IPS Working Papers

TOWARDS A UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE

CHEW HAN EI
and
CAROL SOON

APRIL 2021
IPS Working Papers No. 39

Institute of Policy Studies

About Institute of Policy Studies (IPS)

The Institute of Policy Studies (IPS) was established in 1988 to promote a greater awareness of policy issues and good governance. Today, IPS is a think-tank within the Lee Kuan Yew School of Public Policy (LKYSPP) at the National University of Singapore. It seeks to cultivate clarity of thought, forward thinking and a big-picture perspective on issues of critical national interest through strategic deliberation and research. It adopts a multi-disciplinary approach in its analysis and takes the long-term view. It studies the attitudes and aspirations of Singaporeans which have an impact on policy development and the relevant areas of diplomacy and international affairs. The Institute bridges and engages the diverse stakeholders through its conferences and seminars, closed-door discussions, publications, and surveys on public perceptions of policy.

IPS Working Papers No. 39

TOWARDS A UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE

CHEW HAN EI

Senior Research Fellow

Institute of Policy Studies

han.chew@nus.edu.sg

and

CAROL SOON

Senior Research Fellow

Head, Society & Culture

Institute of Policy Studies

carol.soon@nus.edu.sg

April 2021

CONTENTS

Abstract **ii**

Sections

1. DIGITAL "DIVIDES" IN THE COVID-19 PANDEMIC 2
- 1.1. Digital Divides Amplifying Social Inequalities 5
- 1.2. How Singapore is Currently Bridging the Digital Divides 8
- 1.3. Narrowing the Digital Literacy Gap in Singapore 11

2. PROPOSING A UNIFIED FRAMEWORK FOR DIGITAL LITERACY 15
- 2.1. Defining Digital Literacy 16
- 2.2. Reference Framework: Digital Competence Framework 19
- 2.3. Singapore Context: Digital Media and Information Literacy 22
- 2.4. Mapping Existing Frameworks to DigComp 2.1 24
- 2.5. Hierarchy of Frameworks, Programmes and Campaigns 32
- 2.6. Digital Media and Information Literacy Framework 2.0 (DMIL 2.0)? 34
- 2.7. Career-Related Digital Competences 36
- 2.8. Emerging Research on Career-Related Digital Competences 38

3. THE UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE 45
- 3.1. Revised Outcomes of UFDL 45
- 3.2. Functions of the Unified Framework for Digital Literacy 48

4. IMPLEMENTATION OF THE UNIFIED FRAMEWORK FOR DIGITAL LITERACY (UFDL) 49
- 4.1. Microsoft Digital Literacy Course 49
- 4.2. International Computer Driving License (ICDL) Digital Citizen 50
- 4.3. IC3 Digital Literacy Programme 52

5. CONCLUSION 55

6. REFERENCES 59

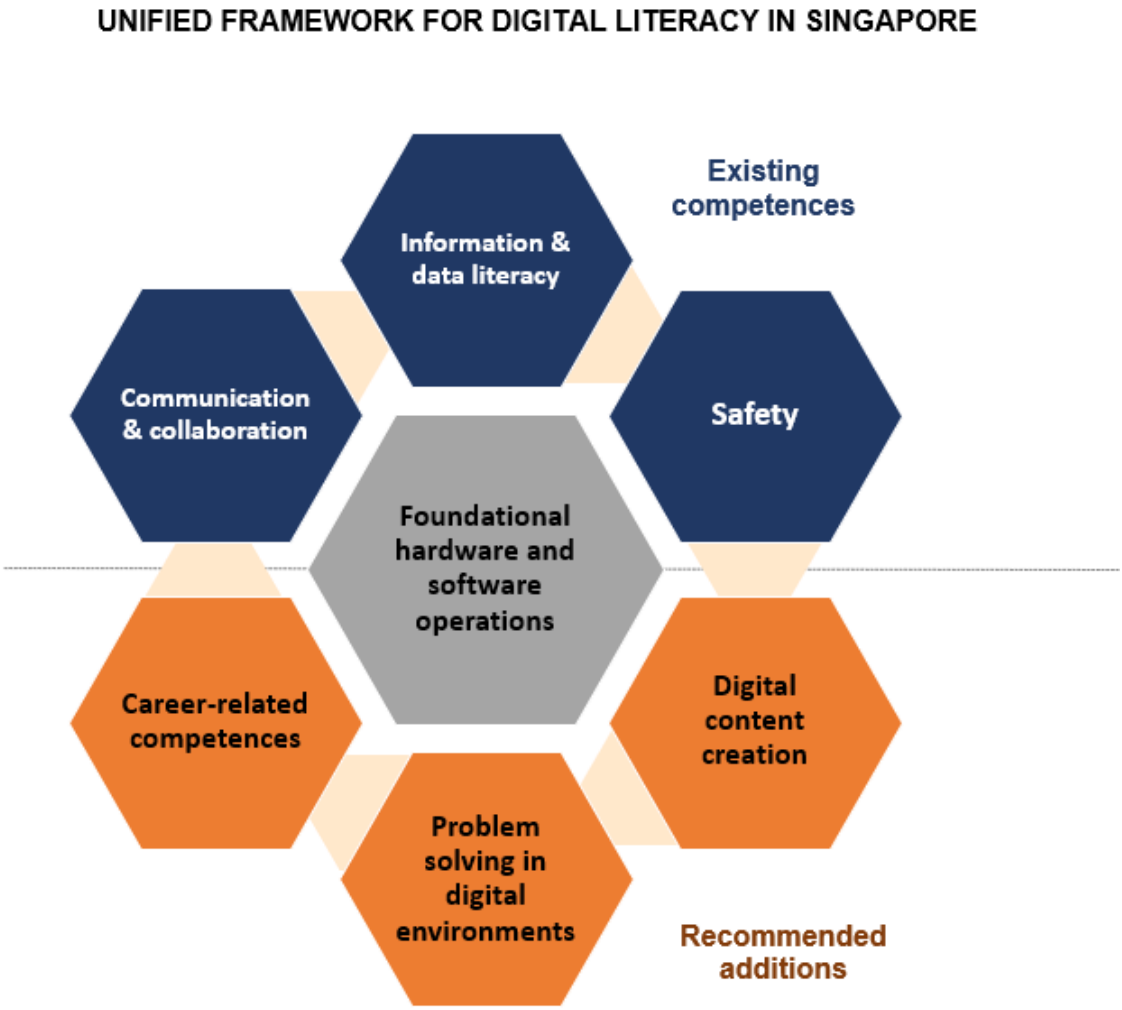
7. APPENDIX 64

TOWARDS A UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE

ABSTRACT

The unprecedented challenges posed by the COVID-19 pandemic have brought to the forefront the critical nature of digitalisation. For individuals, businesses and economies, digital transformation is now a must-do and no longer a good-to-have. However, digital technology can both connect and divide. It can bring about tremendous benefits especially in times when safe distancing is mandatory, but it can also compound and worsen existing economic and social inequalities. In this working paper, we specifically address the second-level digital divide of digital literacy (the first level being physical access and the third level, participation). Based on a systemic review and mapping exercise of local and international digital literacy frameworks, we propose a Unified Framework for Digital Literacy in Singapore (UFDL). The key premise of the proposed UFDL is that existing digital literacy frameworks in Singapore mostly focus on digital consumption skills such as online safety and information literacy, and less on digital production skills such as problem solving and digital content creation. The proposed UFDL is intended to be a comprehensive and unifying digital skills framework that will strengthen policy coherence across different domains. Recommendations are also made for the formulation of a set of career-related digital competences and the implementation of a national digital literacy curriculum.

Main policy recommendation:



Other policy recommendations:

1. **Develop a framework that expands and unifies frameworks such as the Digital Media and Information Literacy Framework to include "production" digital skills** such as digital content creation and problem solving.

2. **Synergise the National Digital Literacy Programme** for in-school learners and the **Digital Media and Information Literacy Framework** for out-of-school learners to strengthen policy coherence and continuity.

3. **Include career-related competences** in an overarching national framework. There is urgent need to create a set of basic career-related competences curriculum and benchmarks so that Singaporeans can acquire foundational digital skills with which to deepen and broaden their competences. This will enable Singaporeans to track and acquire competences as they upgrade their employability or transit to different sectors.

4. **Formulate a national digital literacy curriculum** so that education and training institutions and lifelong learning organisations can use the curriculum as a template to develop and innovate their delivery and assessment services.

TOWARDS A UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE

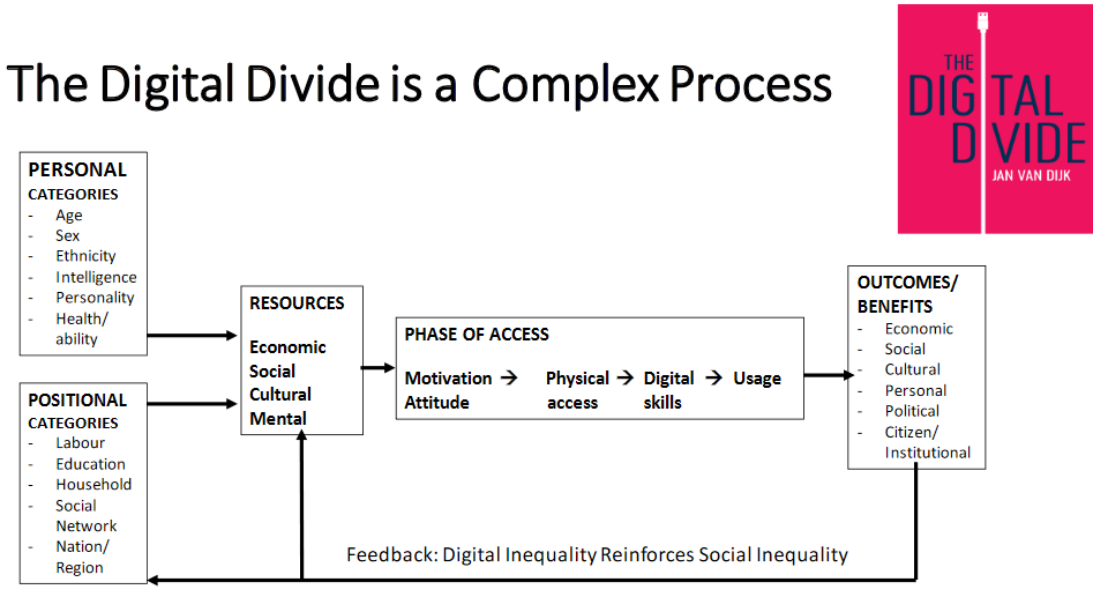
1. DIGITAL "DIVIDES" IN THE COVID-19 PANDEMIC

At the time of writing, the world has just marked the one-year anniversary since the World Health Organization (WHO) declared COVID-19 a global pandemic. Intermittent lockdowns to curb spread are still the norm and countries have started their vaccine rollouts. Armed with the vaccines, hopeful leaders and peoples are planning for a post-COVID-19 future and many of these recovery plans include advancing towards a vision of a digital economy where citizens are well equipped with digital competences. In Singapore, the government set up the SG Digital Office in June 2020 to accelerate digital adoption among seniors, hawkers, and heartland enterprises (CNA, 2020). In early 2021, a new Digital for Life movement was also launched to "build a digitally inclusive society where digital technologies are accessible to all, and no one is left behind" (IMDA, 2021a). Indeed, bridging the digital divide has become a rallying call for Singapore (and many countries) to emerge in an advantageous position in a post-COVID world.

However, the digital divide that countries are trying to bridge is technically not a single divide. The digital divide is in fact a complex concept and made up of several divides that require different types of interventions (Pang & Chew, 2020). Van Dijk (2005, 2020) identifies four types (or phases) of digital divides:

motivation and attitudes, physical access, digital skills, and usage gaps (see Figure 1).

FIGURE 1: A CAUSAL MODEL OF RESOURCES AND APPROPRIATION THEORY OF THE DIGITAL DIVIDE



Source: Adapted from *The Deepening Divide*. (Van Dijk, 2005, p.24)

Early research on the digital divides in the 1990 s mostly focused on who had or did not have physical access to the necessary hardware (Katz & Aspden, 1997; Hoffman & Novak, 1998). Most of this early body of work studied demographic predictors of digital access such as age, household income and geography. Current research on this first-level digital divide of physical access is frequently cited in advocacy efforts for universal access to the internet and digital access as a basic human right. This gap and the gaps in motivation to want to be digitally connected are expected to gradually close over the next decade as cost of technology adoption lowers.

The next wave of digital divide research in the early 2000s focused on skills and the know-how to use the digital technologies effectively (Attewell, 2001).

Researchers who espoused this second-level digital divide acknowledged the techno-deterministic assumption of the first-level digital divide: benefits do not automatically follow adoption. Just because users have internet access and devices does not necessarily mean they will benefit from the use of digital technologies. They also need to be equipped with the skills and know-how.

This working paper is located in this second stream of digital divide research, focusing on digital literacy and skills. Research on the digital skills gap has found that those who are more educated and more digitally literate are able to perform more complex tasks online like content creation and strategic communications. They also tend to learn skills faster and better (Van Dijk, 2020). In addition to demographic predictors, the research questions in this stream of work centre on the types of skills required for effective use of digital technologies. Unlike the first-level gap in physical access that is expected to close gradually, this second gap in digital skills will likely widen without targeted interventions.

Beyond the second-level digital divide lies the third-level digital divide — in participation (Jenkins et al., 2006) and usage, or emerging digital differentiation (Peter & Valkenburg, 2006). The key research questions centre on who are using the internet for capital-enhancing activities (e.g., improving their learning, information-seeking, productivity, and other activities) that enhance their income and influence, and who are using the internet for consumption activities (e.g., entertainment, simple messaging, and e-

commerce). Current studies uncovered a consistent finding — people with higher education and of higher social class tend to engage in more capital-enhancing activities while people with low education and social class tend to engage in consumption activities (Robinson et al., 2020a; Bonfadelli, 2002; Eynon, 2009; Zillien & Hargittai, 2009).

Across all these three levels of digital divides, those on the “right side” of the divide benefit much more from using the internet than people who have been left behind on the “wrong side”. Closing all these different digital divides has implications for the economic and social well-being for both citizens and countries.

1.1. Digital Divides Amplifying Social Inequalities

As the world grapples with the COVID-19 pandemic, digital skills and remote work have become a lifeline for workers to retain their employment and for businesses to ensure their economic survival. During lockdowns, workers who can do their work remotely are less likely to be impacted by lockdown measures, and even when they have to be laid off or furloughed they are better placed to leverage their digital competences and pivot to other industries and jobs (APEC, 2020).

However, researchers are observing that digital divides and digital inequalities are exacerbating existing social inequalities during the pandemic (Robinson et al., 2020b). Even in countries where digital technologies are widely available,

access remains uneven and those who are left behind are often those who can least afford it (ITU, 2019). Workers in non-digital occupations (many of them at the frontline or in the service industry) still have to show up physically for their jobs and put themselves at greater health risks. Others who do not have access to the internet and technology, particularly the poor and vulnerable, have lost employment and do not have the digital competences to transition to other forms of employment.

In homes where there is high connectivity and access to devices, students can participate in home-based learning; while those who are digitally disadvantaged face greater risks of falling behind their peers in their education pathways. During the early months of local and nation-wide lockdowns around the globe, it was estimated that half the world's student population (850 million children and youth) had to stay away from school (UNESCO, 2020). While some schools tried to fill the gaps via virtual lessons, the lack of access to a stable internet connection posed a hurdle that disproportionately affected underprivileged children.

The public health crisis is also worsened by digital inequalities. Digital inequalities relating to healthcare have been exacerbated because "the digitally disadvantaged are less likely to use eHealth services, [and so] they bear greater risks during the pandemic in order to meet ongoing medical care needs" (Khilnani et al., 2020, as cited in Robinson et al., 2020). In the Netherlands, van Deursen (2020) found that those with no or bad internet

access searched and found less information about COVID-19 and on how to handle it. Fewer of those with no and poor access knew and followed government measures. They also communicated less with others on dealing with the situation and getting social network support. Even for a developed country like the Netherlands, which has 98 per cent internet penetration rate, those with the most risks for being infected and becoming sick — the elderly, persons with low education and jobs requiring physical presence — were the ones who were using less and benefitting less from COVID-19 information and communication online.

Digital divides reflect and amplify existing social, cultural, and economic inequalities; and the COVID-19 pandemic has intensified the urgency to bridge these divides — both digital and socio-economic. Those who are "digitally under-resourced are suffering disproportionately from being inhibited in their ability to learn, to earn a living, or access healthcare facilities and are clearly subject to greater risks than those who could mitigate the effects of the pandemic with digital resources" (Robinson et. al., 2020a).

Recent research points to the immense potential of digital technologies to be a lifeline for millions of people in the age of the pandemic. Van Dijk's (2020) recommendations for reducing inequalities and tacking the pandemic using the internet demonstrate the critical role digital technologies play.

TABLE 1: RECOMMENDATIONS FOR REDUCING INEQUALITIES AND TACKLING THE PANDEMIC USING THE INTERNET

For reducing both social and digital inequalities	For approaching the COVID-19 crisis using the internet
• Revitalising social mobility everywhere • Long-term digital/social programmes for disadvantaged groups in their own communities • Provide cheaper digital technology • Design technology that is easier to use • Better government and other public regulation for the internet, especially Internet platforms improving trust	• Accessible, readable, reliable and up-to-date information of COVID-19 on both the internet and traditional media • Offer communication venues for communication support about the disease on the internet for all • Produce reliable COVID-19 information and reduce unreliable information about the disease in the social media • Design and supply mobile apps for COVID-19 information and privacy-friendly tracing and warning systems

Source: Adapted from *The Digital Divide* (Van Dijk, 2020, p.155)

Digital technologies, when accessed and used inequitably, can widen existing social and economic inequalities. Without prompt collective action, there are clear and present risks of those who are already disadvantaged falling further behind as digital inequalities layer on and compound existing social equalities. This paper acknowledges this amplification effect of digital inequalities on social inequalities and offers a revised national framework for closing the digital skills gap in Singapore.

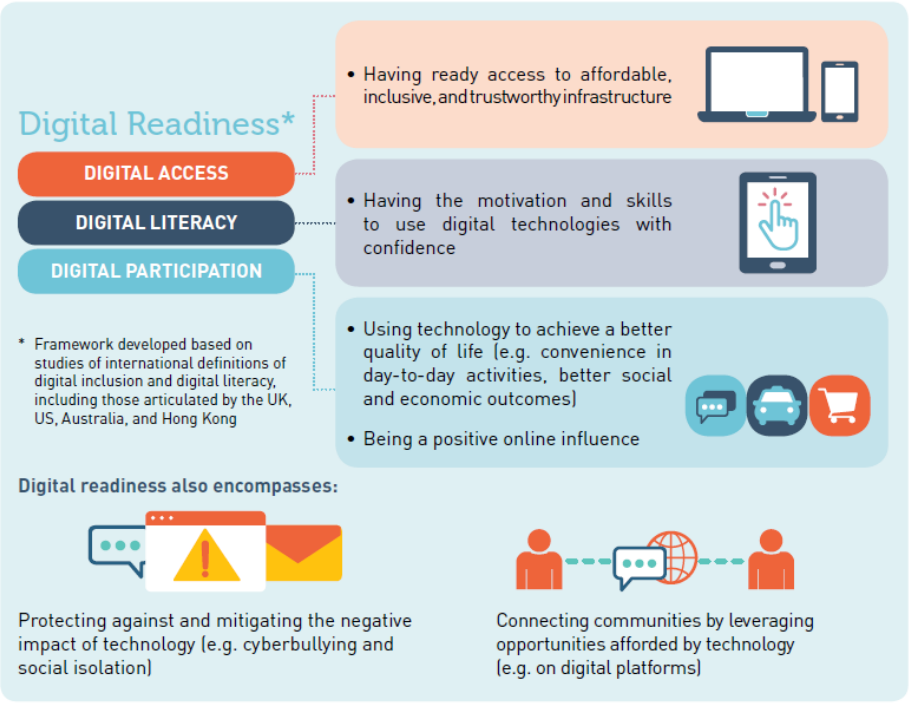
1.2. How Singapore is Currently Bridging the Digital Divides

In 2019, about 89 and 98 per cent of Singapore households have access to a computer and the internet, respectively (IMDA, 2020). Singapore's mobile

penetration stands at 150 per cent (IMDA, 2021b). Despite being one of the most connected countries in the world, bridging the digital divides remains a top national agenda. To ensure that all Singaporeans have access to the opportunities and benefits of a digital society, the Singapore government launched the *Digital Readiness Blueprint* in 2018 (MCI, 2018).

In the blueprint, digital readiness is defined as: a) having access to digital technology; b) having the literacy and know-how to use this technology; and c) being able to participate in and create with this technology (see Figure 2). Except for the divide in motivation and attitudes, the digital readiness framework is consistent with the theory of the digital divide in Figure 1 in the areas of access, literacy (skills) and participation (usage).

FIGURE 2: DIGITAL READINESS IN THE CONTEXT OF SINGAPORE



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

To achieve the vision of digital readiness, four strategic thrusts were formulated in the blueprint (see Figure 3):

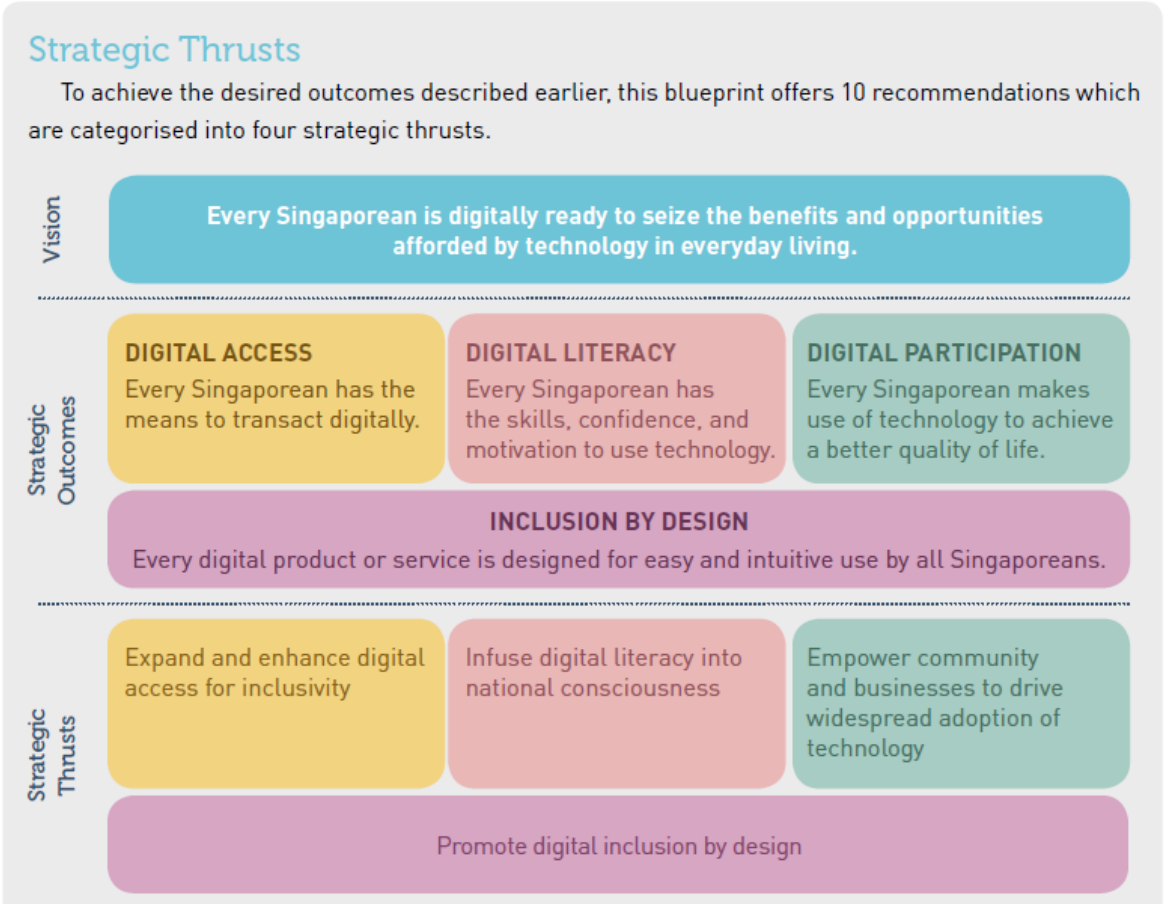
Strategic Thrust 1: Expand and enhance digital access for inclusivity

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

FIGURE 3: STRATEGIC THRUSTS UNDER THE *DIGITAL READINESS BLUEPRINT*



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

1.3. Narrowing the Digital Literacy Gap in Singapore

As part of Singapore's COVID-19 recovery plan, the country accelerated its digitalisation efforts in March 2020 with the formation of a ministerial committee on digital transformation, co-chaired by the Minister for Communications and Information Mr S. Iswaran and the Minister for Trade and Industry Mr Chan Chun Sing. Key priorities of the committee include "helping people to learn new skills and seize technology-related jobs, as well as getting more small businesses, especially those battered by the pandemic, to go digital" (Tang, 2020).

Adoption in the community is championed by a newly formed SG Digital Office with flagship initiatives such as Hawkers Go Digital and Seniors Go Digital. These dedicated programmes are complemented by other existing information and media literacy public education programmes, including the Media Literacy Council's Better Internet Campaign, the National Library Board's S.U.R.E. programme, and the Cyber Security Agency of Singapore's National Cybersecurity Awareness Campaign. Many training providers and initiatives in the people and private sectors also conduct similar programmes but for targeted segments. Tables 2 and 3 below list the public and private sector initiatives (this is a growing list and not meant to be exhaustive).

TABLE 2: EXAMPLES OF PUBLIC SECTOR DIGITAL TRANSFORMATION INITIATIVES

Public sector initiative	Agency	Focus
Silver Infocomm Initiative (SII) — Silver Infocomm Junctions (SIJs)	IMDA	**[Motivation]** Promote IT awareness and literacy among seniors
Digital for Life movement	IMDA	**[Motivation]** Galvanise the community to help Singaporeans embrace digital as a lifelong pursuit
NEU PC Plus	IMDA	**[Access]** Home access programmes for low-income families
Enable IT for persons with disabilities (2014)	IMDA	**[Access]** Enable Persons with Disabilities (PWDs) through adoption of Infocomm and Assistive Technologies
Seniors Tech and Read (S.T.A.R) service and Read Assist (NLB)	NLB	**[Access]** Support seniors in accessing library resources
SkillsFuture Singapore (SSG) — SkillsFuture for Digital Workplace (SFDW)[1]	SSG	**[Skills]** Prepare Singaporeans for technological changes in their workplace and daily lives
National Digital Literacy Programme	MOE	**[Skills]** Enable students to acquire digital skills across the "Find, Think, Apply, Create" framework
Media Literacy Council (MLC)'s Better Internet Campaign, the National Library Board (NLB)'s S.U.R.E. (Source, Understand, Research, Evaluate.) programme, and the Cyber Security Agency of Singapore (CSA)'s Cyber Awareness Campaign	MLC, NLB, CSA	**[Skills]** Various campaigns by public agencies to raise awareness about information, media, and digital literacy
Hawkers Go Digital and Seniors Go Digital	SDO	**[Targeted segments]** Helping hawker stallholders and seniors go digital

[1] The programme SFDW is designed to help all Singaporean adults, including those planning to return to the workforce. For individuals**:** To understand emerging technologies and how they impact work, interpret, and use data, and adopt a positive mindset for change, innovation and resilience. For employers: To equip staff with the right mindset and skills to welcome technological changes to the workplace, and to take advantage of new opportunities in the future economy.

SMEs Go Digital programme[2]	IMDA	**[Targeted segment]** Help SMES to use digital technologies and build strong digital capabilities

TABLE 3: EXAMPLES OF PRIVATE SECTOR AND COMMUNITY INITIATIVES

Public sector initiative	Organisation	Focus
Beyond Social Services	Beyond Social Services	**[Access]** Provide laptops to young people, their caregivers, and others in their community to facilitate schoolwork, job search and remote working opportunities
Bridge the Digital Divide	Xpointo Media	**[Access]** Solicit corporate donations of working condition used laptops to re-direct to partnering non-profit organisations
Code for Change, Microsoft Imagine Cup	Microsoft	**[Skills]** Help young talents nationwide develop computational thinking skills
Engineering Good	Engineering Good	**[Targeted segments]** Empower disadvantaged communities by improving their quality of life through sustainable engineering solutions
ReadAble	ReadAble	**[Targeted segments]** From building language and numeracy skills to improving digital literacy skills among disadvantaged communities
SingTel-TOUCH: Cyber	SingTel & Touch	**[Targeted segment]** App is designed to help parents better

[2] Under the SMEs Go Digital programme, SMEs can first refer to the sector-specific digital roadmaps to determine the digital solutions to use at each stage of their growth. Next, they can consult digital specialists at the SME Digital Tech Hub if they need expert help to better appreciate digitalisation before they embark on it. When they are ready to get started, they can select from the list of proven digital solutions pre-approved by IMDA or embark on industry-led pilot projects to achieve new growth.

Wellness Toolkit		understand and protect their children from online risks
Digital literacy for single mothers	Daughters of Tomorrow	**[Targeted segment]** IT literacy courses to equip low-income women with skills to enhance their employability
Tech Able (Singtel Enabling Innovation Centre and ST Engineering Enabling Technology Centre)	SG Enable	**[Targeted segment]** Promote the adoption of assistive technologies among persons with disabilities and employers

The tables above list a plethora of programmes and initiatives targeted at closing the digital divide in access to affordable devices and the internet for various target segments. Likewise, there are multiple programmes and initiatives to ensure that citizens have the skills and how-how to use digital technologies. However, the efforts by a growing number of agencies and organisations to close different digital divides for different groups raise several questions. For one, how would we know if existing efforts make substantive progress at the collective level towards the vision of a Smart Nation? With the focused attention on some groups, would outcomes be different for others who are not part of these programmes? Would the resultant digital skills proficiencies be different for different programmes and initiatives? These considerations set the premise for our proposal for a “Unified Framework for Digital Literacy in Singapore”.

2. PROPOSING A UNIFIED FRAMEWORK FOR DIGITAL LITERACY

The **Unified Framework for Digital Literacy in Singapore (UFDL)** aims to complement and support the strategic outcomes of “digital literacy” under the *Digital Readiness Blueprint*. The framework was conceptualised through a systematic review of Singapore’s national digital literacy frameworks and benchmarking them against other international frameworks. The UFDL is intended to strengthen policy coherence across different frameworks, programmes, and campaigns so that efforts to upskill Singaporeans in their digital competences are harmonised at the collective level. Table 4 below lists the key digital literacy frameworks, programmes and campaigns that were reviewed.

TABLE 4: KEY DIGITAL LITERACY FRAMEWORKS, PROGRAMMES AND CAMPAIGNS REVIEWED

Local organisations	**Digital literacy frameworks / programmes / campaigns**
Ministry of Communications and Information, Singapore	Digital Media and Information Literacy Framework
Ministry of Education, Singapore	National Digital Literacy Programme
Cyber Security Agency of Singapore	Go Safe Online — Cyber Awareness
National Library Board, Singapore	S.U.R.E Programme
Media Literacy Council, Singapore	Better Internet Campaign
International organisations	**Digital literacy frameworks / programmes / campaigns**
European Commission	Digital Competences 2.1
UNESCO	Global Framework of Reference on Digital Literacy Skills
Microsoft	Microsoft Digital Literacy
ECDL Foundation	ICDL / ECDL certifications
Pearson Education Inc	Internet Core Competency certification

2.1. Defining Digital Literacy

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

> Digital literacy is 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.

Digital literacy is specifically tracked as Sustainable Development Goal (SDG) Target 4.4 which aims to “substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship” by 2030 (Montoya, 2018).

In Singapore, Strategic Thrust 2 of the *Digital Readiness Blueprint* by the Ministry of Communications and Information describes “a digital society as one where citizens not only have access to technology, but also embrace it, utilizing technology confidently and effectively to connect with the world around them” (p.14).

> Digital Literacy is defined as having the skills, confidence, and motivation to use technology, and is key to our journey towards our Smart Nation vision.
>
> Besides an appreciation of what digital technology can do and the know-how to use it, digital literacy is also about being able to think critically about the information that one has received. With the proliferation of fake news, being able to discern misinformation has become even more important (p. 22).

The specific inclusion of fake news in the formulation of digital literacy in Singapore bears special mention. As will be explained in subsequent sections, programmes and campaigns that fall under the digital literacy thrust of the *Digital Readiness Blueprint* often emphasise information literacy over the

other types of digital literacy. **This working paper will present arguments that this emphasis on information literacy, while appropriate for the information challenges confronting Singapore, may have the unintended effect of eclipsing other digital competences.**

To achieve Singapore's digital readiness vision, the Ministry of Communications and Information also established the Digital Media and Information Literacy Framework (DMIL) to provide an overarching frame to guide existing public education efforts (MCI, 2019). The framework seeks to empower Singaporeans to be discerning consumers of information who appreciate the possibilities, problems and prospects afforded by technology. The framework does not provide a definition of digital literacy; it establishes a set of common outcomes for programme owners to work towards and focuses on developing in Singaporeans (authors' emphases):

- A fundamental appreciation of the benefits, *risks*, and possibilities that technology can bring and how online platforms and digital technologies work;
- A basic understanding of how to *use information responsibly*; and
- The know-how for *safe and responsible use* of digital technologies.

At face value, the three outcomes take on a risk mitigation accent: *an appreciation of the risks*, *responsible use of information*, and the *safe and responsible use of digital technologies*. In contrast, the definition of digital

literacy by the UNESCO Institute for Statistics and SDG Target 4.4 takes on an enabling accent, which emphasises digital literacy as competences critical for participation in economic and social life.

Adopting the enabling approach (as opposed to mitigating) can shift the focus to capability building so that citizens can be confident in embracing the opportunities brought about by developing technologies. As a first step, we appraise the local frameworks against the Digital Competence Framework by the European Commission, one of the early frameworks in digital literacy, which has undergone several revisions since its establishment.

2.2. Reference Framework: Digital Competence Framework

The Digital Competence Framework by the European Commission represents one of the longest-standing frameworks on digital competence (Carretero et al., 2017). First completed in 2013 by the European Commission's Joint Research Centre, the DigComp project was initially commissioned with the following objectives (Ferrari, 2012, p.1):

- To identify the key components of Digital Competence in terms of the knowledge, skills and attitudes needed to be digitally competent.
- To develop Digital Competence descriptors that will feed a conceptual framework and/or guidelines that can be validated at European level, taking into account relevant frameworks currently available.

- To propose a roadmap for the possible use and revision of a Digital Competence framework and descriptors of Digital Competences for all levels of learners.

The framework is currently in version 2.1 and comprises five key components (Carretero et al., 2017, p.11):

1. 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.

2. 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.

3. 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.

4. 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.

5. 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.

2.3. Singapore Context: Digital Media and Information Literacy

The Digital Media and Information Literacy Framework aims to guide digital literacy programme owners and public agencies in the planning of media literacy and information literacy programmes, and has five key learning outcomes ([MCI, 2019]; see below and Figure 4):

Learning Outcome 1: Appreciate the Benefits, Risks and Possibilities that Technology Can Bring

- Why it is important to keep up with rapidly advancing technology
- How technology can bring both benefits and risks

Learning Outcome 2: Understand How Online Platforms and Digital Technologies Work

- How digital footprints work and how to manage them
- How algorithms work on the internet (intermediate)
- How digital advertising works (intermediate)
- How human factors can influence thinking and behaviour online (intermediate)

Learning Outcome 3: Understand How to Use Information Responsibly

- What are some examples of information sources
- How to assess the credibility of an information source
- What is the difference between fact and opinion
- Why people create and spread false information

- What is the damage caused by creating and spreading false information
- What are the different types of false information (intermediate)
- What is the difference between disinformation and misinformation (intermediate)

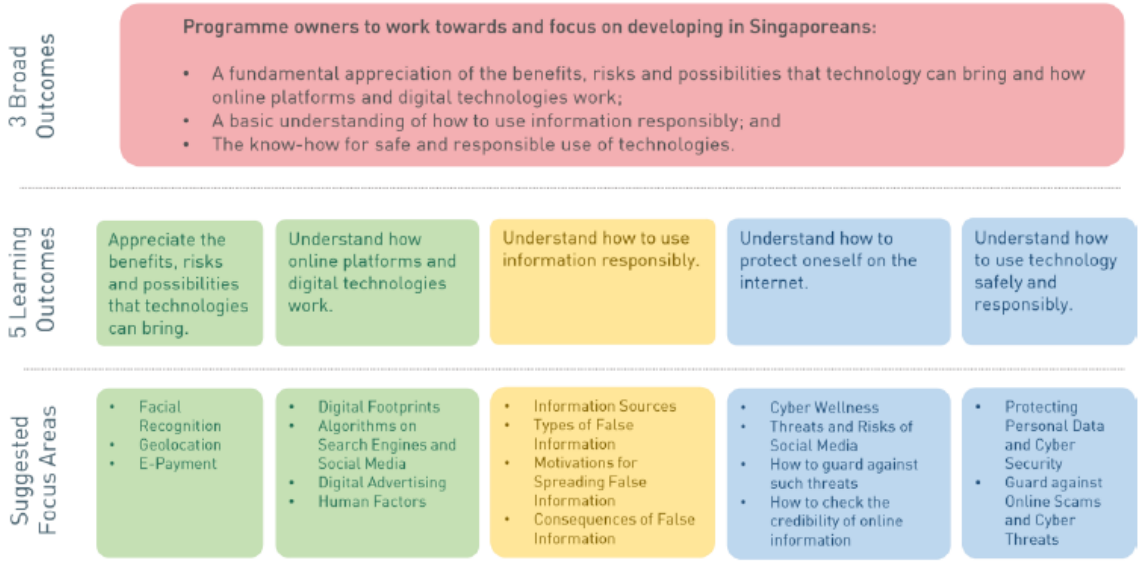
Learning Outcome 4: Understand How to Protect Oneself on the Internet

- What is cyber wellness
- What are the threats and risks of social media
- How to guard against the threats and risks of social media
- How to check the credibility of information encountered or received (intermediate)

Learning Outcome 5: Understand How to Use Digital Technologies Safely and Responsibly

- Protect personal data and cyber security, including
    - How to secure digital devices and online accounts
- Guard against online scams and cyber threats, including
    - What are the different types of online scams
    - What phishing is and how to recognise the tell-tale signs
    - How to respond to an online scam
    - How to guard against cyber threats
- Guard against online scams and cyber threats, including (intermediate)
    - What are the different types of cyber threats
    - What cyber threats and malware can do

FIGURE 4: DIGITAL MEDIA AND INFORMATION LITERACY FRAMEWORK (SINGAPORE)



Source: *Digital Media and Information Literacy Framework* (MCI, 2019, p.3)

2.4. Mapping Existing Frameworks to DigComp 2.1

When the DMIL framework is mapped to DigComp 2.1, the singular focus of Singapore's digital literacy framework becomes apparent. The learning outcomes and suggested focus areas exclude digital competences in the areas of collaboration, digital content creation and problem solving:

TABLE 5: MAPPING DIGCOMP 2.1 TO DMIL

DigComp 2.1 components	DMIL Learning Outcomes
Information and data literacy	LO1 Appreciate the benefits, risks, and possibilities that technology can bring LO2 Understand how online platforms and digital technologies work
Communication and collaboration	
Digital content creation	
Safety	LO3 Understand how to use information responsibly LO4 Understand how to protect oneself on the internet LO5 Understand how to use digital technologies safely and responsibly
Problem solving	

The emphasis on information literacy and online safety is also apparent in other national programmes and campaigns designed to improve the digital literacy of Singaporeans. These programmes have a strong emphasis on information literacy and online safety and the other aspects of digital literacy tend not to be emphasised. Table 6 below maps the DigComp 2.1 components to programmes and campaigns in Singapore:

TABLE 6: MAPPING DIGCOMP 2.1 TO THREE KEY INFORMATION CAMPAIGNS IN SINGAPORE

DigComp 2.1 components	S.U.R.E. — NLB	Cybersecurity Awareness Campaign — CSA	Better Internet Campaign — MLC
Information and data literacy	✓	✓	✓
Communication and collaboration	✗	✗	?
Digital content creation	✗	✗	✗
Safety	✓	✓	✓
Problem solving	✗	✗	✗

NLB: National Library Board; CSA: Cyber Security Agency; MLC: Media Literacy Council

2.4.1 The S.U.R.E campaign

The National Library Board launched the S.U.R.E programme in 2013, to promote the "importance of information searching and discernment to the public" (NLB, n.d.). The acronym stands for "source", "understand", "research", and "evaluate", four ideas for individuals should practise when assessing the veracity of information. To cater to the different needs and segments of the population, it has since upgraded the S.U.R.E programme to S.U.R.E. 2.0 — S.U.R.E for School; S.U.R.E. for Work; and S.U.R.E. for Life.

S.U.R.E. distils key information literacy concepts into four simple ways (NLB, n.d.):

- **Source: Look at its origins. Are they trustworthy?**

  Make sure that the source of information is credible and reliable.

- **Understand: Know what you're reading. Search for clarity.**

  Look for facts rather than opinions. Question personal biases.

- **Research: Dig deeper. Go beyond the initial source.**

  Investigate thoroughly before making a conclusion. Check and compare with multiple sources.

- **Evaluate: Find the balance. Exercise fair judgement.**

  Look from different angles. There are at least two sides to every story.

2.4.2 The Go Safe Online Campaign

Go Safe Online is a cyber security awareness campaign by Singapore's Cyber Security Agency (CSA). The campaign focuses on the personal consequences of not adopting good cyber security practices, as well as the four basic cyber hygiene habits that internet users should take to safeguard their digital assets (CSA, 2019). The four cyber hygiene habits are:

i. Use an anti-virus software
ii. Use strong passwords and enable 2FA
iii. Spot the signs of phishing
iv. Update your software promptly

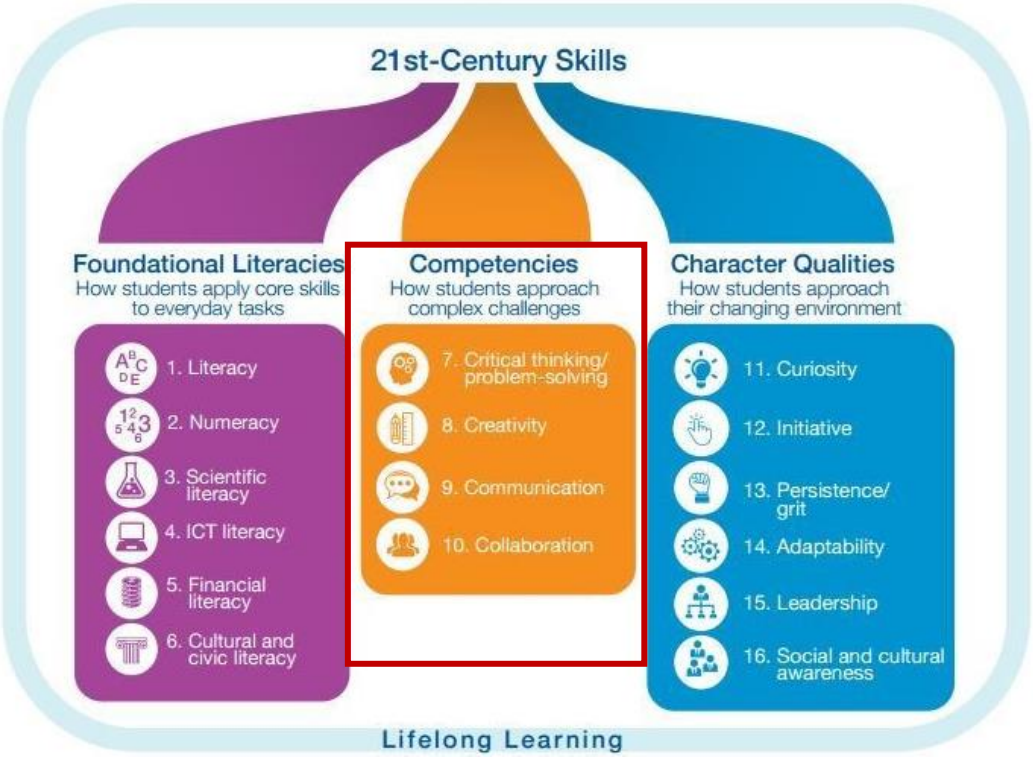
2.4.3 The Better Internet Campaign 2020

The Better Internet Campaign is the Media Literacy Council's flagship programme to "champion digital and media literacy in Singapore" (MLC, n.d.). The theme for the 2020 campaign was #1ClickAway and underscores the

power behind the simple act of a click. It seeks to encourage internet users to embrace “conscious, discerning, and empathetic actions online”, in order to create a safer, smarter, and kinder” internet for all (MLC, n.d.).

Our review of the current policy ecosystem points to a strong emphasis on information literacy and safety. While such as focus is useful and appropriate for the current challenges faced by citizens and the government, such a focus might inadvertently underplay core competences required by citizens in navigating complex challenges in the world today: problem solving, creativity, communication, and collaboration (see Figure 5).

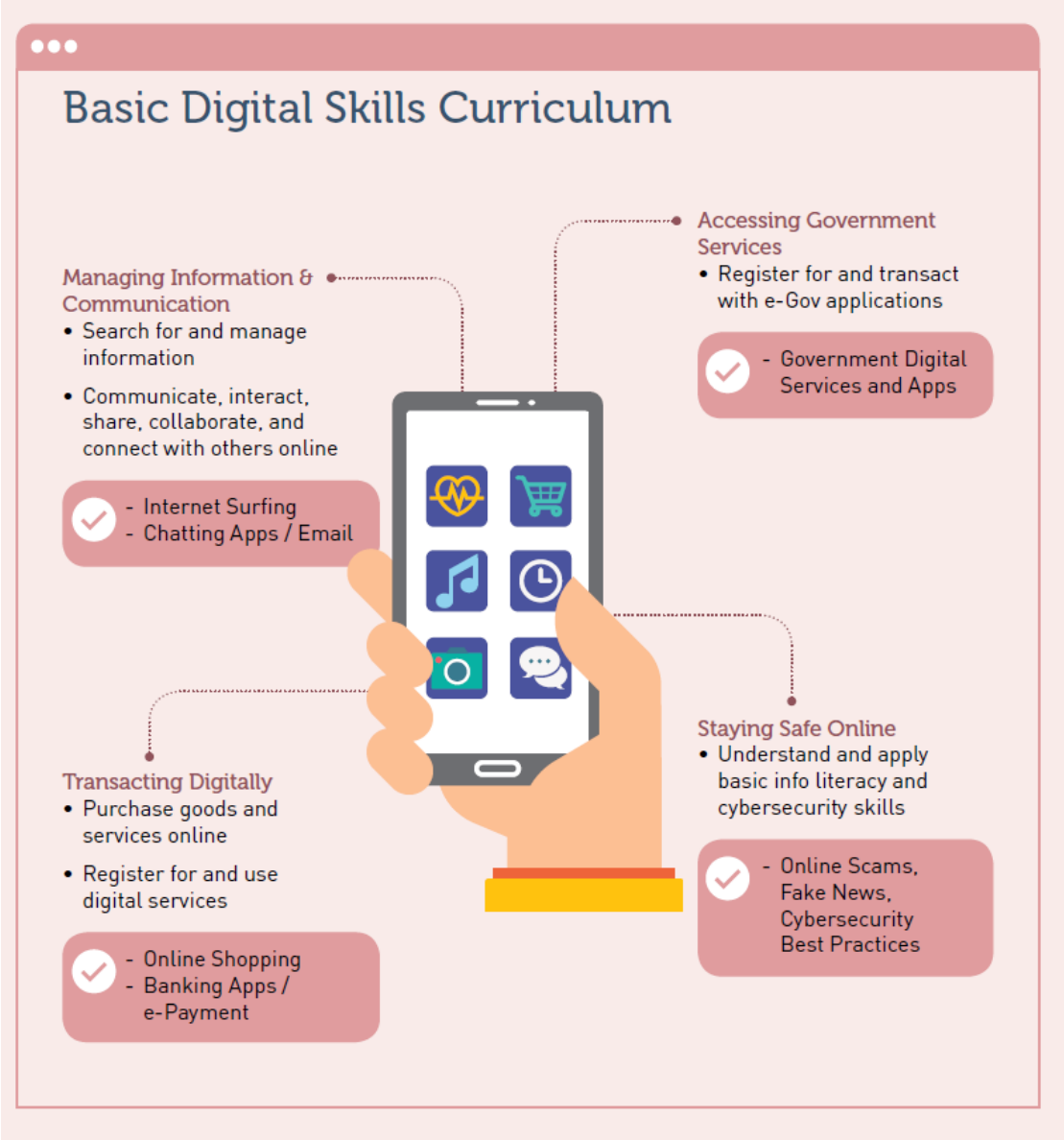
FIGURE 5: 21ST CENTURY SKILLS FOR LIFELONG LEARNING



Source: *New Vision for Education* (WEF, 2015) as cited in “What are the 21st-century skills every student needs?” (Soffel, 2016)

In terms of skills, the digital readiness blueprint recommends that the following basic digital skills be mastered (Figure 6):

FIGURE 6: BASIC DIGITAL SKILLS CURRICULUM IN SINGAPORE



Source: *Digital Readiness Blueprint* (MCI, 2018, p.24)

When the proposed basic digital skills curriculum is mapped to DigComp 2.1, the same gaps in problem solving and digital content creation are observed (see Table 7).

TABLE 7: MAPPING DIGCOMP 2.1 TO BASIC DIGITAL SKILLS CURRICULUM (SINGAPORE)

DigComp 2.1 components	Digital Readiness Blueprint Thrust #2 Basic Digital Skills Curriculum
Information and data literacy	▪ Managing Information — Knowing how to search for and manage information ▪ Transacting Digitally ▪ Accessing Government Services
Communication and collaboration	▪ Managing Communication — Communicate, interact, share, collaborate, and connect with others online
Digital content creation	
Safety	▪ Staying Safe Online
Problem solving	

It is worth nothing that a 2018 update to the UK Essential Digital Skills Framework added “problem solving” and “being safe, legal and confident online” (see Figure 7). The update to the UK framework also positions foundational hardware and software skills (like turning a computer on and off or opening and closing an application) at its centre. If the missing “production” digital competences gaps are also deemed important for Singaporeans to acquire, the unifying framework should incorporate these components.

FIGURE 7: ESSENTIAL DIGITAL SKILLS FRAMEWORK 2018

Source: *Essential Digital Skills Framework* (Department for Education, 2018)

Given the recent changes in reference frameworks and the gaps in the current basic skills curriculum, the first recommendation of this working paper is to develop a comprehensive and unifying digital skills framework that includes additional components that cover skills in digital content creation and problem solving. Examples of these include skills such as creating and editing simple content in simple formats like a word processor and problem-solving skills such as solving technical problems relating to digital devices.

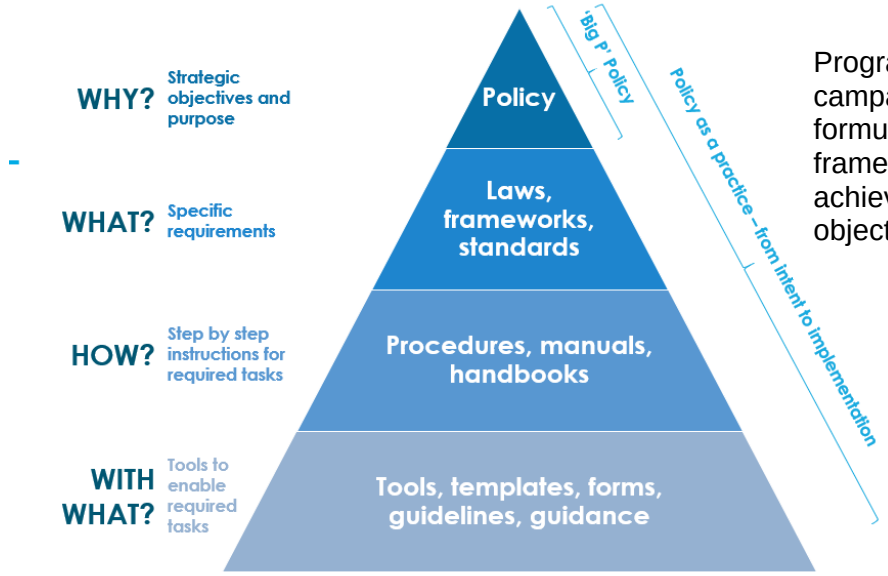
2.5. Hierarchy of Frameworks, Programmes and Campaigns

The importance of a tailored and up-to-date national digital literacy framework cannot be over-emphasised in efforts to realise the Smart Nation vision. Frameworks are key so that programmes and campaigns formulated under them are cohesive and harmonised. Procedures and guidelines formulated under a unified framework can then turn the “intent” of the Smart Nation to “actual practice” (See Figure 8 below).

Programmes are sets of coherent and logically structured interventions with expected results linked to the achievement of policy goals and objectives. They are set within a timeframe with well-defined implementation tasks (Aragrande et al., 2001).

Campaigns are “intended to generate specific outcomes or effects in a relatively large number of individuals, usually within a specified period of time, and through an organised set of communication activities” (Rogers & Storey, 1987, p.821). Government campaigns are typically aimed at producing policy results, such as advertising to get people involved in government services or activities (e.g., family planning, crime prevention and national retirement savings plans) or are designed to influence household behaviour (e.g., changing eating habits or hygiene regimes) that is linked to policy goals (e.g., reducing healthcare costs).

FIGURE 8: POLICY AS A PRACTICE — FROM INTENT TO IMPLEMENTATION



Source: *What's in a name? Deconstructing and defining "policy"* (de Sousa & Capdevila, 2019)

Given that programmes and campaigns are derivatives of existing frameworks, it is imperative that the DMIL is as comprehensive as possible to achieve Singapore's vision of digitally ready citizens. Gaps in a framework will result in gaps in the programmes and campaigns created under the umbrella of the framework. Specifically, the current DMIL places strong emphasis on online safety and information literacy. Similarly, the three national programmes and campaigns reviewed earlier also emphasise online safety and information literacy and the other digital competences are currently off the main agenda at the time of writing.[3]

[3] The Better Internet Campaign by Media Literacy Council places some emphasis on communication in the current theme of "Be safe. Be smart. Be kind". The suggested National Basic Skills Curriculum includes communication and collaboration skills.

While there is value for each of this framework, given that different agencies focus on different constituents who have their own needs, there is much to be gained from coordinating the different approaches and initiatives and aligning them under a common framework. Greater focus and coordination will help us multiply societal benefits, help Singaporeans better identify what and where support is available, and avoid potential dissonant messaging and duplicative resourcing. The collective digital readiness work will also complement ongoing national efforts to strengthen and improve ICT infrastructure, platforms and public service delivery.

2.6. Digital Media and Information Literacy Framework 2.0 (DMIL 2.0)?

In recommending a unifying framework, we reviewed other existing frameworks in the local context that can fill current gaps. The Ministry of Education had recently launched the National Digital Literacy Programme (NDLP) for in-school learners, which was conceptualised such that students at different stages of their education journey will be able to acquire digital skills across four components in the “Find, Think, Apply, Create” framework (MOE, 2020):

Find: Gather and evaluate information from, and use digital resources in a safe, secure, responsible, and ethical manner

Think: Interpret and analyse data, and solve problems

Apply: Use software and devices to facilitate the use of knowledge and skills in new contexts; keep up with technological developments

Create: Produce content and artefacts, and engage and collaborate with others digitally

The 2020 NDLP framework and the existing Cyber Wellness Programme line up seamlessly with DigComp 2.1 in Table 8:

TABLE 8: MAPPING DIGCOMP 2.1 TO THE NATIONAL DIGITAL LITERACY PROGRAMME

DigComp 2.1 components	NDLP MOE	
Information and data literacy	**Find:** Gather and evaluate information from, and use digital resources in a safe, secure, responsible, and ethical manner	✓
Communication and collaboration	**Create:** Produce content and artefacts, and engage and collaborate with others digitally	✓
Digital content creation	**Create:** Produce content and artefacts, and engage and collaborate with others digitally	✓
Safety	Cyber Wellness programme by MOE	✓
Problem solving	**Apply:** Use software and devices to facilitate the use of knowledge and skills in new contexts; keep up with technological developments **Think:** Interpret and analyse data, and solve problems	✓

Source: *Strengthening digital literacy* (MOE, 2020)

The only limitation about the NDLP framework is that it is intended for in-school learners only. Out-of-school citizens who can also benefit from the programmes formulated under this framework currently fall outside the purview of the NDLP. We also noted that the actual curriculum and guidelines for implementing the “Find, Think, Apply, Create” framework are currently being developed and are unavailable for public access.

The second recommendation of this working paper is to synergise the two key national frameworks for in-school (NDLP) and out-of-school learners (DMIL) such that there is policy coherence and continuity in the frameworks. Based on the current review, the more recently formulated NDLP has better coverage of digital competences and better alignment with 21st century skills. The unifying framework should also include as core competences the digital competences of digital content creation and problem solving, and our National Basic Digital skills curriculum should cover all of the above five components.

2.7. Career-Related Digital Competences

In the employment domain, the SkillsFuture for Digital Workplace (SFDW) by SkillsFuture Singapore (SSG) seeks to equip Singaporeans with foundational digital skills in key areas of mindset, data, technology, and innovation, and prepare them for technological changes in their workplace and daily lives. For their employers, the programme seeks to help equip staff with the relevant mindset and skills to welcome technological changes to the workplace, and to

take advantage of new opportunities in the future economy. According to the SSG website (SSG, n.d.), learning outcomes listed on the SFDW website include being:

- aware of the type of jobs in the future economy;
- able to work in a technology-rich environment;
- able to apply frequently used mobile apps in your daily life;
- aware of the importance of cyber security in daily/work applications;
- aware of how data and information can be used;
- able to perform functional outcomes such as applying for SkillsFuture Credit or performing basic cyber security actions, e.g., setting up passwords to protect data or information; and
- able to develop an action plan to continue learning

Career-related digital competence is also recognised in UNESCO's 2018 global framework of reference on digital literacy skills, which noted that career-related competences might not have been appropriately captured by previously existing frameworks like DigComp 2.1 (Law et al., 2018). For UNESCO, **career-related competences refer to competences in the use of digital technologies that are important productivity tools for particular business sectors.** Examples include competences in using learning management systems for teachers, computer-aided design and computer-aided manufacturing applications for architects, engineers and construction workers, health information systems for medical practitioners, and social media for marketing professionals.

In this endeavour to construct a unified framework for digital literacy in Singapore, **our third recommendation is to include career-related competences in the unifying framework.** Career-related competences are competencies in operating specialised digital technologies for a particular field. There is an urgent need to create a set of basic career-related competences curriculum and benchmarks so that Singaporeans have strong foundational digital skills with which to deepen and broaden their competences.[4]

2.8. Emerging Research on Career-Related Digital Competences

Using the UNESCO digital literacy framework, AlphaBeta (2021) identified 28 specific digital skills comprising eight competences and four proficiency levels to capture 28 specific digital skills (Figure 9):

[4] Disclosure: At the time of writing, the authors are embarking on a national benchmarking exercise of career-related competences in collaboration with SSG.

FIGURE 9: ALPHABETA DIGITAL SKILLS INDEX 2021

COMPETENCE AREA	PROFICIENCY LEVELS			
	BASIC SKILLS		ADVANCED SKILLS	
	Foundational user	*Specialized user*	*Integrator*	*Innovator*
VERTICAL COMPETENCES				
1. Devices and software operations	Use basic digital software/hardware	Use specialized software for industry/ job function	Deploy software/ hardware for use in organizations	Create operations support protocols for new software/ hardware
2. Information and data literacy	Use basic data analysis tools	Use specialized software tools for data visualization and analytics	Knowledge of data mining, engineering and science techniques	Create large-scale data models and database technology
3. Digital content or product creation	Use basic software to generate digital content	Use intermediate or advanced software to generate digital content	Integrate digital tools to develop customized digital content/products	Create original digital content and the tools to develop them
4. Cloud computing competencies	Use basic cloud-based software-as-a-service (SaaS) applications and tools	Use specialized cloud-based software-as-a-service (SaaS) applications and tools	Help organizations transition from on premises-based IT environments to cloud-based environments	Design and refine new cloud and hybrid architectures
HORIZONTAL COMPETENCES				
5. Digital communication and collaboration	Communicate and collaborate with others via digital mediums		Integrate different systems of digital communication to develop optimal collaboration tools	Develop new digital communication and collaboration tools
6. Digital problem solving	Identify suitable software/hardware to solve problems		Use digital tools to streamline work processes and resolve systemic problems	Use advanced problem-solving computational techniques
7. Digital security and ethics	Apply basic data privacy and cyber-hygiene principles		Develop protocols to maintain digital ethics and security	Develop digital security and cyber forensics tools, software and techniques
8. Digital project management	Oversee projects with low digital complexity		Plan and drive medium-to-large scale digital projects	Lead the end-to-end management of large complex digital projects

SOURCE: AlphaBeta analysis. See Annex for full list of skills descriptions and examples.

Source: *Unlocking APAC's digital potential: Changing digital skill needs and policy approaches* (AlphaBeta, 2021, p.15)

In the 2020 APEC report, industry stakeholders LinkedIn and Burning Glass Technologies reported their analyses on closing the digital skills gap for workers (APEC, 2020). LinkedIn identified four types of digital skills (p.17):

Basic: Basic digital literacy such as accessing email and using basic applications such as spreadsheets

Applied: Technical support, animation, computer graphics, digital marketing, enterprise software, graphic design, information management, social media, system administration

Software & Hardware: Computer hardware, computer networking, data storage technologies, game development, mobile application development, product development, scientific computing, signal processing, software development life cycle, software testing, web development

Disruptive: Development tools, artificial intelligence, cyber security, data science, fintech, human-computer interaction, materials science, nanotechnology, robotics, aerospace engineering, genetic engineering

Burning Glass Technologies grouped digital skills into baseline and specialised skills. Its groupings, sub-groupings and descriptions are shown in Figure 10:

Baseline digital skills are readily transferrable, with a definition that is comparable to LinkedIn's basic skills categories.

Specialised skills are grouped into customer relationship management, digital design and marketing, machining, and manufacturing data analysis, computer and networking support, and software and programming.

The report noted that the demand for different types of digital skills varies by industry and economy, likely because different sectors are going through

different phases of digital transformation. However, basic (or baseline) digital skills are in high demand and are highly transferrable across occupations and different economic sectors. Basic skills such as Microsoft Office and Excel are among the top three skills in demand across economies.

FIGURE 10: BURNING GLASS TECHNOLOGIES DIGITAL SKILLS GROUPINGS

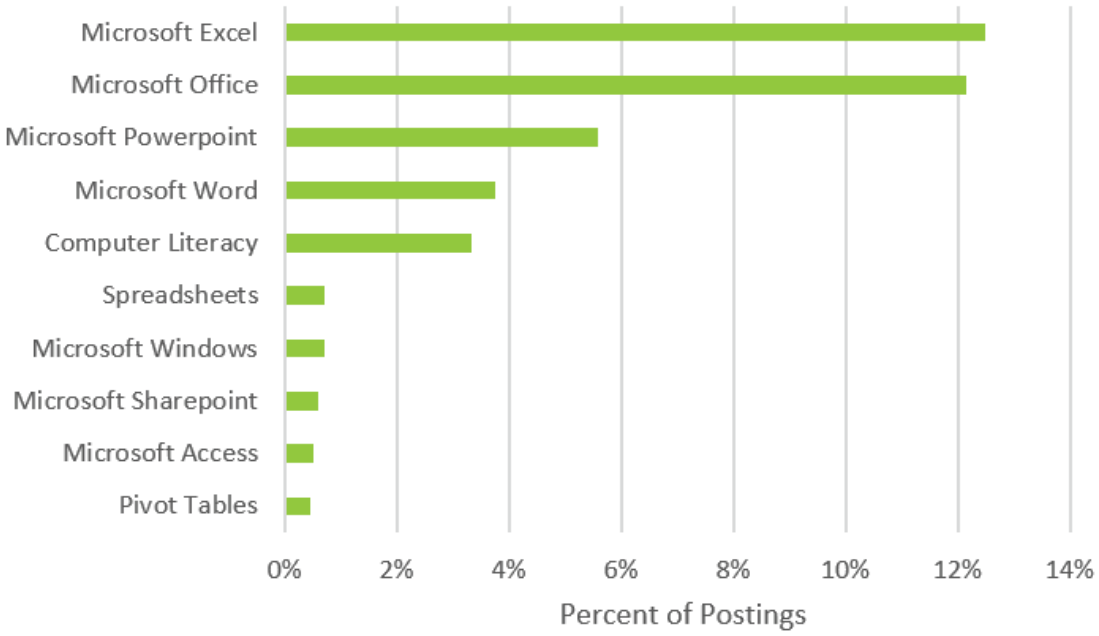
	Digital Skill Grouping	Description	Examples	Weight
Baseline	Baseline	Productivity software	Microsoft Excel, Computer Literacy	0.5
Specific	Customer Relationship Management (CRM)	CRM software	Salesforce, Microsoft CRM	1
	Digital Design and Marketing	Digital production and advertising	Email Marketing, Social Media, Graphic Design	1.5
	Machining and Manufacturing	Machining and engineering software and tools	AutoCAD, 3D Modeling, Computer Numerical Control	2
	Data Analysis	Data analysis tools	R, Stata, Data Science	2.5
	Computer and Networking Support	Set up, support, and manage computer systems and networks	Computer Troubleshooting, Cybersecurity	3
	Software and Programming	Programming languages	Java, Python, SQL, C++	3.5

Source: *APEC Closing the digital skills gap report* (APEC, 2020, p.13)

> "The diffuse nature of these skills also makes them highly portable across industries and occupations. This implies that investment in baseline digital skills is a profitable endeavor for workers, and a worthwhile focus for workforce development. This is because the return on investment in baseline digital skill will be higher than the investment itself. Baseline skills would be best targeted when skilling or re-skilling workers to prepare them for jobs both today and in the future" (p.12).

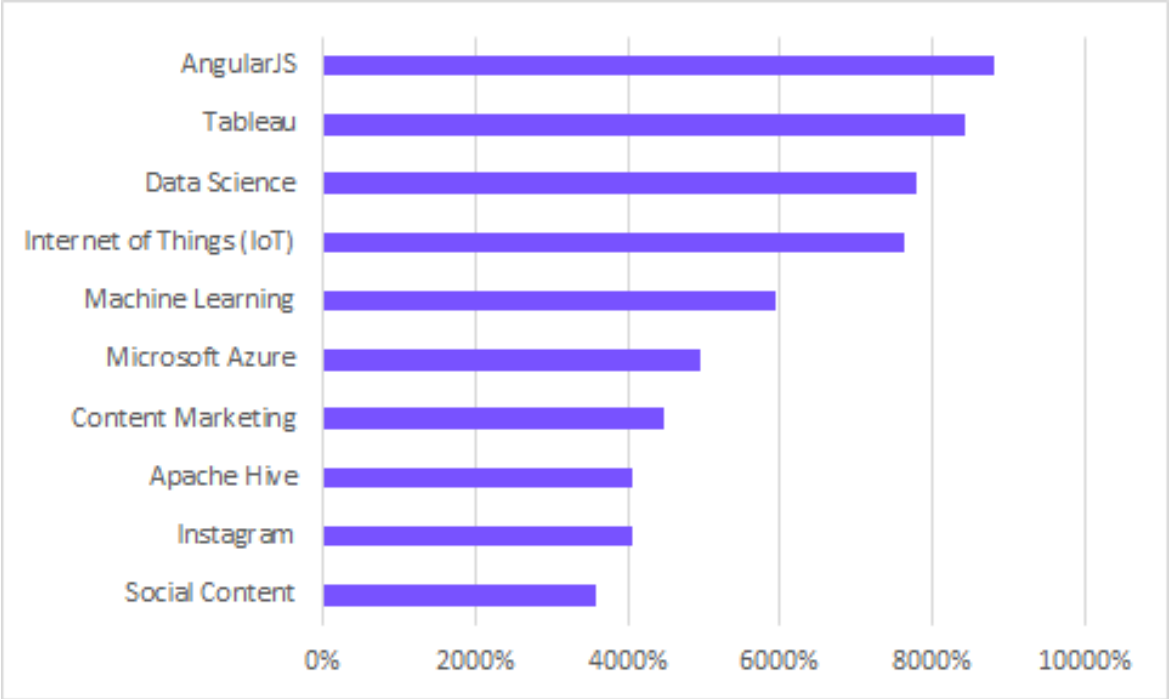
In Singapore, the top three desired digital baseline skills are Microsoft Excel, PowerPoint, and Word (Figure 11) and the fastest growing digital skills are AngularJC (JavaScript for web applications), Tableau (data visualisation), and Data Science (Figure 12).

FIGURE 11: DIGITAL BASELINE SKILLS IN HIGHEST DEMAND, SINGAPORE, 2019



Source: *APEC Closing the digital skills gap report* (APEC, 2020, p.38)

FIGURE 12: FASTEST GROWING DIGITAL SKILLS, SINGAPORE 2013–2019 (APEC, 2020)



Source: *APEC Closing the digital skills gap report* (APEC, 2020, p.39)

These recent reports and emerging insights on career-related digital competences are a useful starting point for the formulation of a career-focused digital competence in the proposed unifying framework. The AlphaBeta Digital Skills Index and the APEC findings on the top baseline digital skills and the fastest growing skills should be examined further with industry stakeholders such as local employers and policymakers so that they can be tailored for Singaporeans. It would also be useful to identify adaptations that are required by employers in different economic sectors. This exercise would be also useful to identify economic segments that have not been covered by the international and regional researchers.

Having reviewed Singapore's national digital literacy frameworks against DigComp 2.1, other international frameworks, and emerging research on career-related digital competences, we propose the following Unified Framework for Digital Literacy (UFDL) in Singapore and the corresponding components. We offer the UFDL as a work-in-progress especially because the sixth competency of career-related competences requires further development. This is because work on this competence is relatively nascent and requires extensive private-public partnerships for the subsequent outcomes to be relevant for the Singapore context. The UFDL, when fully developed, is envisioned as a national framework that will commensurate with other international frameworks and provide thought leadership for other ASEAN countries looking to develop their own digital literacy programmes.

3. THE UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE

FIGURE 13: UNIFIED FRAMEWORK FOR DIGITAL LITERACY IN SINGAPORE

Revised Outcomes of UFDL

0. Foundational hardware and software operations (to adapt from UK Essential Digital Skills Framework and UNESCO's DLGF)

0.1 Physical operations of digital technologies

0.2 Basic operations of software such as browsers and turning apps on/off

1. **Information & data literacy (existing DMIL) —** A fundamental appreciation of the benefits, risks, and possibilities that technology can bring, and how online platforms and digital technologies work
    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

2. **Safety (existing DMIL) —** A basic understanding of how to use information responsibly and the know-how for safe and responsible use of digital technologies
    2.1 To protect devices, content, personal data and privacy in digital environments
    2.2 To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion
    2.3 To be aware of the environmental impact of digital technologies and their use

3. **Communication and collaboration (to adapt from DigComp 2.1):**
    3.1 To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity

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

3.3 To manage one's digital identity and reputation

4. Digital content creation (to adapt from DigComp 2.1)

4.1 To create and edit digital content

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

4.3 To know how to give understandable instructions for a computer system

5. Problem solving (to adapt from DigComp 2.1 and MOE's NDLP)

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

6. Career-related competences (to adapt from UNESCO's DLGF)

6.1 Operating specialised digital technologies for a particular field (work-in-progress)

3.1. Functions of the Unified Framework for Digital Literacy

The UFDL can support Singaporeans in many aspects of their lives. The examples of use identified by the DigComp framework (Kluzer & Rissola, 2015) also apply to the Singapore context. The UFDL can be used by:

- **Citizens with no or low ICT abilities** to identify the most essential skills to improve their personal and professional lives and to understand where they are making progress;
- **Jobseekers** to identify and describe their digital competence in their CVs, in particular by using self-assessment tools or in consultation with career counsellors. They can also compare their skills against job vacancies to identify those they are lacking and search for further learning opportunities;
- **Employers** to define the competences in their vacancies when they are developing a job description;
- **Employment services** to exchange relevant labour market information (such as CVs and vacancies) by using a common “language” and to offer career guidance;
- **Education and training institutions and lifelong learning organisations** to develop and innovate their delivery and assessment services and policymakers to design better policies, e.g., for teacher training and professional development.

4. IMPLEMENTATION OF THE UNIFIED FRAMEWORK FOR DIGITAL LITERACY (UFDL)

Having proposed the UFDL, we also considered how the framework could be implemented. Just as the conceptualisation of the UFDL was benchmarked against other globally established frameworks, we also propose benchmarking the implementation of the UFDL against internationally recognised enterprise programmes. In this section, we reviewed three existing enterprise digital literacy programmes that can be adapted for the implementation of the UFDL:

TABLE 9: DIGITAL LITERACY PROGRAMMES FOR ADAPTATION

Enterprise	Digital Literacy Programme
Microsoft	Digital Literacy Standard Curriculum
ICDL	International Computer Drivers Licence (ICDL)
Certiport	Internet and Computing Core Certification (IC3)

4.1. Microsoft Digital Literacy Course

The Microsoft digital literacy course (Microsoft.com, n.d.) has six learning pathways that are aligned with UFDL (and DigComp 2.1). Given that it is an enterprise programme under Microsoft, many of the learning objectives are naturally associated with the use of the Microsoft Office suite of software. Nevertheless, the adoption of this enterprise programme would equip many Singaporeans with the top three digital skills in-demand as identified by the APEC report on closing the digital skills gap (2020).

TABLE 10: MICROSOFT DIGITAL LITERACY COURSE OUTLINE

Course 1: Work with computers	▪ Interact with a computer ▪ Use a computer ▪ Work with applications ▪ Work with connected devices
Course 2: Access information online	▪ Get connected ▪ Browse the web ▪ Search the web
Course 3: Communicate online	▪ Communicate using email ▪ Chat online
Course 4: Participate safely and responsibly online	▪ Online safety and privacy ▪ Online civility
Course 5: Create digital content	▪ Introduction to Microsoft Office ▪ Work with Word documents ▪ Format and edit text in Word ▪ Format and edit objects in Word ▪ Discover more Word features ▪ Create and edit PDFs in Word
Course 6: Collaborate and manage content digitally	▪ Use OneDrive cloud storage ▪ Share and collaborate with documents ▪ Manage time with a digital calendar ▪ Work with contacts and tasks

Source: “Digital literacy: Expand economic opportunity for everyone” (Microsoft.com, n.d.)

4.2. International Computer Driving License (ICDL) Digital Citizen

The ICDL Digital Citizen programme outlines the basic skills needed to use a computer and the internet and is offered by the European Computer Driving License Foundation (ECDL) Limited. ECDL and the International Computer Driving License (ICDL) Foundation provide certification for the computer skills and competences acquired through their programmes. Their Digital Citizen programme is designed for complete beginners and covers the following skill sets (ICDL Europe, n.d.):

TABLE 11: ICDL DIGITAL CITIZEN PROGRAMME

Category	Skill set
Computer basics	• Parts of the computer • Types of computer • Getting started • The keyboard and mouse • Shut down the computer
Introduction to the desktop	• Icons • Taskbar and start button • Windows • Storing information • Applications and file types
Introduction to documents	• Creating a document • Name and save • Change font • Bold, italic, underline • Cut, copy and paste • Save and print
Introduction to the web	• Evaluating information • Online security • Connecting to the internet • Navigating and downloading • Search engines • Online services and forms
Communications	• Email accounts • Creating an email • Replying to and forwarding an email • Online communities • Instant messaging • Voice over Internet Protocol

Source: “ICDL Digital Citizen programme” (ICDL Europe, n.d.)

ICDL also offers the more advanced ICDL Digital Citizen Plus module and the ICDL Workforce modules, which are designed to build the digital skills of the modern workplace. These modules will help employees and candidates demonstrate their effective use of technology with skills and knowledge that can be further developed. The ICDL Workforce modules offer a starting point

for the development of a set career-related competences within the proposed UFDL.

TABLE 12: ICDL WORKFORCE MODULES

ICDL Workforce	Skill set
Essential skills	• Application essentials • Computer and online essentials • Computer essentials • Online essentials
Office applications	• Documents • Spreadsheets • Presentation • Teamwork
Good practice	• IT security • Online collaboration • Data protection • Remote work

Source: “ICDL Workforce modules” (ICDL Europe, n.d.)

4.3. IC3 Digital Literacy Programme

The IC3 certification (Internet Core Competency Certification) is a global benchmark for basic computer literacy, including operating systems, hardware, software, and networks offered by Pearson Education Inc. The IC3 Digital Literacy Programme covers the following modules (Certiport, 2020):

TABLE 13: IC3 DIGITAL LITERACY OBJECTIVE DOMAINS

IC3	Skill set
Technology basics	• Explain fundamental software concepts • Customise digital environments • Identify, troubleshoot, and resolve technical problems with assistance
Digital citizenship	• Cultivate, manage, and protect your digital reputation • Apply digital etiquette standards • Explain best practices for digital citizenship
Information Management	• Use and refine criteria for online searches • Manage online data collection, storage, and retrieval • Evaluate digital information sources and multiple search results
Content creation	• Create basic digital content • Responsibly repurpose digital resources • Create, edit, and publish or present original digital media content for a specific audience
Communication	• Express yourself through digital means • Interact with others in a digital environment • Customise the message and medium for a specific audience
Collaboration	• Identify digital etiquette standards for collaborative processes • Use digital tools and technologies to collaborate on the creation of content • Use collaboration tools to work with others to examine issues and problems from multiple viewpoints
Safety and security	• Identify threats and security measures in a digital environment • Avoid mental health threats while using digital technologies (catfishing, FOMO) • Manage device security (encryption, biometric passwords, viruses)

Source: “IC3 Digital Literacy Certification Global Standard Six” (Certiport, 2020)

The proposed competences in the UFDL in Singapore are mapped to the three enterprise digital literacy programmes below (see Table 14). Based on this map, none of the three enterprise digital literacy programmes provides full coverage for the implementation of the UDFL. A hybrid of the full IC3

programme with the career-related competences of ICDL Workforce would provide a well-grounded starting point of a comprehensive digital literacy programme for Singaporeans. The Microsoft Office software suite should also be included on grounds that it accounts for many of the top in-demand digital skills across economic sectors.

The fourth recommendation of this working paper is the formulation of a national digital literacy curriculum for Singaporeans so that education and training institutions and lifelong learning organisations can develop and innovate their delivery and assessment services. This curriculum can be used as a template that trainers and learners can use to customise enterprise programmes according to their needs.

TABLE 14: MATCHING ENTERPRISE DIGITAL LITERACY PROGRAMMES TO THE UFDL

UFDL competences	Microsoft DL	ICDL	IC3
Foundational hardware and software operations	✓	✓	✓
Information & data literacy	✓	✓	✓
Safety	✓	✓	✓
Communication & collaboration	✓	✓	✓
Digital content creation	✓	✓	✓
Problem solving	?	?	✓
Career-related competences	?	✓	?

5. CONCLUSION

In these unprecedented times, COVID-19 has shown how digital connectivity is a critical need. Being connected to the internet has direct implications on the citizens' ability to access life-saving information and resources. In light of the pandemic, the Secretary General of the United Nations stated in the Roadmap for Digital Cooperation that "connectivity needs to be prioritized as a foundation to ensure the continuation of critical services, enable digital literacy and promote social inclusion" (United Nations, 2020, p.6). In Singapore, the COVID-19 pandemic has also accelerated and intensified digitalisation efforts and its leaders have made it clear that digitalisation is no longer a good-to-do but a must-do. In his 2020 parliamentary speech, Minister for Communications and Information of Singapore said that "Digitalisation and

digital inclusion are the twin engines that will take us to our digital future... and (COVID-19) has given us the impetus to invest in a decisive, all-out push" (Wong, 2020).

This working paper has intentionally focused on narrowing the digital *literacy* divide, but acknowledges that there are still disparities in digital access that need to be addressed. Many community groups and members of parliament have spoken out on the need to close the access divide especially for low-income households, seniors, and persons with disabilities. However, it is worth nothing that social inequality and digital inequality are not mutually exclusive issues, and it would be techno-deterministic to assume that the provision of digital access (or training for that matter) would automatically close social inequalities. As the introduction of this working paper pointed out, it is vitally important that going forward, policymakers consider the amplification and attenuation effects between social and digital inequalities and formulate policies that take these interactions into consideration.

We make two final points for consideration in promoting digitalisation efforts though the Unified Digital Literacy Framework for Singapore:

(1) As recognised in the current digital media and information literacy framework, connectivity is not without its risks;
(2) Closing the digital divide(s) is a means of improving citizens' well-being rather than an end.

We acknowledge that being digitally connected brings about risks. While being digitally connected during the pandemic affords citizens with the ability to learn through video-conferencing platforms and allows them to contribute to economic activity while sheltering safely in place, connectivity also exposes them to cyber risks (United Nations, 2020). During the pandemic, social media have been misused by some to fuel intolerance in the form of anti-Asian racism and xenophobia worldwide (Human Rights Watch, 2020). Cyber attacks on the World Health Organization (WHO, 2020), hospitals and laboratories endanger lives and jeopardise potential advances in responding to the virus.

There are also other attendant digital society issues such as internet addiction, the social phenomenon of “mindless scrolling”, ransomware, and credit card fraud. The electrical consumption of digital technologies is also expected to consume up to 20 per cent of the global electrical demand with one third stemming from data centres alone (Jones, 2018). The use of artificial intelligence in lethal autonomous weapons systems also fast-forwards us into a future with “killer robots” that can make life-and-death decisions without human intervention. Other artificial intelligence tools such as deepfakes can be used to spread misinformation and sway public opinion.

As countries digitalise, these cyber risks are unavoidable, and the key is to seek ways to harness the potential of digital technologies while mitigating the harm that they can cause. As Singapore progresses towards the Smart Nation,

it is imperative that efforts are calibrated to ensure that everyone can experience the benefits of technology while navigating the complex digital environment with its attendant harms and misuses.

Our final word on this working paper draws inspiration from two quotes — one oft-cited and its less known rejoinder. One of the key purposes of formulating any framework is to enable the tracking of progress made towards the key objectives. As the management adage goes, "what gets measured gets managed"[5] This is also one of the main objectives of recommending the Unified Framework for Digital Literacy in Singapore. However, measuring the progress made towards digital competence should not be an end in and of itself. To quote the lesser-known Goodhart's Law, "when a measure becomes a target, it ceases to be a good measure" (Strathern, 1997, p.308).

What we should really care about are the outcomes of narrowing the digital divides: that citizens are able to enhance economic productivity because of their access to digital resources; that the digital resources are providing citizens with opportunities from different facets of life such as education, jobs, and health services; and that the economic, social, and political well-being of citizens are being elevated with the narrowing of the digital inequalities.

[5] The quote is most often attributed to renowned management guru Peter Drucker but there are no reliable references that he actually said this. The earliest known expression of this quote is by Lord Kelvin, otherwise known as William Thomson, in a lecture on electrical units of measurement (Thomson, 1883).

6. REFERENCES

AlphaBeta. (2021). *Unlocking APAC's digital potential: Changing digital skill needs and policy approaches.* https://alphabeta.com/our-research/unlocking-apacs-digital-potential-changing-digital-skill-needs-and-policy-approaches/

Aragrande, M., Argenti, O., & Lewis, B. (2001). Studying food supply and distribution systems to cities in developing countries and countries in transition. *Methodological and Operational Guide* (revised version). United Nations Food and Agricultural Organization. http://www.fao.org/3/X6996E/x6996e0a.htm

Asia-Pacific Economic Cooperation (APEC). (2020, December). *APEC Closing the digital skills gap report: Trends and insights*. https://www.apec.org/Publications/2020/12/APEC-Closing-the-Digital-Skills-Gap-Report

Attewell, P. (2001). Comment: The first and second digital divides. *Sociology of Education*, *74*(3), 252–259. https://doi.org/10.2307/2673277

Bonfadelli, H. (2002). The internet and knowledge gaps: A theoretical and empirical investigation. *European Journal of Communication*, *17*(1), 65–84. https://doi.org/10.1177/0267323102017001607

Carretero, G. S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use*. EUR 28558 EN. DOI: 10.2760/38842.

Certiport. (2020). *IC3 Digital Literacy Certification Global Standard Six.* https://certiport.pearsonvue.com/fc/ic3/gs6/overview

CNA. (2020, June 1). *1,000 digital ambassadors to be recruited to help stallholders, seniors go online*. https://www.channelnewsasia.com/news/singapore/1000-digital-ambassadors-recruit-help-stallholders-seniors-12789146

Cyber Security Awareness Alliance (CSA). (2019, December 31). *Go Safe Online 2019*. https://www.csa.gov.sg/gosafeonline/go-safe-for-me/homeinternetusers/go-safe-online-2019

de Sousa, T. & Capdevila, E. B. (2019, April 17). *What's in a name? Deconstructing and defining "policy".* Government of New South Wales. https://www.digital.nsw.gov.au/article/whats-name-deconstructing-and-defining-policy

Department for Education, UK. (2018). *Essential digital skills framework.* https://www.gov.uk/government/publications/essential-digital-skills-framework

Eynon, R. (2009). Mapping the digital divide in Britain: Implications for learning and education. *Learning, Media and Technology*, *34*(4), 277–290. https://doi.org/10.1080/17439880903345874

Ferrari, A. (2012). *Digital competence in practice: An analysis of frameworks.* Sevilla: JRC IPTS.

Hoffman, D. L., & Novak, T. P. (1998). Bridging the racial divide on the internet. *Science*, *280*(5362), 390–391. https://doi.org/10.1126/science.280.5362.390

Human Rights Watch. (2020, May 12). *COVID-19 fuelling anti-Asian racism and xenophobia worldwide*. https://www.hrw.org/news/2020/05/12/covid-19-fueling-anti-asian-racism-and-xenophobia-worldwide

ICDL Europe (n.d.). *ICDL programmes*. https://icdleurope.org/icdl-programmes/

Infocomm Media Development Authority of Singapore (IMDA). (2020). *Infocomm usage — households and individuals.* https://www.imda.gov.sg/infocomm-media-landscape/research-and-statistics/infocomm-usage-households-and-individuals

———. (2021a, February 8). *President Halimah Yacob launches President's Challenge 2021, announces new national movement* [Press release]. https://www.imda.gov.sg/news-and-events/Media-Room/Media-Releases/2021/President-Halimah-Yacob-Launches-Presidents-Challenge-2021-Announces-New-National-Movement

———. (2021b). *Statistic on telecom service for 2020 Jul–Dec.* https://www.imda.gov.sg/infocomm-media-landscape/research-and-statistics/telecommunications/statistics-on-telecom-services/statistic-on-telecom-service-for-2020-jul

International Telecommunications Union (ITU). (2019). *Measuring digital development: Facts and figures 2019*. https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019_r1.pdf

Jenkins, H., Clinton, K., Purushotma, R., Robison, A. J., & Weigel, M. (2006). Confronting the challenges of participatory culture: Media education for the 21st century. Chicago: MacArthur Foundation. http://www.newmedialiteracies.org/wp-content/uploads/pdfs/NMLWhitePaper.pdf

Jones, N. (2018). How to stop data centres from gobbling up the world's electricity. *Nature*, *561*(7722), 163–167.

Katz, J., & Aspden, P. (1997). Motivations for and barriers to internet usage: Results of a national public opinion survey. *Internet Research*. https://doi.org/10.1108/10662249710171814

Khilnani, A., Schulz, J., & Robinson, L. (2020). The COVID-19 pandemic: New concerns and connections between eHealth and digital inequalities. *Journal of Information, Communication and Ethics in Society*, *18*(3), 393–403.

Kluzer, S., & Rissola, G. (2015). *Guidelines on the adoption of DigComp*. Telecentre Europe. https://all-digital.org/wp-content/uploads/2015/12/TE-Guidelines-on-the-adoption-of-DIGCOMP_Dec2015.pdf

Law, N., Woo, D., de la Torre, J., & Wong, G. (2018). *A global framework of reference on digital literacy skills for indicator 4.4. 2.* UNESCO Institute for Statistics, UIS/2018/ICT/IP/51. http://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf

Media Literacy Council (MLC). (n.d.). *About the Better Internet Campaign 2020*. https://www.betterinternet.sg/Campaign-2020/About/Campaign

Microsoft.com. (n.d.). *Digital literacy: Expand economic opportunity for everyone*. https://www.microsoft.com/en-us/digitalliteracy

Ministry of Communications and Information (MCI). (2018). *Digital readiness blueprint.* https://www.mci.gov.sg/-/media/mcicorp/doc/mci_blueprint-report_final.ashx

——— (2019). *Digital media and information literacy framework.* https://www.mci.gov.sg/literacy/-/media/literacy/library/topic/mci-dmil-framework.ashx

Ministry of Education (MOE). (2020). *Strengthening digital literacy.* https://www.moe.gov.sg/microsites/cos2020/refreshing-our-curriculum/strengthen-digital-literacy.html

Montoya, S. (2018). *Meet the SDG 4 data: Indicator 4.4.1 on skills for a digital world.* http://uis.unesco.org/en/blog/meet-sdg-4-data-indicator-4-4-1-skills-digital-world

National Library Board (NLB). (n.d.) *About the S.U.R.E campaign*. https://sure.nlb.gov.sg/about-us/sure-campaign/

Pang, N. & Chew, H. E. (2020 June 15). Don't define digital access problem as a divide. It's more complex than that. *Today*. https://www.todayonline.com/commentary/how-well-we-define-digitalisation-problem-determines-how-well-we-can-solve-it

Park, Y. (2019). *DQ Global Standards Report 2019: Common framework for digital literacy, skills and readiness:* DQ Institute. https://www.dqinstitute.org/wp-content/uploads/2019/11/DQGlobalStandardsReport2019.pdf

Peter, J., & Valkenburg, P. M. (2006). Adolescents' internet use: Testing the "disappearing digital divide" versus the "emerging digital differentiation" approach. *Poetics, 34*(4–5), 293–305.

Robinson, L., Schulz, J., Blank, G., Ragnedda, M., Ono, H., Hogan, B., Mesch, G. S., Cotten, S. R., Kretchmer, S. B., Hale, T. M., Drabowicz, T., Yan, P., Wellman, B., Harper, M.-G., Quan-Haase, A., Dunn, H. S., Casilli, A. A., Tubaro, P., Carvath, R., Chen, W., Wiest, J. B., Dodel, M., Stern, M. J., Ball, C., Huang, K.-T., & Khilnani, A. (2020a). Digital inequalities 2.0: Legacy inequalities in the information age. *First Monday*, *25*(7). https://doi.org/10.5210/fm.v25i7.10842

Robinson, L., Schulz, J., Khilnani, A., Ono, H., Cotten, S. R., Mcclain, N., ... & Tolentino, N. (2020b). Digital inequalities in time of pandemic: COVID-19 exposure risk profiles and new forms of vulnerability. *First Monday, 24(7).* https://doi.org/10.5210/fm.v25i7.10845

Rogers, E. M., & Storey, J. D. (1987). Communication campaigns, in C. R. Berger & S. H. Chaffe (Eds.), *Handbook of Communication Science* (pp. 817–846). New Burry Park.

SkillsFuture Singapore (SSG). (n.d.) *Digital workplace — what is it?* https://www.skillsfuture.gov.sg/digitalworkplace#whatisit

Soffel, J. (2016, March 10). *What are the 21st-century skills every student needs?* World Economic Forum. https://www.weforum.org/agenda/2016/03/21st-century-skills-future-jobs-students/

Strathern, M. (1997). "Improving ratings": Audit in the British University system. *European Review*, *5*(3), 305–321.

Tang, S. K., (2020, June 13). *Iswaran, Chan Chun Sing to chair new ministerial committee on digital transformation*. CNA. https://www.channelnewsasia.com/news/singapore/iswaran-chan-chun-sing-ministerial-committee-digitalisation-12832576?cid=h3_referral_inarticlelinks_24082018_cna

Thomson, W. (1883). Electrical units of measurement. *Popular lectures and addresses*, *1*(73).

United Nations. (2020, May 29). Road map for digital cooperation: Implementation of the recommendations of the High-Level Panel on Digital Cooperation — Report of the Secretary-General, A/74/821. https://www.un.org/en/content/digital-cooperation-roadmap/

United Nations Educational Scientific and Cultural Organization (UNESCO). (2020). *Half of world's student population not attending school: UNESCO launches global coalition to accelerate deployment of remote learning solutions.* https://en.unesco.org/news/half-worlds-student-population-not-attending-school-unesco-launches-global-coalition-accelerate

van Deursen, A. J. (2020). Digital inequality during a pandemic: Quantitative study of differences in COVID-19-related internet uses and outcomes among the general population. *Journal of Medical Internet Research, 22*(8), e20073. https://doi.org/10.2196/20073

Van Dijk, J. A. (2005). *The deepening divide: Inequality in the information society*. Sage Publications.

Van Dijk, J. (2020). *The digital divide*. John Wiley & Sons.

Wong, L. (2020, June 5). Coronavirus pandemic highlights critical need for digitalisation. *The Straits Times*. https://www.straitstimes.com/politics/pandemic-highlights-critical-need-for-digitalisation

World Economic Forum (WEF). (2015). *New vision for education*. http://www3.weforum.org/docs/WEFUSA_NewVisionforEducation_Report2015.pdf

World Health Organization (WHO). (2020, April 23). *WHO reports fivefold increase in cyber attacks, urges vigilance* [Press release]. https://www.who.int/news/item/23-04-2020-who-reports-fivefold-increase-in-cyber-attacks-urges-vigilance

Zillien, N., & Hargittai, E. (2009). Digital distinction: Status-specific types of internet usage. *Social Science Quarterly*, *90*(2), 274–291. http://www.jstor.org/stable/42940587

7. APPENDIX

DIGITAL INTELLIGENCE — DQ GLOBAL STANDARDS REPORT 2019

We also reviewed the Digital Intelligence Global Standards (Park, 2019) below (p.15) but ultimately excluded it in the main review as the framework of 24 competencies would add significant complexity to implementation. Some competencies like “digital empathy” (p.16; ability to be aware of, be sensitive to, and be supportive of one’s own and other’s feelings, needs and concerns online) and “self-awareness and management” (p.17), are not readily operationalisable to objective measures that are not self-reported and this would eventually make them challenging to be tracked objectively in a national framework.

1. **Digital Citizen Identity:** The ability to build and manage a healthy identity as a digital citizen with integrity.

2. **Balanced Use of Technology:** The ability to manage one's life both online and offline in a balanced way by exercising self-control to manage screen time, multitasking, and one's engagement with digital media and devices.
3. **Behavioral Cyber-Risk Management:** The ability to identify, mitigate, and manage cyber-risks (e.g., cyberbullying, harassment, and stalking) that relate to personal online behaviors.
4. **Personal Cyber Security Management:** The ability to detect cyber threats (e.g., hacking, scams, and malware) against personal data and device, and to use suitable security strategies and protection tools.
5. **Digital Empathy:** The ability to be aware of, be sensitive to, and be supportive of one's own and other's feelings, needs and concerns online.
6. **Digital Footprint Management:** The ability to understand the nature of digital footprints and their real-life consequences, to manage them responsibly, and to actively build a positive digital reputation.
7. **Media and Information Literacy:** The ability to find, organize, analyze, and evaluate media and information with critical reasoning.
8. **Privacy Management:** The ability to handle with discretion all personal information shared online to protect one's and others' privacy.
9. **Digital Co-Creator Identity:** The ability to identify and develop oneself as a co-creator of the digital ecosystem.
10. **Healthy Use of Technology:** The ability to understand the benefits and harms of technology on one's mental and physical health and to use technology use while prioritizing health and well-being.
11. **Content Cyber-Risk Management:** The ability to identify, mitigate, and manage content cyber-risks online (e.g., harmful user-generated content, racist/hateful content, image-based abuse).
12. **Network Security Management:** The ability to detect, avoid, and manage cyber threats to cloud-based collaborative digital environments.
13. **Self-Awareness and Management:** The ability to recognise and manage how one's value system and digital competencies fits with one's digital environment.
14. **Online Communication and Collaboration:** The ability to use technology effectively to communicate and collaborate collectively, including at a distance.
15. **Content Creation and Computational Literacy:** The ability to synthesise, create, and produce information, media, and technology in an innovative and creative manner.
16. **Intellectual Property Rights Management:** The ability to understand and manage intellectual property rights (e.g., copyrights, trademarks, and patents) when using and creating content and technology.
17. **Digital Changemaker Identity:** The ability to identify and develop oneself as a competent changemaker in the digital economy.
18. **Civic Use of Technology:** The ability to engage in civic participation for the well-being and growth of local, national, and global communities using technology.
19. **Commercial and Community Cyber-Risk Management:** The ability to identify, mitigate, and manage commercial or community cyber-risks online, such as

organizational attempts to exploit individuals financially or through ideological persuasion (e.g., embedded marketing, online propaganda, and gambling).

20. **Organizational Cyber Security Management:** The ability to recognize, plan, and implement organizational cyber security defenses.
21. **Relationship Management:** The ability to skillfully manage one's online relationships through cooperation, conflict management, and persuasion.
22. **Public and Mass Communication:** The ability to communicate with an online audience effectively to exchange messages, ideas, and opinions reflecting wider business or societal discourses.
23. **Data and AI Literacy:** The ability to generate, process, analyze, present meaningful information from data and develop, use, and apply artificial intelligence (AI) and related algorithmic tools and strategies in order to guide informed, optimized, and contextually relevant decision-making processes.
24. **Participatory Rights Management:** The ability to understand and exercise one's powers and right to online participation (e.g., their rights to personal data protection, freedom of expression, or to be forgotten)

About IPS Working Paper Series

The IPS Working Papers Series is published in-house for early dissemination of works-in-progress. This may be research carried out by IPS researchers, work commissioned by the Institute or work submitted to the Institute for publication.

The views expressed in the Working Papers are strictly those of the author(s) alone and do not necessarily reflect the views of the IPS.

Comments on the Working Papers are invited. Please direct your comments and queries to the author(s).

IPS Working Papers are available from the IPS at $7.00 each (before GST). Postage and handling charges will be added for mail orders.

For more information, please visit www.lkyspp.nus.edu.sg/ips or
contact email: ips@nus.edu.sg or tel: 6516-8388.

Institute of Policy Studies
Lee Kuan Yew School of Public Policy
National University of Singapore
1C Cluny Road House 5
Singapore 259599

Tel: (65) 6516 8388
Web: www.lkyspp.nus.edu.sg/ips
Registration Number: 200604346E