds to develop broadband		x
	Make broadband affordable by adopting appropriate policy and regulation		x
	Boost affordability and usability of broadband-enabled products and services, with a focus on addressing barriers faced by those at risk of being left behind	x	
	Expand initiatives to map network coverage and infrastructure needs, to develop priority lists for investment		x
	Support efforts to provide broadband connectivity to refugees and displaced individuals*		
	Promote advanced market commitments for rural broadband access*		
Skills	Build human digital capacity and skills to help users, small and medium-sized enterprises (SME) and public sector agencies make the most of digital opportunities	x	
Use	Foster locally relevant content creation and local hosting	x	
	Implement e-government initiatives	x	
Ecosystem	Promote free flow of data	x	
	Monitor and collect reliable ICT data	x	
	Improve IoT and Smart City policy frameworks		x
	Consider and, if appropriate, apply open access approaches to infrastructure		x
	Undertake public consultations on policy & regulation		x

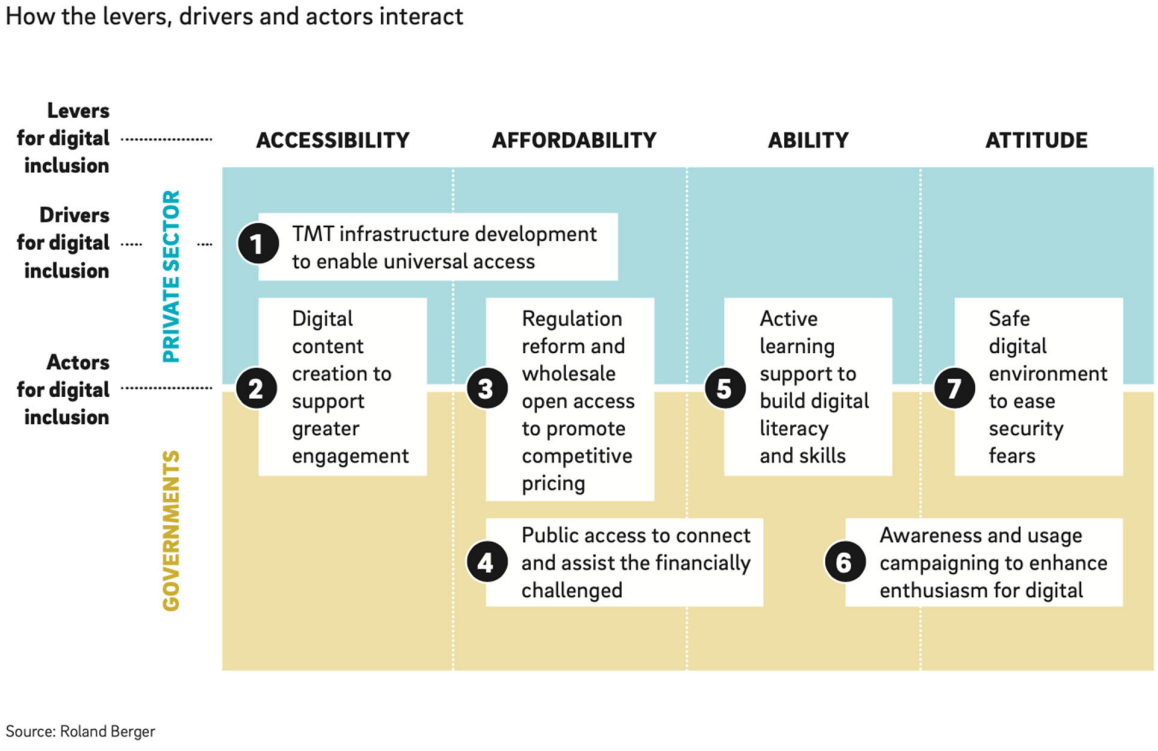
	Identify champions or leaders in broadband to mobilise political and technology support		x
	Include in broadband plans efforts on digital inclusion, measures to protect children online, a focus on limiting environmental impacts and addressing climate, and public access initiatives		x
	Integrate gender in national broadband plans and strategies and undertake action plans to advance gender equality in access to broadband		x
Market Interventions	Implement new approaches and frameworks for spectrum allocation & licensing		x
	Update ICT regulations to promote more investment and market approaches for sustainability	x	
	Foster digital innovation by preserving intellectual property (IP) rights	x	
	Encourage e-business and entrepreneurship		x
	Incentivise public private partnerships		x
	Incentivise and accelerate broadband investment		x
	Merge regulation and convergent services		x
	Improve right-of-way regulations		x
	Lower taxations and duties		x

*May not apply to local context

8.3 Roland Berger's Digital Inclusion Framework

From the private sector, the Roland Berger Digital Inclusion Framework also maps the different levers for digital inclusion according to access, skills, use, and the ecosystem. It further conceptualises how governments and the private sector can co-act to close the digital divide:

Figure 8. Roland Berger's Digital Inclusion Framework

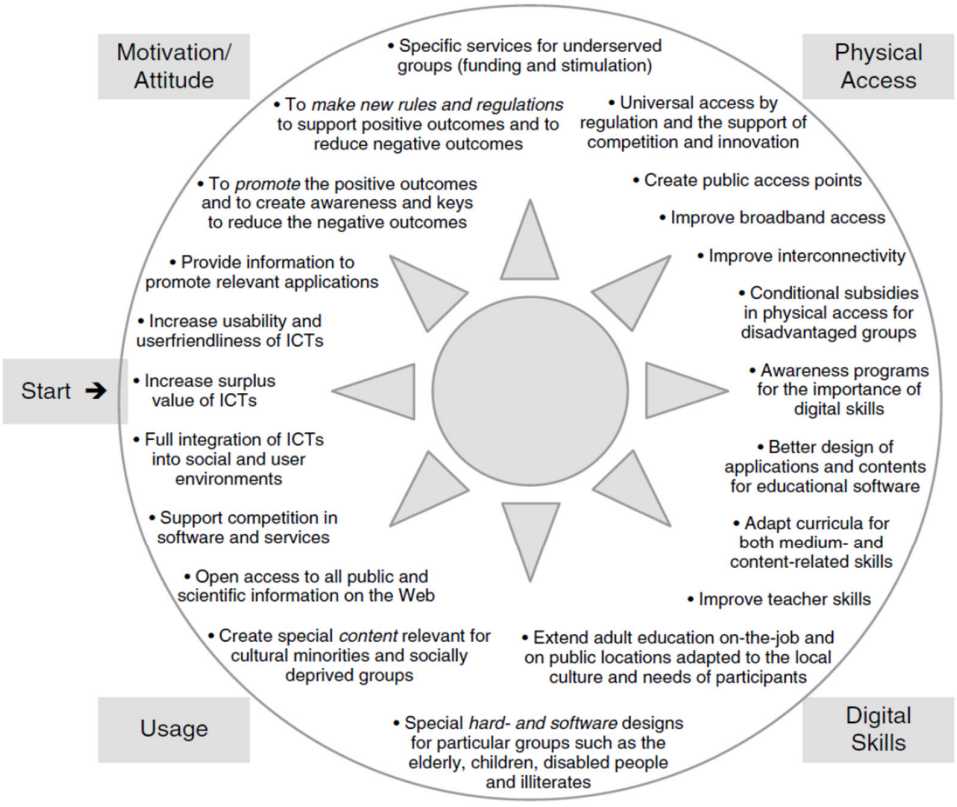


		Prioritisation recommended	Progress on track
Access	Technology, media, and telecommunications (TMT) infrastructure development to enable universal access		x
	Public access to connect and assist the financially challenged	x	
Skills	Active learning support to build digital literacy and skills	x	
Use	Digital content creation to support greater engagement	x	
	Awareness and usage campaigning to enhance enthusiasm for digital	x	
Ecosystem	Safe digital environment to ease security fears	x	
	Regulation reform and wholesale open access to promote competitive pricing		x

8.4 Jan van Dijk's wheel of policy instruments

In the revised edition of *The Digital Divide*, van Dijk (2019) included a "wheel of policy instruments" that specifies recommendations for closing the different levels of the digital divide:

Figure 9. A "wheel of policy instruments" to bridge the digital divide



Source: Jan van Dijk (2019) *The Digital Divide*, p.149

8.5 Insights from roadmaps and strategies

Technology that works for people

Undergirding these roadmaps and strategies is the fundamental requirement to ensure that digital content and services are affordable and relevant for the people so that they are aware of the benefits and be motivated to be online. In fact, developing "technology that works for people" is the first of three objectives that the European Commission will focus on to shape Europe's Digital Future in the next five years (European Commission, 2020). The other objectives are "a fair and competitive economy" and "an open, democratic, and sustainable society".

In developing technology that works for people, the people for whom digital solutions are meant to benefit must include various disadvantaged groups such as seniors, those with lower educational attainment, and persons with disabilities (especially in Singapore). Co-designing and co-creation with these disadvantaged groups can ensure that solutions will take into account and address their situation- and context-specific vulnerabilities and needs (UNDESA, 2021). This point on context-specific design was also made by our expert interviewees — Jan van Dijk, Eszter Hargittai, and Anett Numa.

> [Anett Numa on consulting the private sector] "So always working together, and I would say asking as much information from the private sector as possible, because they are the ones that are influencing the economic ecosystem the most, so it's important to get information back from there as well… one very cool thing that we have also is that our Prime Minister's office has a different department, like innovation department where the CEOs — the biggest companies' CEOs or founders — are advising the Prime Minister with decisions like where to spend your money."

Sustainable digital growth

In many of these roadmaps, openness and transparency are at the heart of sustainable digital growth. To garner multi-stakeholder support, governments need to initiate open and transparent discussions about regulatory frameworks and digital issues with the private sector, non-governmental organisations, and the academia.

To drive adoption, digital solutions should be designed in alignment with social development policies and the Sustainable Development Goals (UNDESA, 2021; UN, 2020). For Singapore, in particular, it is important that the growth of technology products and services is matched by an increase in digital trust and understanding of issues such as data privacy and data rights.

> [Jan van Dijk on digital trust] "Trust in the Internet is going down because with all these problems going on now in the Internet — privacy, surveillance, hate speech, and disinformation. And people know this of course. This is trust, this is why the first phase in my framework is motivation and attitudes."

Collective action

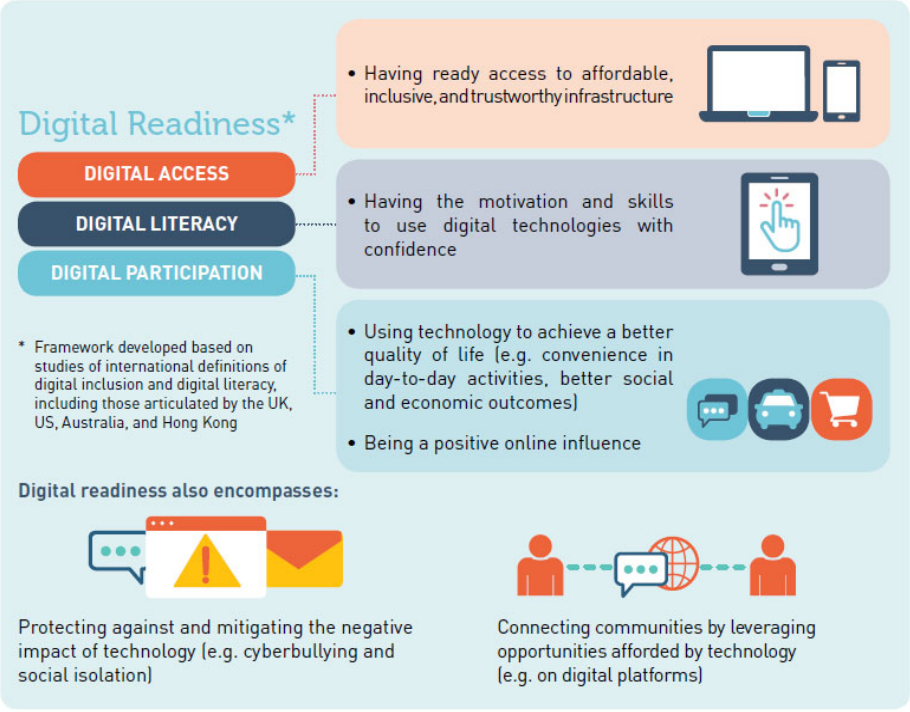
To bridge the different digital divides, a whole-of-society approach is needed. Governments will have to mobilise multi-stakeholders such as the private sector, academia, civil society

organisations, representatives and members of disadvantaged groups, and philanthropic and religious organisations (UNDESA, 2021). The different stakeholders will need to come together with their specific perspectives, expertise and capabilities and work to ensure that ICTs benefit everyone. Such multi-stakeholder partnerships are critically important for fostering agile and multifaceted solutions to address the evolving needs of vulnerable groups in society especially during the COVID-19 pandemic. The Singapore Together Alliances for Action (AfA) is a good example of collective action. Examples of AfAs with a digital inclusion remit include, among others, digitalising the built environment, smart commerce, and productivity through robotics (MTI, 2020).

9 Singapore's roadmap to digital inclusion

Singapore's own roadmap to digital inclusion is encapsulated in the country's Digital Readiness Blueprint launched in 2018 to ensure that all Singaporeans have access to the opportunities and benefits of a digital society (Digital Readiness Blueprint, 2018). The blueprint is aligned with the three key types of digital inclusion that have been discussed thus far. The blueprint defines digital readiness as: (i) having access to digital technology; (ii) having the literacy and know-how to use this technology; and (iii) being able to participate in and create with this technology (see Figure 10).

Figure 10. Digital readiness in the context of Singapore



Source: *Digital Readiness Blueprint* (Digital Readiness Blueprint, 2018, p. 10)

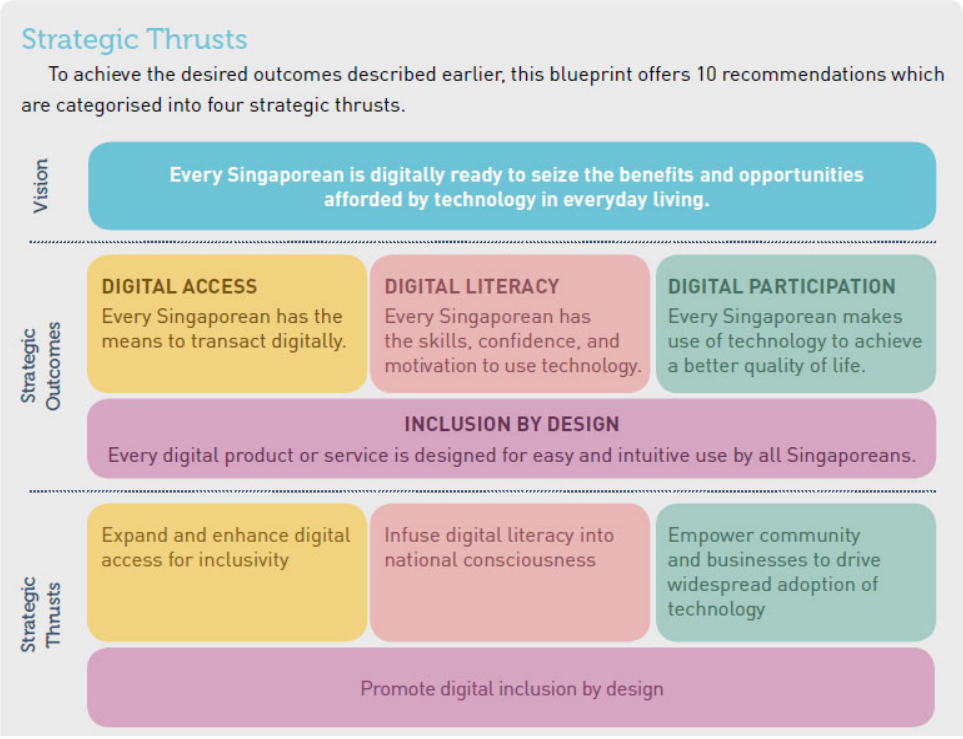
To achieve the vision of digital readiness, the blueprint focuses on four strategic thrusts (see Figure 11):

Strategic Thrust 1: Expand and enhance digital access for inclusivity
Strategic Thrust 2: Infuse digital literacy into national consciousness
Strategic Thrust 3: Empower community and businesses to drive widespread adoption of technology
Strategic Thrust 4: Promote digital inclusion by design

As part of the country's digital inclusion efforts, the IMDA launched the Digital for Life movement in February 2021, to "build a digitally inclusive society where digital technologies are accessible to all, and no one is left behind" (Digital for Life, 2021).

The national movement launched to encourage digitalisation received $2.5 million in seed funding provided by the President's Challenge and is targeted to grow to $10 million over the next three years, to fund community-initiated projects that encourage people to adopt digital technology such as e-payment and video conferencing (C. Wong, 2021a). Some of the initiatives under the Digital for Life movement include (Table 22):

Figure 11. Strategic thrusts under the Digital Readiness Blueprint



Source: *Digital Readiness Blueprint* (Digital Readiness Blueprint, 2018, p. 13)

Table 22. Digital for Life movement projects

Organisation	Project
Youth Corps Singapore	Interactive online coding game for primary school students
Trigen	Project Wire Up helps seniors stay connected to their loved ones and keep healthy during the pandemic
Google	Code in the Community teaches basic coding to children from disadvantaged backgrounds
Cyber Youth Singapore (CYS)	Trains youths to impart cybersecurity and digital wellness knowledge to other youths
Project D.I.P.	Provide digital access to underprivileged students in rental households and impart basic digital maintenance skills
Rahmatan Lil Alamin Foundation (RLAF)	Coach seniors to use digital government services with ease

The initiatives reflect the four key areas in IMDA's Digital Inclusion Programme. Digital access for each of these groups are covered under programmes that are intended to serve their specific needs:

1. Seniors through the Seniors Go Digital Programme
2. Low-income households through the Home Access Programme
3. Needy students through the NEU PC Plus Programme
4. Persons with Disabilities through the Enable IT Programme

Seniors

To help seniors access the Internet and learn digital skills, the IMDA launched the Seniors Go Digital initiative in 2020 (a continuation of the Silver Infocomm Initiative that was launched in November 2007 to promote awareness and literacy among seniors). The programme offers financial help for those who cannot afford smartphones and mobile plans with funding from Community Chest and private donors. Under this scheme, the three telecommunications companies — Singtel, M1 and Starhub — have rolled out subsidised phone plans for the elderly.

Public access for seniors has also been enhanced through the establishment of 50 SG Digital Community Hubs where seniors can pick up digital skills such as going cashless with e-payment apps (Yuen, 2020b). Seniors can also pick up digital skills at public libraries where they can go on a library learning journey comprising monthly one-hour sessions on topics such as how to access e-newspapers, Wireless@SGx (the national public access Wi-Fi), using QR codes, and the library mobile application (Tan, 2021).

For the hawkers, many of them also seniors, the Hawkers Go Digital campaign was launched in 2020 to encourage over 18,000 stallholders in more than 100 hawker centres and markets, coffee shops, and industrial canteens to adopt e-payment methods. Since its

launch, more than half of Singapore's hawker stalls (over 10,000 of 18,000) now offer e-payments (CNA, 2021). Transaction volume and value for January 2021 also crossed the 1.2 million and S$14 million mark respectively for the first time. Digital Support for Hawkers groups, an initiative by SG Together Alliance for Action (AfA) — Online Ordering for Hawkers, have also been set up in 30 hawker centres island-wide to help hawkers increase consumer demand through community group-buys. A similar scheme — Heartlands Go Digital — for heartland enterprises to adopt e-payment was later launched.

To catalyse the uptake of digital solutions, 1,000 digital ambassadors were hired to help stallholders and seniors learn digital skills, such as buying things online and using smartphone apps to communicate with their friends and family (Baharudin, 2020). The digital ambassadors aim to promote digitalisation among 100,000 stallholders and seniors in 2021. With the recent rise of online scams in Singapore, the digital ambassadors have also turned their attention to helping prevent vulnerable seniors from falling victim to scammers (*The Straits Times*, 2021).

Low-income households

According to National Volunteer and Philanthropy Centre (NVPC), there are over 100,000 individuals earning less than $1,000 who are on part-time employment, either by choice or due to extraneous circumstances, in Singapore. In 2020, there were about 50,000 households living in public rental flats. About 60 per cent are headed by persons aged 55 years and above and about 90 per cent had a household income of $1,500 or less at the point where they requested for a rental flat. Among the low-income households surveyed, 39 per cent faced challenges in paying off their debts.

The pandemic has created additional financial strain on low-income households. Based on a study conducted by a local charity Beyond Social Services, most financial assistance applicants — 80 per cent of them — live in public rental housing, and the rent they pay as a percentage of their household income has more than doubled due to the COVID-19 crisis. The median per capita income was $425 before the pandemic and fell to $113 (Menon, 2021).

The NEU PC Plus Programme (NPP) was first launched in 1999 to provide low-income households with school-going children with the opportunity to obtain brand new computers at an affordable price. Eligible beneficiaries not only get subsidised personal computers or laptops but may also opt for a bundle with three years of free broadband subscription. The latest enhancement during the COVID-19 pandemic further accelerated the hardware delivery and broadband installation for students to use for home-based learning. By May 2020, over 67,000 beneficiaries have been supported by NPP. Together with the NPP, there are also other community programmes to help the underprivileged and the less savvy stay abreast of tech adoption. For example, the East Coast Digital Blueprint comprises a set of digital initiatives including a laptop donation programme for the needy families in the East Coast constituency (S. Wong, 2021).

(Needy) students

Under the National Digital Literacy Programme by the MOE, all secondary school students will receive a personal laptop or tablet for learning by 2021 (Yuen, 2020a). This is seven

years ahead of the original target of 2028, driven by the need for home-based learning during the pandemic. Students from lower-income households will get additional subsidies through the NPP so that there are no out-of-pocket expenses (MOE, 2020b). Students without a Wi-Fi subscription at home will also receive help from MOE and IMDA to get free subscriptions. The scheme was revised during the pandemic so that households with three or more school-going children are eligible to apply for one more subsidised desktop or laptop (IMDA, 2020a).

In terms of digital skills, the National Digital Literacy Programme provides a Code For Fun programme and cyber wellness education for primary school students (MOE, 2020a). Secondary school students are taught computational thinking skills, personal learning devices, and are offered computing as a subject. Students in higher education acquire baseline digital competencies (e.g., digital well-being and ethics) and advanced digital competencies for certain sectors (e.g., cyber-security, logistics, manufacturing, and finance).

To help low-income families and their pre-schoolers bridge the digital divide, the NTUC First Campus launched the Digital Kampung Programme to loan iPads to more than 2,000 low-income families and their children. SIM cards are provided to families without Wi-Fi access so that they can access the Internet and parents will also receive a guide on how to use the device, along with tips on screen time and cyber wellness.

Persons with disabilities (PWDs)

The review thus far has yet to discuss the fourth key area of IMDA's Digital Inclusion Programme — persons with disabilities — and this is a category that is often overlooked in digital inclusion plans (van Dijk, 2019). PWDs are estimated to be between 12 and 27 per cent of any population (Fox, 2011; Perrin & Atske, 2021). In Singapore, PWDs are estimated to be 2.1 per cent of the student population, 3.4 per cent in the adult population (18–49 years old) and 13.3 per cent of the older residents aged 50 years and above (MSF, 2018). In the comprehensive labour force survey conducted by the Ministry of Manpower in 2018, resident unemployment rate for PWDs was at 12.9 per cent — nearly six times higher than the overall rate of 2.2 per cent in the same year (MOM, 2018). Local reports illustrate the problem: there is often widespread workplace and employer discrimination, and many employers are not aware of the kinds of workplace accommodations required for PWDs to assist them in their work (Phua, 2020). Moreover, opportunities for PWDs to develop skills for the knowledge economy are sorely lacking due to insufficient resources to do so (NVPC, 2017).

Although the disabled could find many advantages from Internet use, especially those with mobility problems, they in fact have less physical access to and use of digital media (van Dijk, 2019). This gap is present in all parts of the world (Fox, 2011; Ofcom, 2015; Duplaga, 2017). Disabled people are less likely to go online than the able-bodied (Dobransky & Hargittai, 2016), and the disabled on average show lower levels of skill (van Dijk & van Deursen, 2014). The Dutch researchers observed that users with visual impairment fared significantly below the national average when asked to perform strategic tasks that require more than just "button knowledge", which explains their low levels of participation in informational and educational activities online. Further, the disadvantage is compounded by

age, suggesting that literacy and other mobility issues present significant barriers to operating digital devices on top of their existing disability (van der Geest et al., 2013).

In a study of the disability digital divide in Sweden, Johansson, Gulliksen, and Gustavsson (2020) found that most disability types reported less access to the Internet and lower skills as compared to the general population after controlling for demographic and socio-economic factors. Overall, the largest proportions of people reporting difficulties in using the Internet are language-related disabilities, followed by intellectual disabilities and memory-related disabilities. Those who are illiterate will have limited digital skills since they cannot handle words, documents or the names of menus or links.

The results of the Swedish study suggested that most people with disabilities are lagging the general population (p. 114), in that:

- they have less access to devices;
- they use the Internet to pay bills less;
- they use the Internet for online shopping less;
- they use mobile bank ID for identification less; and
- they feel less included in the digital society.

One of the key reasons for the disability digital inequality is the design of hardware and the web. Many devices are not adapted for people with physical handicaps, and official web guidelines for the blind and deaf are often ignored (van Dijk, 2019).

In Singapore, the Third Enabling Masterplan on Promoting Independent Living of Persons with Disabilities through Technology and Design by the Ministry of Social and Family Development lists co-solutioned recommendations to improve digital accessibility across all domains (MSF, 2020). Singapore also accedes to the UN Convention on the Rights of Persons with Disabilities (UNCRPD), which is a comprehensive convention to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all PWDs, and to promote respect

The World Wide Web Consortium (known as the W3C: https:// www.w3.org) issues guidelines for accessing of Web content; referred to as Web Content Accessibility Guidelines (WCAG).

The Web Content Accessibility Guidelines (WCAG) outlines the following four basic principles in making websites accessible:

- Perceivable: Information and user interface components must be presentable to users such that they can perceive the presented information, i.e., it cannot be invisible to all their senses.
- Operable: Users must be able to operate interface components and navigate. The interface cannot require interaction that a user cannot perform.
- Understandable: Users must be able to understand the information as well as the operation of the user interface.
- Robust: Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies. Users must be able to access the content even as technologies advance.

GSMA outlined some “Principles for Driving the Digital Inclusion of Persons with Disabilities” in their 2020 report.

for their inherent dignity (MSF, 2020).

Singapore government digital services are also required to comply with a set of Digital Service Standards, which include the Web Content Accessibility Guidelines (WCAG), an internationally adopted standard that ensures digital accessibility for PWDs. The Smart Nation and Digital Government Group (SNDGG) has put in place measures to ensure compliance with WCAG, such as providing website designers with standardised components and layouts that incorporate accessibility design considerations. The Singapore Government Design System provides a list of accessibility guidelines for designers, developers, and writers. At the Inclusive Business Forum 2020 on workplace disability inclusion, the Government Technology Agency (GovTech) shared five steps it has taken towards building more inclusive products and services (Poon, 2020).

However, despite the masterplan, efforts, and standards, this is an area that Singapore is doing relatively weaker in compared to other digitally advanced countries. As mentioned earlier in this report, according to EIU and the EIII, the Singapore national portal, http://www.gov.sg, failed 31 tests and passed 361 tests conducted by an automated web accessibility checker.

9.1 Fostering digital inclusion for the public and private sectors

Beyond the four key target segments for digital inclusion by the IMDA, Singapore has also been actively promoting digital transformation in the private sector. A slew of initiatives to boost the country's digital transformation was launched amid the pandemic.

As part of the Fortitude Budget in 2020, eligible businesses received an incentive of up to $5,000 if they adopted e-payment solutions such as e-invoicing and PayNow Corporate. Food and beverage, and retail businesses received up to $10,000 under this SMEs Go Digital scheme. Another feature of the SMEs Go Digital programme is the Chief Technology Officer-as-a-Service initiative. This initiative is intended to help SMEs identify and access resources they need to digitally transform and includes quick access to digitalisation resources via a web application and a shared pool of skilled CTOs for SMEs that need in-depth digital advisory (C. Wong, 2021c; *Today*, 2021).

In 2021, the Ministry of Communications and Information launched the Digital Leaders Programme to help promising local companies to speed up their efforts to transform digitally. The programme will help companies to build new digital capabilities and hire a core digital team to develop and execute their digitalisation strategy so that they can develop new business models and capture new growth opportunities.

An Open Innovation Platform was also created to match real-world business challenges with innovative tech solutions. The virtual crowdsourcing platform aims to help the public and private sectors solve technology challenges. An additional $50 million was injected in 2021 to co-fund more projects under the platform and deliver new features aimed at speeding up the process to find and develop solutions for challenges that organisations face.

To better prepare public service officers for the digital economy, Singapore's Smart Nation and Digital Government Office (SNDGO) set up a new academy to offer 95 training

programmes and train more than 6,000 public service officers in areas such as data analytics and cybersecurity (Tang, 2021). Ground-up feedback was also sought from the Smart Nation ambassadors who coach and guide Singapore residents in the use of technology in their daily lives (Wong, 2020). Key feedback included making the technological solutions more accessible, inclusive, and transparent, as well as the importance of the human touch in the outreach efforts.

Public-Private Partnerships (PPPs)

GovTech has taken the lead to partner organisations in the private sector on government projects. About $3.8 billion will be spent across 250 ICT projects to transform, integrate, and streamline more digital services across different sectors to create a more digitally empowered nation. Projects include an auto-marking system for schools, adoption of cloud systems, deployment of AI for the public sector, video analytics, natural language processing, fraud analytics, and personalised services. Table 23 shows a selection of PPPs in recent years and Table 24 shows selected initiatives by non-governmental organisations:

Table 23. Public private partnerships in Singapore

PPP	Purpose
Twitter x Government of Singapore 2021 Partnership	• Enhancing and upskilling Singapore's workforce • Promoting and strengthening Internet safety and digital literacy among Singaporeans • Supporting the government's COVID-19 communications on Twitter
#GetReadySG with Microsoft and Generation[9]	To upskill, place, and fill demand for tech-enabled jobs for up to 1,000 Singaporeans as part of the SGUnited Jobs and Skills Package through two programmes: • TechSkills Accelerator's (TeSA) company-led training, hire and train programme, in partnership with IMDA (for in-demand job roles such as full stack developer, data engineer/analyst, cloud support, and DevOps practitioner) • SGUnited Mid-Career Pathways programme (with Temasek Polytechnic): company training (which will train participants in job roles of junior full stack developer, cloud support and DevOps, as well as business intelligence and data analyst)
Singtel Digital Silvers programmes	Volunteers from Singtel will help seniors to learn how to use digital devices and go online through weekly hands-on sessions at senior activity centres, among other things. Skills taught include learning how to use apps for messaging and video calls, shopping online and using social media apps for entertainment. The programme aims to help more than 10,000 seniors over the course of two years.

[9] #GetReadySG is the first public-private sector collaboration with a leading technology company and a global non-profit organisation to bridge holistic training in both hard and soft skills with employment.

Grab and Microsoft	Up to 5,000 Grab driver-partners and delivery-partners (Adecco, Capgemini, Grab, Ninjavan, Onloop, Shopfront) and 250 tertiary students set to benefit from three training and development programmes co-developed by both companies. For driver and delivery-partners seeking alternative career options: computer science fundamentals, web development, Java programming, relational databases, and UI/UX (user interface/user experience) concepts + soft skills that include critical thinking and interpersonal skills For driver-partners and delivery-partners seeking to pick up digital knowledge and skills: basic computing and digital skills content such as Internet usage, online productivity and communications tools, online security and safety, and others Singapore Polytechnic students: build foundational knowledge of AI by completing Azure AI fundamentals training via the Microsoft Learn platform
Google: Skills Ignition SG	To build in-demand skills for digital marketing or cloud technology through vocational and on-the-job training: free 40-hour course on Google Digital Garage, https://learndigital.withgoogle.com/digitalgarage, where learners can acquire skills such as curating content, setting up an e-commerce site and promoting a brand via social media

Table 24. Digital initiatives by non-governmental organisations

Organisation	Project
Beyond Social Services	Together with Kebun Baru MP Henry Kwek, Beyond Social Services launched a pilot programme called Kebun Baru Wi-Fi project. Residents in select blocks at Kebun Baru will now enjoy free Wi-Fi at their void decks.

Engineering Good	• Computers Against COVID
	  ○ Collect, refurbish and distribute used laptops to families who do not have access to these devices to stay digitally connected
	  ○ Distributed more than 4,000 laptops as of May 2021 and still aiming to fulfil request at an average of 150–200 laptops a month
	
	• Digital Literacy
	  ○ Train the Trainer
	  ○ Monthly webinars
	
	• Digital for Social Good (D4SG)
	D4SG is an initiative by Engineering Good and New Hope Community Service to collect, refurbish and provide desktops to local charities and non-profit organisations for their operational needs.

ReadAble	Teach children language skills, numeracy skills, and basic digital literacy skills
Bridge The Digital Divide	A social initiative to drive donations of used devices such as laptops, tablets and mobile phones among organisations and individuals to needful recipients through partnering non-profit social service organisations
better.sg	Advise and help non-profit organisations do more good with technology
Daughters of Tomorrow	IT literacy courses to equip low-income women with skills to enhance their employability
Touch Community Services	Digitally Ready Families (DRF) is a digital-readiness programme that aims to provide low-income families with essential Digital Life Skills. A post-programme survey done three months after the first run found that parents were better able to communicate the reasons for setting boundaries when their children used digital devices, leading to better compliance.

9.2 Critique of current digital inclusion efforts

Access for the unconnected; Connecting the last 10 per cent

Despite its near ubiquitous physical access, Singapore, like many other digitally advanced countries such as Estonia and South Korea, still has a sizeable offline population. Widely referred to as “laggards”, this group of individuals are often members of vulnerable groups in the population who are the most resistant to change and least aware of the benefits that digital technology can bring.

Reaching out to low-income households in Singapore remains a challenge as many may be unaware of the available schemes or are unwilling to seek help (Oh, 2019). Anthea Ong, a former Nominated Member of Parliament noted the problem of too many targeted assistance schemes that often overlap with varying criteria and limiting conditions attached. This creates two problems. First, there is confusion and lack of understanding about what needs to be done as beneficiaries of some financial assistance schemes will not qualify for other support (Ong, 2020); second, some will inadvertently fall through the cracks (Cunico et al., 2017).

For instance, the current NPP scheme offered by IMDA is intended to improve access for low-income families and needy students but because of all the means-testing and conditions, coverage falls short (Ng & Lim, 2020). Overlapping schemes are a source of confusion for the less literate because they face challenges in deciding between schemes and often have problems remembering the terms and conditions of their scheme once enrolled. Ng and Lim (2020) proposed an alternative method of administering the assistance in the form of automatic allocation, which already has precedents in other schemes such as the Baby Bonus, Workfare Income Supplement (WIS), and Silver Support. This can eliminate unnecessary confusion and streamline current processes to ensure that standard basic assistance is provided at a more efficient rate to the needy. Ng and Lim (2020) also suggested that stepped levels of subsidies according to household income and number of

household members could be introduced, like the subsidy ladders for childcare and baby bonus.

Others have pointed out that the conditions in specific schemes are limiting their effectiveness (Ong, 2020). For instance, the NPP programme had initially permitted only one laptop per eligible household, regardless of household size. The allocation has increased to two, due to the need for home-based learning during the pandemic. Second, its coverage is limited as it excludes pre-school, home-schooled, and university students. It also disadvantages persons with disabilities, who only receive a 50 per cent subsidy as compared to 75 per cent for students. Under the Home Access scheme, adults have no option to apply for a personal computer, only a tablet or smartphone. This is a problem as personal computers have been found to offer much higher utility for improving digital skills across the board, specifically those beyond basic technical knowledge.

Web accessibility for Persons with Disabilities (PWDs)

This area for improvement has been mentioned in several sections of this review. While Singapore accedes to UNCRPD, the country has no legally binding equivalent for non-government websites, and this may be one of the reasons why Singapore does not perform as well on global indicators in this dimension. Poor web accessibility has a significant impact on PWDs in the workforce. A small-scale survey in Singapore found that most blind persons are employed to work with a computer and inaccessible sites contribute to them losing 30.4 per cent of time on average (R. X. Ang, 2020). The study also noted that there is a lack of disability-friendly courses for PWDs to improve and pick up digital skills despite the demand (Goh, 2021; MSF, 2020).

Digital literacy for the less literate

In spite of the good intentions behind the Hawkers Go Digital programme, there remain several hurdles in the adoption of digital technologies among Singapore hawkers who tend to be less literate and elderly.[10] Elderly hawkers who are less literate (and sometimes illiterate) are not confident about handling digital transactions (Yip, 2021; Wong & Naheswari, 2021).

Media reports indicate that many hawkers are keen to offer cashless payments, but some are concerned about having to pay suppliers in cash and the low take-up rate among customers (M. Z. Lim, 2020). High platform fees on delivery apps have also deterred hawkers from taking advantage of third-party delivery platforms (Wong & Naheswari, 2021; Yip, 2021). Some hawkers who had tentatively adopted cashless payments lost their enthusiasm after customers repeatedly duped them (Sholihyn, 2020). Some hawkers have even accumulated losses of around $100 to $150 over the course of a year (Teh, 2020).

There have been stopgap measures such as better UI design implemented to prevent fraud. The applications for the Singapore Quick Response Code (SGQR) were improved such that when hawkers collect payment, they will get a vocal signal in English or Mandarin or a sound

[10] News of hawker stalls shutting down have even prompted some netizens to utilise the power of social media to help elderly hawkers increase consumer demand. At the time of writing, Instagram account @wheretodapao has amassed a following of 37,600 and is still growing daily. Another Instagram account @savetheelderlyhawkers has a following of more than 2,900.

signal when the transaction has gone through (Y.-C. Tham, 2020). Other improvements included larger fonts, distinct payment alerts, and colours to highlight new digital transactions (C. Wong, 2021b).

More broadly and with the rise of online scams in recent years, Singapore's digital ambassadors have reached out to seniors to raise their awareness of cybersecurity and encourage adoption of good cyber hygiene practices. The SG Cyber Safe Seniors Programme is a collaboration between IMDA, the Cyber Security Agency of Singapore, and the Singapore Police Force with the aim to prevent vulnerable seniors from falling victim to scammers.

Trust in digital services

There are other attendant trust issues as digitalisation is promoted. The Boston Consulting Group's *Bridging Singapore's Digital Divide in Government Services 2021* report highlighted that the lowest income group surveyed registered approximately 30 per cent lower satisfaction in digital government services than that of the highest income group surveyed. More importantly, 66 per cent of the lowest income group trusted that their personal information would be safe from hacking, compared to 82 per cent in the highest income band. Only 69 per cent of the lower income group had a belief that personal information would not be used for any purpose other than which it was collected, compared with 84 per cent for the highest income group. This reveals a clear gap in relative trust of and satisfaction with digital government services between income groups that needs to be addressed.

In the education sector, there are also privacy concerns about the Device Management Application (DMA) that the MOE deploys on the students' learning devices (Teng, 2021). The DMA allows schools and parents to monitor device usage by restricting access to certain applications and content such as inappropriate websites with adult or extremist content, as well as gaming websites or applications. It can also manage screen time by setting limits on the amount of time spent on the devices. Since its implementation, there have been some public concerns of security and privacy breaches. MOE has clarified that the DMA enhances effective classroom management and tracks search history but not students' locations (Mohan, 2021).

10 Strengthening Singapore's pathways forward

Beside the Digital Readiness Blueprint and the Digital Media and Information Literacy Framework mentioned earlier in this report, Singapore has other national strategies and programmes in place to ensure that the city-state stay at the forefront of digitalisation:

- To better encourage cooperation between Singapore's economic partners in emerging areas such as digital identities, AI, and data innovation, the Ministry of Trade and Industry has also established multiple bilateral digital economy agreements. These agreements aim to align digital rules and standards, facilitate interoperability between digital systems, and support cross border data flows and safeguard personal data and consumer rights. Singapore has concluded negotiations

for the Digital Economy Partnership Agreement with Chile and New Zealand, and the Singapore-Australia Digital Economy Agreement entered in force in December 2020. Discussions with South Korea and the UK to establish digital economy agreements are underway.

- The Singapore's Research, Innovation and Enterprise (RIE) Plan 2025 is the latest installation of a series of five-year National Technology Plans to develop high-technology activities that would move Singapore up the economic value chain and build a strong base of scientists, engineers and technologists. The new RIE for 2025 will be focusing on cyber security, 5G networks, and AI as the three key drivers of post-COVID-19 digital economy (Lai, 2020; I. Tham, 2020).
- The Digital Government Blueprint by GovTech is the statement of the government's commitment to build digital services that cater to citizens' and businesses' needs. In its latest update of the blueprint in 2020, GovTech stated that "COVID-19 has also reaffirmed our emphasis on capability building, and compelled different parts of the Government to accelerate the use of data and of technology to offer digital services that minimise physical contact, and to use technology and digital tools to keep us safe" (Digital Government Blueprint, 2021).

The rest of this chapter focuses on what other measures Singapore can take to strengthen its digital pathways forward. Drawing on the insights from the preceding chapters and best practices from academia and other countries, these recommendations seek to further improve access, technology design, digital literacy, digital inclusivity, policy and research. These recommendations are loosely based on the "wheel of policy instruments" by van Dijk (2019) and are localised for Singapore's context.

10.1 Better access and delivery

Free public spaces

Even with individual and household access approaching ubiquity, it is imperative that the government continues to invest in free public digital spaces. Carmi and Yates (2020) noted that one of the main issues that emerges from the literature and existing policies is that there are not a lot of public spaces where people can develop their literacies. Other than the public libraries, it is important that more public spaces are created for people from different backgrounds to get free access to the Internet, computers and help from others who are trained to help people according to their needs (Carmi & Yates, 2020; Rhinesmith, 2012; Rhinesmith & Stanton, 2018; Strover et al., 2020). In Singapore, public awareness and use of the new SG Digital Community Hubs needs to be significantly increased for their impact to be more pronounced (COVID-19 Safe Management Measures notwithstanding).

Example of innovative free public spaces — Wash & Learn programme in Detroit (Analysis and Recommendations for Advancing Digital Inclusion in Long Beach, 2019)

The Detroit Community Technology Project has launched a series of initiatives that address the digital divide. In 2017, Libraries Without Borders (BSF) launched "Wash & Learn", a programme that transforms laundromats throughout Detroit into informal learning spaces. BSF equipped each laundromat with a KoomBook digital library server, creating a Wi-Fi hotspot that laundromat patrons can use to access pre-loaded educational content at any hour of the day. Partner organisations help BSF curate, customise, and adapt the materials to meet the needs of participating community members.

Increasing night access

Free Internet access is not always available after hours. Singapore's community libraries typically operate from 11am to 9pm daily. This means that individuals with irregular working hours are expected to pay for computer access at Internet cafés. Related to this issue is the provision of night caregiving services, which would be beneficial to low-income families, particularly for individuals who engage in shift work (AWARE Singapore, 2018).[11] In Singapore, despite overwhelming evidence of this demand for night childcare services, only 3 per cent of childcare centres operate past 7pm on weekdays.[12] This makes it doubly difficult for low-income families with young children to pick up digital skills after hours as they would have to be caregiving. Even if they can get caregiving relief, they would run into the earlier issue of limited free Internet access at night. By increasing the points and duration of access to our current ICT infrastructure, the most vulnerable groups can have better access that are currently limited by time of day.

Cultivating community champions

Another recurrent theme is the importance of local leaders in ensuring that digital inclusion programmes are relevant to the residents of a community. This is already practised in Singapore. An example is the CyberGuide programme by RSVP Singapore which features "IT course for seniors by seniors". As the following paragraphs show, this peer-to-peer model has been shown to work in various contexts and programmes around the world and is a best practice that practitioners can adopt in their digital inclusion initiatives.

In a study of technology adoption among older adults in Singapore, Low and colleagues (2021) suggested that "community leaders", such as regulars at community areas, or residents who interact frequently with neighbours, could be trained in technology use, so that they can educate their peers. Beaunoyer, Dupéré and Guitton (2020) observed that people who learnt from their social contacts developed skills quicker. Further, there is evidence to suggest that peer-to-peer training models can help seniors increase their digital use and gain confidence (Pihlainen et al., 2021; Woodward et al., 2013). Digital literacy programmes can hence apply a train-the-trainer model to assist seniors in building the skills and confidence to teach others in their free time (Hunsaker et al., 2020). Cultivating this cadre of

[11] The AWARE report finds that provision of night-time care services can incentivise more low-income mothers to engage in shift work.

[12] Engagements with community partners suggest that night-time childcare services after regular working hours could be useful to some low-income families.

embedded community champions is important because while the national frameworks are meant to be "universal", people with different socio-economic background, age, and education will need to have some form of customisation to their learning needs for education programmes to be effective. Carmi and Yates (2020) refer to this as "community over scale" and emphasise that there is no one-size-fits-all programme.

Example of a community champion programme — The Silver Surfer project in Luxembourg (Analysis and Recommendations for Advancing Digital Inclusion in Long Beach, 2019)

The "Silver Surfer" project in Luxembourg recruits senior volunteers specially trained in Internet safety to teach other older adults how to use digital technologies safely. It not only helps to improve the digital literacy of older adults, but also promotes the active participation of older people in society. The project trains seniors as Silver Surfers based on the peer-to-peer training model and lets them act as multipliers. It promotes the voluntary commitment of older people and encourages lifelong learning, as the seniors receive basic training, which is then supplemented by regular additional training on specific topics. This supports the active participation of older people in society and values their contribution and skills.

> [Eszter Hargittai on warm experts[13]] "Actually many older adults help other older adults and we don't think of older adults as a potential source of help. But (i) some of them know quite a bit; (ii) other older adults often feel more comfortable getting assistance from their peers; and (iii) many of these older adults have the time to give to help."
>
> [Jan van Dijk on engaging community workers] "In my country we have a social cultural bureau doing all kinds of surveys, not only quantitative or qualitative ones on how the population are doing or how if they think government policies are working or not, but you can also go to the others — for instance, social helpers, teachers in a particular neighbourhood school, and the like. They know if a particular campaign of the government is working or not."

Zero-rating policies for educational resources

Zero rating allows users to access select Internet services and content without incurring mobile data charges (Bates et al., 2017). In the developing world, it is commonly used to attract new users and increase adoption. This policy has gained renewed attention in the developed world during the pandemic as learning shifts from schools online. South Korea recently introduced a zero-rating policy for data use on educational websites as part of their digital transformation of education in the COVID-19 era (World Bank, 2021). As home-based learning becomes a norm, the implementation of a zero-rating policy in collaboration with mobile carriers can greatly lower the cost of online learning especially for needy families with school-going children.

[13] Warm experts are nonprofessional persons who help inexperienced users come to terms with digital devices.

10.2 Better design

Going to the users

By going to where the users are and observing how they interact with the digital content, tech designers will notice that websites that seem easy to navigate for designers may be disorienting and confusing for users. Usability tests have found that the most frequently experienced problem was the lack of orientation when navigating between websites, but also within websites and between search results (van Deursen & van Dijk, 2009a). Website menus such as roll-over were sources of confusion for seniors and low-educated participants. The National Healthcare System in the UK has outlined a set of principles for designing for digital inclusion:

1. Go to where people are
2. Work with the people who know them best
3. Co-design: from initial discovery phase to live service and beyond
4. Build solutions that fit into people's everyday lives
5. Use existing tools and resources wherever possible
6. Outcomes first, then digital
7. Watch your language

> [Jan van Dijk on collecting community feedback] "You need this personal and neighbourhood approach. Really, this is very important. South Asian countries have more top-down government approaches for everything, and they don't even know that what they are doing is not really working at the bottom. **So you have to go to the bottom, to the neighbourhoods, to where the people are.** You know actually where those populations who might have problems with digital media are. Ask them whether they know about this campaign from the government and then talk about complaints of the government."

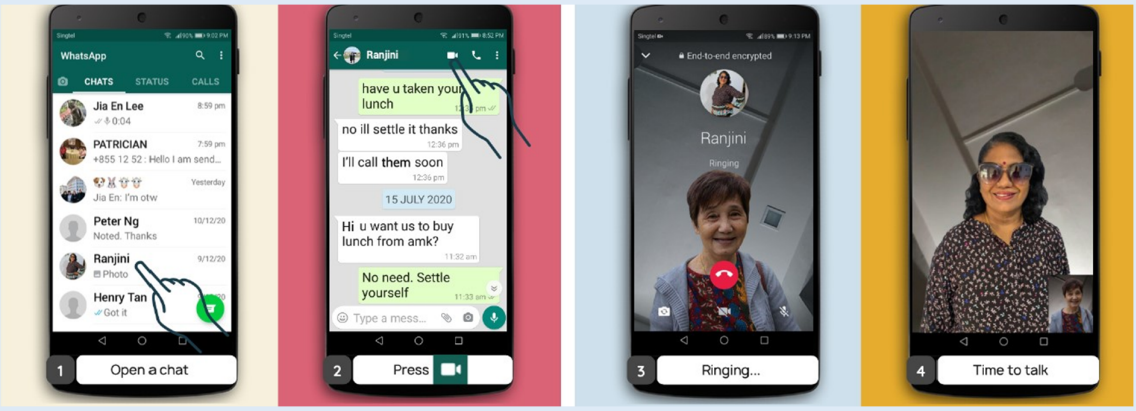
Simplifying user interfaces

Designers can use the affordances of new technologies to simplify the use of technology and encourage adoption. The *Visa Digital Inclusion Research 2021* conducted among 200 seniors in Singapore reported that higher awareness of the simple-to-use contactless cards also translated to higher use — 68 per cent of seniors used contactless cards compared to the other higher involvement digital payments methods, such as the QR code (22 per cent) and contactless mobile like PayLah! (31 per cent).

Another example are audio information systems to assist low-literacy groups which has been deployed widely in developing countries with lower literacy rates. In Ghana, The Mobile Midwife Application enables pregnant women, new mothers, and their families to receive weekly SMS and/or voice messages. Even though Ghana has relatively high overall literacy compared to many neighbouring countries, nearly all the participants chose to receive the messages by pre-recorded audio. Lessons for design from similar successful digital inclusion programmes share common characteristics: social support, collaborative learning, hands-on experience, inclusive programme design, a multi-faceted approach, and simple user interfaces ('Digital Inclusion Archives', n.d.).

Example of simplifying user interfaces — How Ah? guidebooks by the #CanOneLah! initiative in Singapore

Figure 12. Graphic-based guidebooks provided by the #CanOneLah! Initiative (Vijayahkumar, 2021)



The #CanOneLah! initiative in Singapore provides take-home graphic-based guidebooks on the basics of WhatsApp, Zoom, and YouTube that are easy to use for low-literacy seniors (see above). These guidebooks are available in English, Mandarin, Tamil, and Malay.

> [Eszter Hargittai on improving existing digital assets] "Websites need to be accessible, and devices need to be more accessible… can we offer interventions to help these populations do better with what they have and what's available?"

10.3 Better inclusivity

Improving accessibility guidelines for Persons with Disabilities (PWDs)

As mentioned earlier in this report, inclusivity for PWDs is an important area for improvement in Singapore. Although government websites are compliant with accessibility standards for PWDs, there are no such requirements on other websites in Singapore. The Australian Digital Inclusion Alliance has put forth several initiatives in this regard:

Move towards all government websites to be compliant with the latest accessibility standards (WCAG 2.1).	Progress on track
Ensure whole-of-government adherence to the Australian Standard AS EN 301 549, accessibility requirements suitable for public procurement of ICT products and services.	Progress on track
Incentivise the adult learning sector to incorporate inclusion and accessibility in ICT and design courses by 2022.	Prioritisation recommended

Adopting some of these guidelines can help Singapore make progress on improving digital inclusivity for PWDs.

> [Johannes Bauer on inclusive design] "Currently a lot of our technology is actually not designed for people that are not part of the normal distribution of the population."

More inclusive content

The limitations of Singapore's scale notwithstanding, the country should continue to provide more local and multicultural choice in content. Inclusive content can come in the form of training materials using minority languages and designs that are based on minority cultural experiences (van Deursen & van Dijk, 2009a; Galperin, 2017). Providing more inclusive content can also be done in partnership with the industry such as the case of SK Telecom in South Korea (SK Telecom, 2019). The telecom company participates in the content development and service expansion of a "Happiness Library" for visually challenged people, which provide voice services to read books and magazines.

Digital inclusion of older persons

In a policy brief on ageing in the digital era, the UN Economic Commission for Europe outlined a set of actions to ensure digital inclusion of older persons. The full set of actions is reproduced below with the recommendations on the ones that Singapore can focus on to further improve digital inclusion for seniors:

	Prioritisation recommended	Progress on track
Universal connectivity — Ensure that all have access to the Internet		x
Affordability — Ensure equal access to digital technologies, devices, and the Internet		x
Digital skills — Enhance digital literacy to reduce the digital skills gap		x
Access to services — Ensure access to everyday services that move online		x
Combat ageism — Tackle stereotypes and prejudice against older technology users	x	
Design for all — Foster digital accessibility	x	
Relevance — Leverage digital technologies for the well-being and participation of older persons	x	
Human rights — Protect human rights and ensure secure, safe, and ethical digital environments		x
Choice — Ensure autonomy and ability to choose whether to use digital technologies	x	
Backup — Maintain continued offline access to goods and services	x	

> [Jan van Dijk on lifelong learning] "Of course, the elderly in every country have the most problems in dealing with the Internet, so that means *adult education is needed*. And it's not easy to reach people with adult education, they must be motivated. When they are motivated, go to places they always go to, they want to go to."
>
> [Anett Numa on adult education in Estonia] "We have to put a lot of effort in the education sector, especially when we talk about technology, like to start providing access to computer classes, not just for the students and students in universities and high schools, but also the elderly."

Example of digital inclusion for seniors — Together programme with Uniper in Israel (Analysis and Recommendations for Advancing Digital Inclusion in Long Beach, 2019)

To combat the isolation of the elderly during the pandemic, the Israeli government has installed 450 Uniper devices: a TV-based and mobile solution for care and social engagement, including live and interactive health and wellness content, HIPAA-compliant video telemedicine,[14] remote assessments, family communications, and peer-led groups. This end-to-end solution transforms a TV or mobile device into an interactive connexion point that allows older adults to access services and social interaction opportunities from the comfort of their own homes.

10.4 Better digital literacy

Updated national digital literacy framework

The authors of this report had recommended an update of the national digital capabilities framework in Singapore that focuses on production digital skills in addition to consumption digital skills (Chew & Soon, 2021). We refer the reader to the paper for the detailed recommendations. Here, we reiterate the importance of the more comprehensive national digital literacy framework as it will provide a common language and terms of understanding for the government, private, and people sectors to collaborate on closing the digital divides.

Longer-term digital literacy programmes for learners

Research has found that digital literacy programmes are often short-term experiences for individual learners. They usually last for weeks or months; whereas for deep digital skills to be acquired, people need "an ongoing learning experience, a place that can provide them support and guidance in case they have difficulties and also monitor their progress" (Carmi & Yates, 2020). It follows that in order to develop long-term digital literacy learning habits, the current array of initiatives and programmes should be evaluated, and the more successful ones should receive continuous funding to build a structured roadmap for digital learners in Singapore.

> [Johannes Bauer on lifelong learning] "There is the need to train digital skills and you know the goal is — **How do we do this across the lifespan**, because it's probably easy to do it while young people are in school, from kindergarten through high school or college, and so forth. But there also has to be **continuing education** and some people who have on the job training, they will almost organically upskill. But even there I mean some jobs go away, maybe it will be necessary to retrain people to take on new jobs that may need different types of computer skills."

Institutionalising a vocational curriculum

In India, SAP Labs India works with partners and offers students a digital-rich learning curriculum and the opportunity for internships and employment at SAP (Galer, 2021). Since 2017, the programme has trained over one million students aged 10 to 16 years in digital literacy; and a total of over 6,000 youth have participated in the vocational curriculum, which includes learning future IT skills, such as data science and analytics, and next-generation

[14] The Health Insurance Portability and Accountability Act of 1996 (HIPAA) is a series of regulatory standards that protect sensitive patient health information from being disclosed without the patient's consent or knowledge.

technologies like AI and machine learning. An average of over 40 per cent of programme graduates obtain jobs after programme completion. This can be explored in Singapore as a viable pathway for vocational students to be trained for the digital economy.

> [Anett Numa on vocational training] “So it's like endless learning in a way, and I think again **every company should be responsible for just raising the awareness and data literacy of their people**, because if you invest that, it's much cheaper than having to deal with consequences later.”

Identifying different pathways for closing digital literacy gaps

A recurrent theme in policy recommendations for digital literacy is that there is no one-size-fits-all programme. This means that different pathways must be identified for different types of users. To tailor to the needs of different user groups, programmes should first focus on how people are using the Internet, rather than just who is using it (Borg & Smith, 2018). One way of doing this is through an online tool such as the digital competence wheel by the EU. The wheel assesses an individual’s digital profile to provide users with relevant support services that address personal barriers and needs. Different pathways can then be charted based on where users are at in their digital journey as outlined below:

- For non-users, information campaigns can be designed to target negative attitudes such as the dangers of the Internet and the complexities of going online.
- For less experienced users, the progression of online activities may be through online entertainment and communication first before progressing to the socially valued activities. This way, the habits and skills can form the foundation for more advanced online activities.
- For older adults who have not learned digital skills at school or at work, tailored adult education must be offered. They can visit public access sites, libraries, or tech community centres with staff members who can teach these skills or help them with a specific Internet activity such as job hunting or accessing government services.

10.5 Better digital policymaking

Improving trust

Trust in government is one of the key driving forces of digital transformation for any country (WEF, 2021). Providing data ownership and visibility over how citizens’ data is used can encourage citizens to adopt these services (Tan et al., 2021). In order for trust and social cohesion to be built and restored, the WEF recommends that more horizontal governance (governing by including the public) should be implemented. Citizens (especially young people) must be heard, and processes need to be implemented to take into account citizens’ needs and visions. The deliberative processes are important to co-determine and co-create solutions fit for the future.

Since 2017, the second author of this review has been collaborating with agencies to design and implement engagement based on deliberative principles. They include the citizens’ panels on the War on Diabetes, Recycle Right, and Work-Life Harmony. Besides impact on policy, the citizens’ panels also made an impact on the participants. They acquired valuable insights on the process of policymaking and gained a deeper appreciation of the work that policymakers do. Their confidence in their ability to make a difference as citizens also

increased. Majority of the participants also expressed interest to take part in future public engagement initiatives and work with the government to solve problems.

It is vitally important that the government not just listens but actively includes citizens, communities, and civil society to help understand the vulnerabilities of the society and co-determine how best to respond to those vulnerabilities. Giving agency and voice to more individuals in society can "lead to better decisions and governance outcomes and help counteract polarisation and social unrest" (WEF, 2021, p. 4).

> [Johannes Bauer on better citizen engagement] "**Be conscious about the goals of users**: 'What are the goals of those people, and what are the goals of the government?' They are not the same actually. When you want to approach those people, you have to first look at their goals, what they want to achieve in using digital media and how to help them, then they know how to learn digital skills better."

> [Jan van Dijk on establishing trust in government services] "The most successful [programmes and campaigns] are actually going to the people themselves and approaching their own problems, and not for the government or the schools or the like. For their problems and knowing what would be relevant for them, of course, that's in your head, but **always look for their problems, their goals, how to help solve them, then you get more trust in what you're doing**, they believe you more and then you can take them through the learning process."

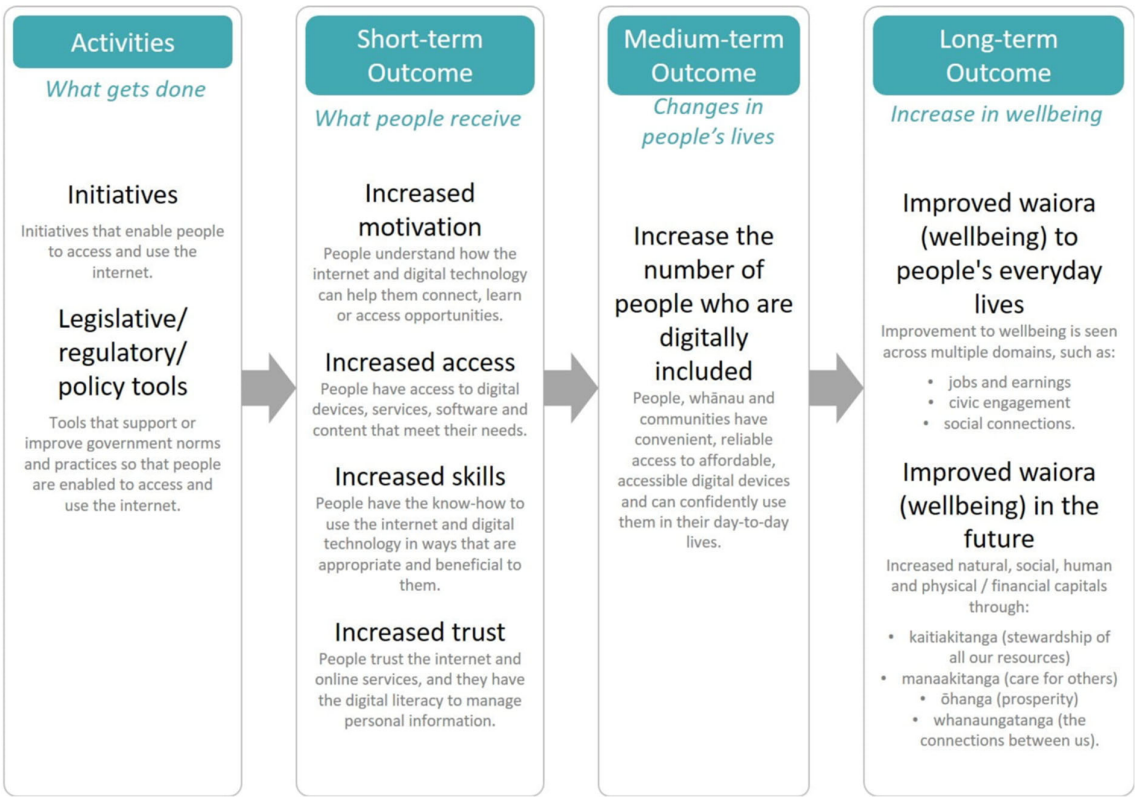
> [Anett Numa on use and trust of e-government services] "I mean it doesn't say anything about literacy, but when we think about accessing online services provided by the government, it shows that you need to have a connection, you need to have a computer, you need to know where to access this, you need to know how to use the service. And this also shows trust."

> [Anett Numa on collecting feedback on government services] "And of course also just **asking as much feedback from the users** like what was your experience when you go to our state portal …. Then, every time that you log out from there, we also ask the feedback, so that you can rate your experience and submit to us. Let's say something was too difficult to use for you, and so on, so I would say that shows a lot."

Better articulation of the value of digitalisation

The New Zealand Government links its digital inclusion framework (2019) to the wellbeing or "waiora" of its people (see Figure 13). By connecting the activities to the short-, medium-, and long-term outcomes for citizens, there is transparency in the value that the government ascribes to digitalisation. This openness creates a conducive environment for different stakeholders to engage and participate in policy making and digital initiatives.

Figure 13. Digital inclusion framework of New Zealand



The Inclusive Internet Index by the Economic Intelligence Unit (2021) also introduced a Value of the Internet component since 2018. This survey tracks the ways in which the Internet brings value to people's lives — from employment and shopping to entertainment and self-expression. Introducing a monitoring tool such as this in Singapore can help policymakers better articulate the value of digital inclusion to the people.

> [Johannes Bauer on a common vision] "All the legwork can be done by entrepreneurs and independent researchers and so forth, but so somebody has to give an overarching direction. That will be a role for government too in my view… we have to **shape realistic visions on outcomes** that we can achieve."

> [Eszter Hargittai on more openness] "**Ongoing support and just being really upfront** and recognising explicitly that problems will happen and that there are such things as scams, is important."

Periodic integration to one-stop shop

A frequently mentioned best practice of e-government is the integration of digital public services on a single accessible platform. In 2016, the government of South Korea implemented this best practice and integrated multiple digital public services, which can then be accessed in community centres around the country (*Digital Government Policy and Best Practices of Korea*, 2021; see Figure 14). Singapore already has the LifeSG app and there has been about 310,000 downloads in 2021. Some users have given feedback that the app is currently just aggregating different websites across the government, and they still have to

download another app or log on to another portal before they can access the services (Figure 15). As the users have reflected, more can be done to improve this one-stop shop by periodic updates to integrate new and existing government services and information.

Figure 14. Integrated digital public services platform used in South Korea

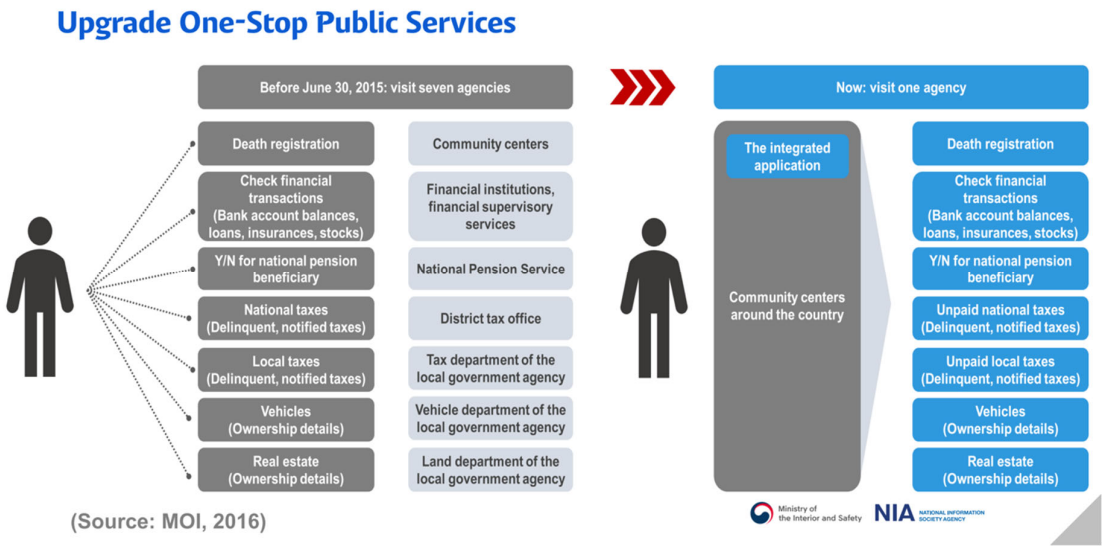
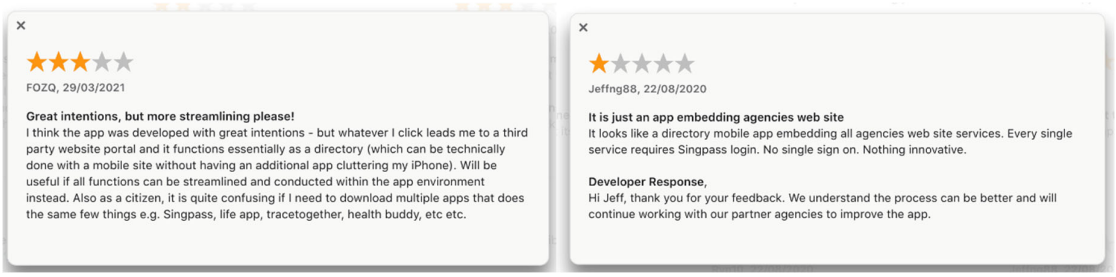


Figure 15. Selected LifeSG reviews on user experiences



Better research and monitoring

Much of what we know, or think we know about the digital divides, is informed by data. The Australian Digital Inclusion Alliance recommends to policymakers a gap and overlap analysis to give a clear picture of what areas of digital capability are not being appropriately addressed, or alternatively, being addressed by multiple organisations. We hope that this landscape review contributes positively to the understanding of Singapore's state of digital inclusion. In our review, we have also identified recurrent research gaps in digital inclusion that can be narrowed with targeted research programmes.

Measuring different digital divides

Current monitoring strategies generally focus on physical and material access. The Digital Future Society proposes that to measure digital inclusion more effectively, data on four key dimensions should be collected and segmented: access, skills, use, and a supportive

environment (Digital Future Society, 2019). The suggested indicators are shown in Figure 16.

In addition to changing what are measured, researchers also emphasised that research should supplement self-reported use and skills by using observational data collection methodologies to profile and record actual online behaviours (Borg & Smith, 2018).

> [Eszter Hargittai on self-reported digital competence] "What's interesting is that when [people] actually started doing [the task], often they would do something different from what they just said. And often what they did didn't necessarily work, which I think is a really important reminder of why what people think about not just what they can do, but *what they would do — is still not a good measure of skill*; because once the rubber hits the road and they actually have to do the actions on a device, it may not be what they thought it would be."

Possible alternative methodologies include lab testing or asking participants to install a background application on their phone or laptop to register frequency of use across different online mediums. Simple evaluative tools and third-party assessments can also be designed to help researchers gather more insights on usage data. Using these evaluative tools, users themselves can be made aware of areas for improvement through their individual digital profiles. This is also echoed by Chew and Soon (2021) in their proposed Unified Framework for Digital Literacy, where they emphasised on the importance for citizens with no or low ICT skills to identify the most essential skills and understand where they are making progress.

Figure 16. Example of indicators of basic online activities

Indicator clusters	Layer 1 indicators (Index: Original Data Source)	Layer 2 indicators (Index: Original Data Source)
Internet use	Individuals using the Internet (%) (ITU-IDI) or People who never used the internet (%) (EC-DESI: Eurostat)	Individuals using the Internet once in the last 3 months (%) (ITU-IDI)
		People who use the Internet at least once a week (%) (EC-DESI: Eurostat)
Basic online activities	Streamed, played, or downloaded content online (%) (EC-DESI: Eurostat)	
	AV communication via the internet (%) (EC-DESI: Eurostat)	
	Created or managed a site or blog (%) (EC-DESI: Eurostat)	
	Searched for advanced information (%) (EC-DESI: Eurostat)	

> [Johannes Bauer on metrics] "We need better data on skills to help individuals develop better skills, but most thinking is needed in terms of how we can measure the effects of technology on the quality of life and then society … it would be helpful to come up with sort of a **more meaningful system of metrics**. So [the global indices] all measure sort of different things and they don't know exactly what they're measuring. But what is missing in my view is something that is related more strongly to the

> outcomes, to that latest dimension of digital uses. And it will be absolutely fascinating to come up with measures that focus more on what are the implications of these technologies for life."
>
> [Jan van Dijk on research] "You can organise a lab but an alternative might also be **field research**. One of the things lacking in digital divide research is that there's no **qualitative research**."
>
> [Eszter Hargittai on research] "**Panel studies**, studies that collect data about the same people over time would be very important to have."

Updating research in access to new technologies

The capabilities of different devices would need to be revisited as new device categories become available (Pearce & Rice, 2013). The current understanding of devices is that while smartphones have improved tremendously in usability, they are still limited in serious uses like for study and work. With tablets gaining popularity and becoming more affordable, research on digital inclusion should continue to account for the technical potential of newer devices vis-à-vis existing ones. Another related research gap is in understanding the differences between smartphone-dependent and multimodal users in terms of content creation and dissemination (Tsetsi & Rains, 2017). This also means that tracking digital inclusion in terms of access would include tracking the devices that are being used to access the Internet.

Research gaps in literacy

Researchers have also raised questions about digital literacy that have not been sufficiently answered. We included three that are relevant to Singapore:

(1) Galperin (2017) suggested studying the substitution effect (which is also common in Singapore) whereby the presence of young people discourages adults from acquiring Internet skills.

(2) van Deursen, Courtois, and van Dijk (2014) recommended studies that investigate the relationship between information skills and communication skills. This research is particularly relevant to understanding the dissemination of misinformation.

(3) van Laar, van Deursen, van Dijk and de Hann (2017) proposed studying the extent to which digital skills contribute to the quality of work performance, higher incomes, and chances of employment. This would help policymakers understand the return to investments on the digital upskilling initiatives.

Research gaps in usage

There is a general dearth of research on the impact of Internet use. Current studies on digital inequality very often assume the "more Internet is better" viewpoint (Scheerder et al., 2019). It is assumed that frequent users reap the most benefits from their use and future research should examine this assumption especially since higher educated users tend to proactively disconnect (presumably to moderate the negative effects of excessive Internet use). The researchers further recommend that more attention be given to the social

determinants of Internet use such as how individuals interact and negotiate with others in different contexts as well as cultural determinants such as cultural capital and social capital. In the space of applied research, Hargittai, Piper, and Morris (2019) suggested looking into ways to engage older adults in capital-enhancing digital activities and new systems for staying socially connected without needing a home computer or smart mobile device.

> [Eszter Hargittai on research gaps] “What ultimately are people benefitting or not from their digital media uses”

> [Johannes Bauer on research gaps] “What are the consequences of different levels of access to different types of technologies and what are the different levels of skills and how do they relate to outcomes?”

10.6 Summary of recommendations

Below, we summarise the recommendations discussed in this chapter and the timeframe for these recommendations.

Domain	Timeframe	Recommendations
Better access	Short term	• Invest in public spaces to hold digital literacy classes • Ensure flexible and private all-day access • Zero-rating policy for data use on educational websites
Better delivery	Short term	• Identify and train community leaders and seniors (social workers, nonprofessional volunteers, etc.)
Better design	Short to mid term	• Redesign and simplify existing digital assets for different user groups • Co-design programmes with target groups • Introduce “low-tech” solutions like audio information systems to assist low-literacy groups
Better inclusivity	Mid to long term	• Improve accessibility standards for PWDs • More multicultural and inclusive content
Better digital literacy	Mid to long term	• Revise Digital and Media Literacy Framework • Longer-term literacy programmes for learners • Institutionalise vocational curriculum
Better digital policymaking	Mid to long term	• Improving trust in digital tools and ecosystem • Better articulation of the value of digitalisation • Integration of digital public services on a single accessible platform • Updating key digital inclusion indicators for skills and use; • Update research when new technologies are available • Supplement survey data with observational and testing methodologies to profile and record actual online behaviours • Design locally recognised evaluative tools (e.g., Digital Competence Wheel) for learners to gauge their skill level and progress in digital learning journeys

11 Final thoughts

In the course trying to understand the “problem” of digital inclusion and its “solutions”, two insights have lingered in our minds; one on the nature of the digital divide and the other on the mindset that policymakers and other stakeholders can take:

> [Johannes Bauer on the “never-closing” nature of digital divides] “But we also did see that having access to those earlier generations of broadband technology actually constrains users, in ways that were sort of detrimental to learning. And so that continues to be a challenge, so we have the slow diffusion of the base connectivity to certain locations. And then we have an increasing gap again when it comes to the next generation of technology, which again is more available in urban areas and to higher-income groups and so forth.”

Indeed, history provides the evidence of technological divides that widen initially, get narrowed, and then widen again when a new technology becomes available. Consider the waves of technological divides in communications from fixed line telephony to dial-up Internet, to mobile telephony, and to the current broadband Internet. Even as we strive to close the digital divide in access, skills and use for the Internet, new divides are already opening up in other new technologies like AI.

The other lingering thought is on the “non-stupid” optimism that we should adopt towards digital technologies. In the context of educational technologies, Facer and Selwyn (2021) argue that we need to develop “non-stupid” optimism about technologies and look beyond the “charismatic allure of the ‘techno-fix’, and instead work toward forms of technology use that can support and sustain the longstanding and hard work of addressing the social and material obstacles to educational and social equalities” (p. 2).

As policymakers, researchers, and practitioners labour to make progress on digital inclusion, we should adopt this “non-stupid optimism” even as we train our sights on the horizon for those emerging divides. Instead of thinking of universal digital inclusion as the end goal, perhaps the practical approach to digital inclusion is to think about how we can draw on the lessons learned from each wave and *accelerate the narrowing of the divides in between technological waves.*

Marc Andreessen, co-founder of Netscape, remarked that “any new technology tends to go through a 25-year adoption cycle” (Johnson, 2013). With collective action, perhaps we can shorten these cycles so that more people can enjoy the benefits of new technologies with the rest of society, sooner.

This landscape review and the accompanying recommendations are our contribution to shorten the adoption cycle for the current wave, and we hope some of the insights will remain useful for the emerging digital divides.

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13 Appendix: Digital inclusion experts interview guide

[GENESIS OF RESEARCH]

1. Let's start with the genesis of your research. You made understanding the digital divide your lifework and recently came up with the resources and appropriation theory of the digital divide. Looking back, why study the digital divide? How is the digital inequality different from other inequalities that exist in our societies? What is novel about the access to ICT compared to access to economic resources?

[MOST CRITICAL DIVIDES]

2. In your research, you mentioned several kinds of divides; which types of digital divides are the most persistent? We think that the physical access is closing but are there divides that are opening up or new divides that are being created?

[DIGITAL SKILLS DIVIDE]

3. I have one specific question about your classification of digital skills — the six types of skills that make up medium-related and content-related skills. Can you share a little about the thinking behind the classifications? Other organisations like UNESCO or the EU have other ways of classifying the skills like the DigComp framework, etc. How do we apply the classifications to closing the digital divide?

[WHO ARE DISPROPORTIONATELY AFFECTED]

4. Who are the most affected and how do you think we should go about bridging the digital divide for them?
5. How do we optimise the potential good of digital technologies while mitigating their potential harm? Practical chicken-and-egg problem.

[POLICY INTERVENTIONS]

6. What can the policymakers do to bridge those persistent divides? What can policymakers do to prepare for future divides? How should digital readiness and digital literacy programmes evolve?
7. Are there good practices that you have seen from policymakers that have been effective in closing the digital divides? What do you think is the secret sauce for the more successful intervention?
8. Are there successful collaborations you can think of between the government, people and institutions?

[WHAT CAN RESEARCHERS DO?] [ROLE OF RESEARCH]

9. What are the current gaps and shortcomings in digital divide research and how to compensate for them?
10. What are the outcomes that are meaningful to measure and track especially with regard to digital skills and participation? The policymakers often question so what if we know?
11. We're close to the end of the hour. Are there any other thoughts that come to mind during our conversation that you like to share? Anything that would be useful for policymakers to know?