Digital Pathways at Oxford

CSIS INDONESIA
LEADING IN STRATEGIC THINKING

CSIS Research Report

TOOLKIT FOR MEASURING DIGITAL SKILLS AND DIGITAL LITERACY

Department of Economics

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A Research Report by CSIS Indonesia

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Toolkit for Measuring Digital Skills and Digital Literacy

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Executive Summary

Despite the leverage that the digital economy brings through digitalization, lacking digital skills and literacy may bottleneck the digital economy adoption. The cutting-edge technology infrastructure should be supported by sufficient digital skills and literacy to optimize it, otherwise, the digital infrastructure cannot realize its full potential to excel the economic growth. Therefore, investing in people to acquire more advanced digital skills acquisition becomes key to developing a just and sustainable digital economy.

Therefore, digital literacy and skills are among the priority agendas discussed in the 2022 Indonesian presidency of the Group of Twenty (G20). Currently, G20 plays a crucial role in closing the gap by leading and guiding the digital economy adoption through digital skills advancement. One of the efforts is to close measurement and implementation gaps, especially in developing economies, and strengthen the comparability of indicators and statistical capacities in G20 countries and beyond.

The Toolkit for Measuring Digital Skills and Digital Literacy Report was prepared by CSIS and Digital Pathways Oxford University to be submitted to G20 countries. It aims to provide the holistic yet flexible measurement of each country's digital skills and literacy level. It combines various prior frameworks and indicators to develop a comprehensive digital skills ecosystem, including infrastructure (digital and physical) and the human endowment in each country. Also, the toolkit provides flexibility by allowing the G20 members to adopt the toolkit differently depending on their characteristics.

The Toolkit for Measuring Digital Skills and Digital Literacy aims to meet three main objectives. Firstly, the toolkit improves the existing measurement and fills the gap from the preceded digital toolkits. It also promotes a novelty of digital skills measurement by combining the firm survey, individual survey, and secondary data to capture the overall condition. Secondly, the toolkit guides a country to optimize the exploration of digital indicators and infrastructures to generate strategic policies for digital economic development. Finally, the toolkit can be a robust starting point for exploring the possible use and extension of measurement, including indicators and surveys, to achieve a more inclusive digital economy among G20 members. This toolkit has four pillars i.e.: 1) Infrastructure and ecosystem; 2) Literacy; 3) Empowerment; and 4) Jobs. Together, those pillars enable the measurement of digital skills in a more comprehensive, objective, and standardized way.

The infrastructure and ecosystem pillar are the supply side of digital literacy as they include the measurement of ICT infrastructure that allows internet users appropriate bandwidth to exchange digital data productively and therefore allows inclusive growth. Meanwhile, the focus of the learning and innovation ecosystem is to increase people's adaptability to meet 21st-century jobs and skills requirements. Innovation systems and processes are also important in creating jobs. The measurement of pillar one is indicated by the level of the nation's trade in information and communication technologies (ICT), public access and use of ICT, and the level of technological adoption by firms. Meanwhile, another critical supply side of digital literacy is the education sector that should be

capable of providing: 1) digital skills & literacy adoption in the basic education; 2) Stakeholders' engagement scheme especially private sectors in skill development; 3) Incentive for innovation related to digital skills development and training.

The second pillar – digital literacy – measures the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies for employment, decent jobs, and entrepreneurship. In regard to this definition, digital literacy is more than an ability to access the internet and technologies using the internet as it concerns the people's use of the internet in a safe, secure and productive way.

The third pillar is empowerment, defined as activities that will capture people's digital capabilities to improve their standard of living (economic empowerment) or income-generating digital activities. As the number of e-commerce and digital platforms increases, they can offer MSMEs and workers better incomes, quality of life and financial inclusion. E-commerce and digital platforms allow people to share their intangible assets and underutilize tangible assets for money or for free with the help of the internet which results in a new business model or sharing economy. This pillar focuses on the ability of both sellers/providers and consumers/users to improve their living standards in the digital economy.

The last pillar, jobs, comprises digital skills and workers' ability to use digital technology for job-related purposes. Thus, the main elements of this pillar are the demand and supply of digital skills as the main elements. The indicators capture digital skills needed to perform in (new) technology-related work activities, tasks, or occupations. This pillar focuses on analyzing supply and demand of digital skills in the labor market.

Lastly, the post-COVID-19 recovery is an opportunity to set the stage for a more inclusive, equitable and age-friendly society, anchored in human rights and guided by the promise of the 2030 Agenda. Digital cooperation can be fruitfully leveraged to build consensus and share good practices, lessons learned, and policy recommendations, instrumental for both inclusive and sustainable development.

A. Background

The coronavirus pandemic and its wide-ranging implications have accelerated digital skills demand in many occupations, including occupations in the information and communications technology (ICT) sector as well as other sectors. Effective use of digital skills has proven to be a driver of resilience, helping workers and entire organizations adapt to the new realities shaped by the pandemic. Digital skills have also helped many workers for whom digital skills were not critical before the pandemic to shift to remote working virtually overnight, such as in teaching and clerical work (CEDEFOP, 2021).

Digitalization also raises challenges for the future of work. Digitalization and automation create new types of jobs but, at the same time, also eliminate jobs with routine and manual tasks. Zucchetti et al. (2019) state that all sectors and geographical regions will be affected, with a growing number of workers needing reskilling and upskilling. It is estimated that nine out of 10 jobs will require digital skills in the future (United Nations, 2018).

Not only related to jobs, but digital activities have also expanded and intensified as many people have had to shift to online solutions. The pandemic has accelerated e-commerce adoption; at the same time, it has shifted customers' mindsets to the point that online shopping has become widely accepted. The pandemic has also changed the education sector dramatically, with the distinctive rise of e-learning, where teaching is undertaken remotely and on digital platforms (Li, 2020). Thus, digital literacy is now necessary for most people, not only because of digital access to the acquisition and development of critical skills, but also to allow individuals to use the internet in a meaningful and beneficial way.

As a result, digital skills and digital literacy should be improved in all areas, including in urban, remote, and rural or displaced environments. This improvement will enable citizens to have equal access to more efficient services, consumers will enjoy more choices and businesses will be able to explore more opportunities and markets. Thus, **digital skills represent the key aspect of digital economic development in a country and provide opportunities for a more inclusive digital transformation in the long term.**

However, fewer than one half of adults worldwide possess such skills. The Organisation for Economic Co-operation and Development (OECD) Survey of Adult Skills (PIAAC, 2013), which was conducted in the OECD and other selected countries, reveals that 15% of adults lack basic digital skills and half of the world's population still does not have access to the internet (International Telecommunication Union, 2018; Hernandez & Roberts, 2018). According to the ITU (2021), the proportion of the global population with internet access varied in 2020. The proportion in most developed economies was already higher than 90%, such as Canada (96.5%) and Japan (91%). In contrast, the proportion was relatively lower in developing countries, such as, China (70.6%), Indonesia (53.7%), and

Turkey (77.7%).[1] Furthermore, even in some countries with a high proportion of internet users, and where the internet has reached saturation, gaps still persist between different groups, such as between men and women, people of different ages, people with different levels of income or educational attainment, and between those living in urban or rural areas (OECD, 2019)

As a result, **there is a widening digital skills gap and it has been exacerbated by the Covid-19 pandemic, especially in developing countries.** This is because digitalization and other emerging technologies are evolving in an increasingly shorter cycle and at a faster pace causing a rapid change in the jobs required and the skills needed for overall success, resulting in a mismatch between digital skills available and those demanded by businesses. The digital skills gap also includes skills shortages. Meanwhile, the Digital Skills Global (2021) report states that the main factor for the widening digital skills gap that affects different sectors and economies in different proportions is the lack of properly trained graduates to fill digital posts in growing technological industries.

As governments are adjusting their strategies in response to the pandemic, it is important to note that an increased reliance on digital technologies could risk the opening of new digital divides and/or widening those that have proved persistent over the years. Global policy coordination is needed to close the digital skills divide and to promote a plan that ensures digital inclusion. The Group of 20 (G20) leaders have focused on digitalization, information technology and digital literacy since their 2016 summit, well before the pandemic. Recently, the G20 governments stressed the urgency of accelerating digital transformation and reflected on how to reap the benefits of the advancements. Thus, in August 2021, the digital ministers of the G20 members adopted a declaration that recognizes the fundamental contribution that digitalization may have in supporting governments in building stronger, inclusive, and more sustainable societies, especially in the aftermath of the Covid-19 pandemic.[2]

Digital literacy and skills will be among the priority items on the agenda discussed by the Indonesian presidency of the upcoming G20 forum in 2022.[3] Several international organizations and research institutions have started to develop indicators to measure digital literacy and skills. However, developing standardized measures is vital, especially for tracking the progress over time and identifying skills gaps among demographic groups in a country. Hence, a measurement toolkit related to digital literacy and skills will be valuable for the Indonesian G20 presidency.

[1] https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
[2] The Declaration that leverages the potential of digitalization for a resilient, strong, sustainable, and inclusive recovery
[3] https://aptika.kominfo.go.id/2021/04/presidensi-indonesia-di-g20-fokus-tingkatkan-keterampilan-digital/

Why a digital skills toolkit?

A digital skills toolkit is defined as a set of indicators that provides guidance for stakeholders on developing a digital skills strategy. It aims at facilitating the development of a comprehensive digital skills strategy at a national level. This toolkit is intended for policymakers in the G20 members, along with their partners in the private sector, non-governmental organizations, and academia.

Several frameworks have already been developed at the international and national levels. For example, the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2018 developed a Global Framework of Reference on Digital Literacy Skills; the ITU in 2018 also developed the Digital Skills Toolkit; the G20 and OECD in 2020 also published a Toolkit for Measuring the Digital Economy and a Roadmap toward a Common Framework for Measuring Digital Economy. G20 members such as Indonesia, the European Union, and Australia have already developed their own frameworks. Nevertheless, a common framework is still required, in particular on digital skills and literacy. Thus, this proposed digital skills measurement toolkit aims at developing **a common framework/tool** that can be used to measure the state of digital skills using relevant indicators in G20 members.

This toolkit builds on and extends the existing toolkits/frameworks. As mentioned previously, digitalization occurs in an increasingly shorter cycle at a more rapid pace, which leads to a rapid change in digital skills. For example, as photo and video-sharing social media applications become more popular, video and photo-editing skills have become increasingly important. Some adjustments to indicators in the existing toolkits are therefore needed in response to that development. Thus, this toolkit can **improve existing metrics and fill the gap** in the existing digital toolkits by providing a framework that incorporates survey guidelines to measure digital skills.

Moreover, this toolkit provides guidance for a country **to optimize the exploration of digital indicators** to generate strategic policies for digital economic development. This toolkit highlights the relevant indicators to measure digital skills in the G20 members, including measurement methods, potential data sources, possible survey questions and possible challenges. This toolkit is also complemented by a survey framework to guide policymakers in measuring the indicators using primary data.

The toolkit can be a robust starting point for exploring the possible use and extension of measurement, including indicators and survey questions, to achieve a more inclusive digital economy among G20 members. Finally, this toolkit can help G20 members to identify digital skills' strengths and weaknesses, to map the digital skills structure, and to support efforts to close the digital skills gap. Finally, this toolkit can provide better evidence as a basis for international dialogue and for the identification and prioritization of programs/agendas by taking into account each economy's level of development.

This report is divided into four parts. First, the report reviews the proposed digital toolkit framework and its pillars and elements. This part also covers definitions and the rationale

behind the pillars and the elements' theoretical background. Second, we dive deep into each of the pillars and elements to discuss the proposed indicators. Lastly, available data, possible questions, other measurement options and possible challenges are discussed for each indicator.

B. Digital skills toolkit: Framework and approach

The digital skill toolkit has at least three added values. **First, this toolkit provides improved measurement of digital skills and an analysis of the existing measures adopted by various governments and organizations.** The proposed digital skills toolkit acknowledges the importance of the previous works and tries to provide measurement improvements as a potential guide for the G20 members to implement a standardized measurement of digital skills. In 2018, the G20 Digital Economy Task Force (DETF) produced the Toolkit to Measure Digital Economy and followed up with the Roadmap toward a Common Framework for Measuring the Digital Economy in 2020. Both documents provide a vital framework and theoretical background for the proposed digital skills toolkit.

In detail, the digital economy measurement toolkit introduces several applicable definitions and explanations of a variety of pillars and indicators related to digital skills. It provides a starting point to gather relevant indicators such as internet/e-commerce/e-banking users, tertiary graduates in the natural sciences, engineering and ICT and the employment of ICT specialists. Moreover, the 2020 roadmap also includes jobs, skills, and growth as the focus areas. ICT usage in school, ICT task intensity of jobs and top-10 skills in high demand for computer-related jobs are some of the proposed indicators to measure skills and jobs in the digital economy. Both documents emphasize the importance of business surveys and capture some of the rising and most in-demand digital skills. However, such methods should be carefully examined to ensure their representativeness and comparability across countries. The proposed digital skills toolkit considers measurement strategies from the previous studies and fills the gap in the existing frameworks.

Second, this toolkit consists of comprehensive pillars and elements, supply-demand, national, and occupation-level analysis and across levels of digital skills, so it allows for a richer analysis. This toolkit measures both the demand and supply sides in the labor market. The supply side is measured by a workforce or individual survey, and the demand side is analyzed using a survey of firms. As digitalization grows rapidly, understanding both supply and demand for digital skills is crucial to building a comprehensive measurement.

Moreover, this toolkit will also explore a more micro-approach to analyzing digital skills at the occupation level based on the individual and firm surveys. As digitalization has occurred across a range of occupations and industries, even in the least digital occupation there are often requirements for some level of digital skills. Nesta (2018) argues that there are occupations, as varied as teachers and chefs, which are currently not digitally intensive, but their digital intensity is expected to grow in the next 10-15 years. Thus, the occupation level-based analysis can provide a more detailed and comprehensive analysis; it complements the supply and demand side analysis. As an alternative, LinkedIn or other job portals' data can be used to analyze the business or demand side.

Finally, this toolkit offers flexibility to each G20 member to optimize the available data and survey implementation. This is because the economic and social backgrounds of the G20 members vary and different sectors are going through different phases of digital transformation in each economy. This toolkit also offers flexibility to each of the G20 members to optimize the available data and survey implementation such as priority sectors, occupations, and location selection. The most important goal is to have a reliable and robust survey framework to develop standardized and comparable indicators.

Given the fact that the G20 members differ in terms of the level of development, the toolkit considers a broad definition of digital skills from basic digital skills/literacy to more advanced and job-related digital skills. Most studies and reports still focus on measuring the basic digital skills or digital literacy skills. Therefore, this toolkit will also address the measurement of intermediate and advanced digital skills, so as to provide a comprehensive map of the digital skills structure in the economy, given that those skill levels will likely increase as sectors/firms become more digitalized. The information regarding these digital skills levels will be retrieved from relevant indicators in the individual and firm surveys.

It is worth noting that although this toolkit provides some measurements, the nature of the toolkit will be more toward an explorative approach and neither aims at scoring purposes nor country comparison. Moreover, this toolkit does not address country-specific issues. But the toolkit is useful to give a starting point to approach digital skills challenges. Finally, this toolkit does not quantify the digital skills gap, even though it addresses both supply and demand. The aim of the supply-demand analysis is to identify the binding constraints and policy prioritization. In addition, the analyses of indicators in this toolkit will also use a gender-equality view to provide a more inclusive digital skills measurement.

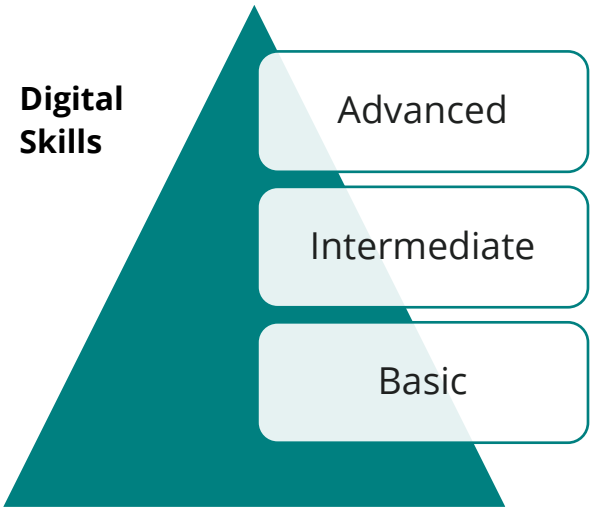
Digital skills definition

Figure 1 explains the proposed digital skills level definition. We adopt UNESCO's definition of basic digital skill (2018). UNESCO's definition of the basic skills covers not only skills related to basic hardware, software, and online operations, but also the other literacies, such as information and media - those skills may not directly link to digital technology, but they are necessary to acquire the basic digital skills. UNESCO also classifies competence areas of digital literacy, i.e., communication and collaboration, critical thinking, data literacy, ICT familiarity, device security, and personal security.

For the intermediate and advanced levels, this toolkit adopts the ITU's definition (2018) with some modifications on both the demand and supply side. Most recent studies, such as OECD (2020), also adopt the ITU (2018) definition. The intermediate level is defined as the ability to configure general digital tools to produce and consume digital content or enhance digital tools through basic programming skills (for example, basic programming knowledge, spreadsheet manipulation). Meanwhile, the advanced level is related to programming and Industry 4.0 technology, including skills involving artificial intelligence (AI), big data, coding, cybersecurity, Internet of Things (IoT), and mobile app development

usually needed by specialists in the ICT sector. It is worth noting that advanced skills are typically acquired through advanced formal education, though this toolkit describes other channels for learning, such as coding boot camps, that are viable options for many countries (ITU, 2018).

Figure 1. Proposed digital skills level definition



Programming and Industry 4.0 skills (ITU, 2018)

Using technology to ***create added value*** and/or skills to ***utilize data*** i.e., gather, visualize, and interpret (ITU, 2018)

Basic ***digital literacy*** skills (UNESCO, 2018)

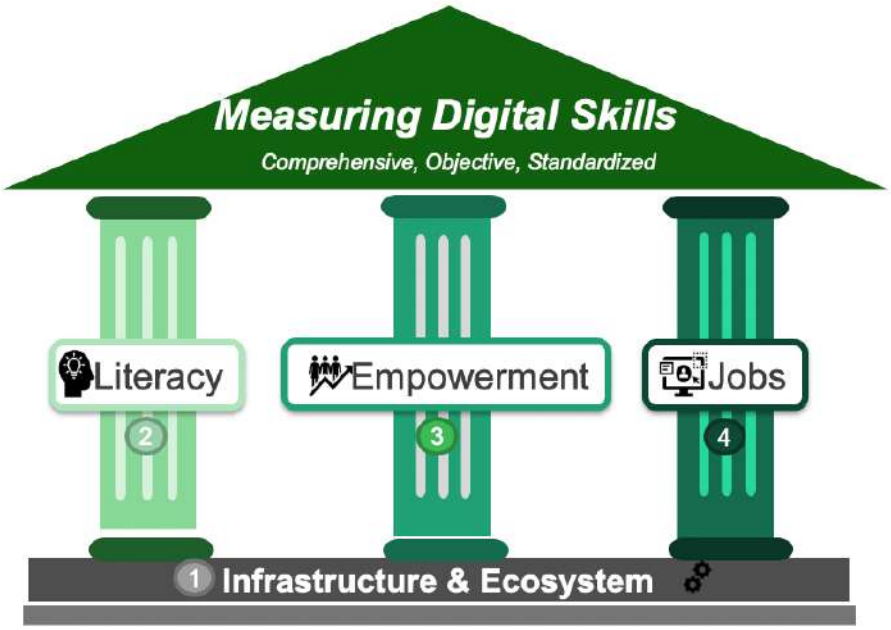
Source: Compiled by CSIS (2021)[4]

Digital skills toolkit: Pillars and elements

The digital skills toolkit comprises three components, namely, pillars, elements, and indicators. **There are four pillars included in the proposed toolkit framework to be measured, which are: 1) Infrastructure and ecosystem; 2) Literacy; 3) Empowerment; and 4) Jobs.** Those pillars together enable the measurement of digital skills in a more comprehensive, objective, and standardized way.

[4] Please refer to Appendix for the summary of relevant digital skills/literacy definition

Figure 2. Proposed digital skills toolkit framework



Source: Compiled by CSIS (2021)

Those four pillars are divided into main elements as specific key factors. And each element will be measured by main indicators. Overall, there are four pillars, nine elements, which will be broken down into around 32 indicators, as shown in Table 1.

Table 1. Pillars, elements, and indicators of the digital skills toolkit

Pillars	**1 Infrastructure & ecosystem**	**2 Literacy**	**3 Empowerment**	**4 Jobs**
Elements	1.1. ICT sector, access and adoption 1.2. Learning and innovation	2.1. Complementarity 2.2. Familiarity 2.3. Security	3.1 User/consumer 3.2 Provider/seller	4.1. Demand for digital skills 4.2. Supply of digital skills
Number of Indicators	**6**	**6**	**9**	**11**

Source: Compiled by CSIS (2021)

Pillar 1 — infrastructure and ecosystem — is not an issue in developed countries. But, in some emerging and developing countries, overcoming supply-side obstacles, such as lack of broadband access, is important to fully reap the benefits of digitalization for inclusive growth. This pillar acknowledges the importance of **equal access to digital**

infrastructure, especially in most developing countries. Thus, Pillar 1 is **a key foundation** for the quality of the digital skills ecosystem and environment. Meanwhile, the focus of the learning and innovation ecosystem is to increase people's adaptability to meet 21st-century jobs and skills requirements. Innovation systems and processes are also important in creating jobs. Various scientific studies show that innovation destroys, but also creates, employment. The race between job creation through the development of new products and job destruction from the introduction of new process technologies has in the past been won by the job-creating effects of innovation (European Parliamentary Research Service, 2018). Meanwhile, the OECD (2018) asserts that innovation is a catalyst for long-term productivity and income growth. Thus, Pillar 1 considers two main elements, i.e., (1) ICT sector access and adoption, and (2) learning and innovation.

Pillar 2 - digital literacy is an empowering tool to achieve a more inclusive digital economic development. UNESCO (2019) defines digital literacy as the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies for employment, decent jobs, and entrepreneurship. In this toolkit, the literacy element reflects basic digital skills. This pillar adopts the Digital Literacy Index (Indonesian Information and Communications Ministry, 2020). The index is adopted from the Digital Literacy Global Framework (UNESCO, 2018). Lastly, this pillar will be disaggregated by gender, age group, education level, and rural-urban to observe whether there is a gap between different groups.

For Pillar 3, empowerment is defined as activities that will capture people's digital capabilities **to improve their standard of living** (economic empowerment) or **income-generating digital activities.** This pillar adopts the G20 Toolkit on Digital Economy (2018). This pillar highlights the development of micro, small, and medium enterprises (MSMEs) and the sharing economy in the digitalization process. As the number of e-commerce and digital platforms increases, they can offer MSMEs and workers higher incomes, better quality of life, and financial inclusion. Platforms and their ecosystems create new economic opportunities both within and beyond the platforms. Moreover, platforms allow people to share their intangible assets and underutilized tangible assets for money or for free with the help of the internet, which results in a new business model or sharing economy. This pillar does not focus only on sellers/providers on the platforms, but also consumer/users, as both can improve their living standards.

The last pillar, Pillar 4, comprises the needs of digital skills and workers' ability to use digital technology for job-related purposes. Thus, the main elements of this pillar are the demand and supply of digital skills as the main elements. The proposed digital skills level definition (Figure 1) is elaborated further below. The indicators will capture digital skills needed to perform in (new) technology-related work activities, tasks, or occupations. As Acemoglu and Autor (2010) assert, technological change (or digitalization in this context) will create a new set of tasks that will demand potentially new skills. McKinsey (2018) predicts that **demand for technological skills will increase** 60% in hours worked from 2016 to 2030. However, on the other side, the proportion of tasks that are not related to computer or digital will decrease; as the OECD (2016) survey finding suggests, only 24.5% of respondents did not have a **computer-related task at work.** This pillar focuses on

the analysis of supply and demand of digital skills in the labor market. Digital skills for jobs are classified into basic, intermediate, and advanced levels, adopted from the ITU (2018) definition. The analysis of skill level will be disaggregated by occupation to provide a more detailed and comprehensive analysis, as mentioned previously.

Sources of data

The four pillars in this digital skills toolkit require different data sources. For Pillar 1, most indicators are derived from the available secondary data, such as, the World Bank, the ITU, the OECD, and UNESCO. Pillar 1 also requires additional information on policy measures such as education policy (e.g., digital skills curriculum and roadmap), stakeholders' engagement in skill development and incentives for innovation related to digital skills development. The combination of these data sets can provide an overview of the infrastructure development and digital ecosystem in each country. Meanwhile, most of the indicators of Pillar 2 and Pillar 3 are derived from the self-assessment individual survey. Finally, Pillar 4 indicators are derived from the combination of self-assessment individual survey, firm-level survey, and other secondary data. In addition, job platform data such as LinkedIn can be used to reduce the surveys' bias from subjectivity and to determine relevant occupations. The data can complement and elaborate the analysis. In addition, the G20 members survey is also employed to provide information on definition, instrument, and programs related to digital skills development in each G20 member. Overall, there are five sources of indicators to construct the digital skills toolkit, as indicated in Figure 3.

Figure 3. Data source of digital skills toolkit

Pillar 1	Pillar 2	Pillar 3	Pillar 4
•Secondary data •Policy measures •G20 surveys •Policy measures from government data	•Individual survey •Secondary data	•Individual survey •Secondary data	•Individual survey •Firm-level survey •Secondary data

Source: CSIS (2021)

Most of the indicators in this toolkit employ the self-assessment method. This is because the toolkit covers a range of digital skill types, from digital literacy to advanced digital skills. The self-assessment method has some advantages, i.e., it is the easiest and least costly to create, deploy and score. Self-assessments can also cover an almost unlimited range of skill types, from basic to advanced. Moreover, self-assessments allow a person to reflect for themselves upon their own strengths and weaknesses. The ITU and Eurostat, the EU's statistical office, are examples of organizations that incorporate self-reporting surveys as part of their large data-collection processes (ITU, 2020). On the other hand, this method has some limitations since it is based on subjective evaluations of one's competence and may not reflect a person's actual competence.

Another possible method is direct testing, or performance-based, which has the most internal validity as a prerequisite for developing skill measurements. However, it is costly and time-consuming, which makes large-scale implementation difficult (Van Deursen et. al., 2014). Besides those methods, knowledge-based assessment that tests skills can also be considered, commonly using questions about factual or procedural knowledge. The advantage of a knowledge-based assessment is that it can test skills at lower cost and with less effort than other testing methods. However, it sometimes focuses too much on features of the technology itself and not on how to use digital skills to solve a real-life problem (ITU, 2020). As an alternative, the toolkit recommends testing a group of respondents and checking the survey's robustness.

Moreover, the **firm-level survey** reflects firms' perspectives on digital skills, in particular in-demand skills. To reduce the survey's bias from subjectivity, the toolkit will also complement the analysis using the available data from job platforms such as LinkedIn.

In terms of occupation, the occupation list can be selected based on available national surveys to obtain the representative list of occupations. Alternatively, the International Standard Classification of Occupations (ISCO) from the International Labor Organization (ILO) can be employed, which allows both general (major and sub-major group or 1-2 digit of ISCO) and detail (minor group and unit group – 3 and 4 digit) approach. Or the O*NET list also can be used to identify the relevant occupations. Job platform data can also be used to select the most relevant occupation, such as top-20 in-demand occupations. In addition, it can be complemented by some critical or advanced digital skills occupations based on research or study. Besides occupation, a task approach can be considered. However, this is only available in a few countries. For the digital skills used in each occupation, O*NET can be used to maintain the same definition across countries.

This part discusses a few lessons learned that can be derived from the pilot survey. It may be useful for other countries to take notes and improve the survey framework, design, and implementation when seeking to implement the toolkit.

Box 1. Lesson Learned from Pilot Survey

Broad vs narrow definition

A digital skills toolkit has at least two definitions. Firstly, the narrow definition affirms that the toolkit measures digital skills and literacy in only one specific aspect, such as livelihood or development. Secondly, the broad definition of digital skills asserts that this toolkit measures all aspects of digital skills and literacy, including the use of digital technology for both livelihood and developing the technology itself (innovation purposes). Detail explanation of those definitions is in Appendix 5.

Since this toolkit is a preliminary step toward capturing development levels in G20 members, it is important to have a comprehensive view. Hence, the broad definition is more appropriate for this initial step in order to measure the level of competencies and to capture digital skills transformation. The broad definition may also encompass the narrow definition, particularly for some pillars – by conducting

individual and firm surveys to collect the data for Pillars 2-4. Thus, this toolkit can be used to further analyze workers' digital skills and empowerment.

Flow vs stock variables

A flow variable refers to a variable that is measured over a period or per unit of time; meanwhile, a stock variable is that which is measured at a point in time. It is better to use either stock or flow for consistency of indicators in this toolkit. Yet, this toolkit uses a combination of stock and flow variables. Most indicators in this toolkit are stock variables, for example: schools with internet access in Pillar 1, digital literacy score in Pillar 2, share of internet users in Pillar 3, and proportion of workers who use the internet at work in Pillar 4. Meanwhile, flow variables are also used, such as ICT goods as a percentage of total exports and imports. Moreover, some indicators based on secondary data such as the proportion of workers who use the internet at work are commonly published annually in stock form.

As this toolkit is an initial step, combining stock and flow variables can provide a better measurement of digital skills development in a country. After an initial condition is identified comprehensively, this toolkit can explore the possibility to use either flow or stock variables for uniformity.

Major vs detailed occupation lists

An occupation's definition considers a high degree of similarity in performing certain duties/tasks; thus, the occupation approach provides a better analysis than the sectoral/industry approach. This is because each industry will have a wide range of occupations that require different levels of digital skills and educational backgrounds.

The ISCO-88[5] foregrounds nine major occupational groups,[6] excluding the armed forces. One of the drawbacks of using a major group is that it is too broad, where IT specialists or other digital-related jobs cannot be captured. The two digits of ISCO-88 can capture ICT professionals (ISCO code 25), but the number of sub-major groups is around 40 occupations. Consequently, it would be a burden for a firm to participate in and fill the questionnaire. This toolkit approach can combine a major group with selected sub-major groups, aiming to get a broad picture of general occupations while simultaneously seeking to obtain details about particular occupations that use digital technology (see Appendix 6).

Major or detailed occupational implications of skills gap

[5] International Standard Classification of Occupations, 1988 (ISCO-88).
[6] 9 major occupations: (1) managers; (2) professionals; (3) technicians and associate professionals; (4) clerical support workers; (5) service and sales workers; (6) skilled agricultural, forestry and fisheries workers; (7) craft and related trades workers; (8) plan and machine operators and assemblers; and (9) elementary occupation.

The choice of occupational classification will have an effect on whether there is a skills gap. Based on the survey results, skills gaps do not appear in occupations that require basic and intermediate levels of digital skills. However, it may be an issue in occupations that necessitate advanced digital skills. Thus, a detailed occupational analysis for a certain digital skill level is needed to enrich the analysis.

Firm self-assessment may not be accurate in measuring the digital skills gap

Firm self-assessment may be bias in measuring the digital skills gap, this because firms commonly conduct a recruitment or selection process to choose the best candidate among a pool of applicants; the best candidate is the individual who has the highest and most suitable digital skills for certain positions. Moreover, firms commonly provide on-the-job training, which includes digital skills training for their new employees; these are part of a firm's efforts to minimize the gap. If the firms are asked to assess the current conditions, the gap may not be present or may be very low.

Thus, self-assessment by firms should be supplemented with other data sources to validate the existence of a digital skills gap. Firm surveys that are complemented by individual surveys can provide a better measurement of the skills gap - more specifically, by using individual surveys on fresh graduates that have not received any on-the-job training.

C. Pillar 1: Infrastructure and ecosystem

The first pillar consists of a comprehensive set of ICT development, infrastructure and adoption, and institutional quality factors in developing a digital skills and literacy ecosystem. This pillar includes two elements: 1) technological access and adoption and 2) learning and innovation ecosystem. It is crucial to continue developing, tracking, and improving the indicators derived from each element over time so as to have a proper foundation for a country in addressing the digital skills challenges both in the medium and long-term.

Most of the indicators are gathered from secondary data. There are two types of indicator data. The first one is the secondary data from available international databases such as World Development Indicators (World Bank), ICT Development Index (ITU), and International Federation of Robotics (IFR). The second is national policy measures that are parts of the soft infrastructure. The aim is to identify the best-practice policy framework required to support digital literacy and skills development. Both sets of data are complementary and essential to building a strong foundation for digital skills development. Table 2 shows the breakdown of each element and selected indicators, which will be discussed in more detail in the next part.

Table 2. Elements and indicators of Pillar 1

Pillar	**Pillar 1. Infrastructure & ecosystem**	
Elements	*1.1 Technological access & adoption*	*1.2 Learning & innovation ecosystem*
Indicators	1.1.1 ICT trade 1.1.2 ICT access and use 1.1.3 Business technological adoption	1.2.1 Schools with internet access 1.2.2 Number of universities in the STEM-related QS Ranking 1.2.3 Patents by origin/bn PPP$ *PLUS* Policy measures such as 1) digital skills and literacy adoption in basic education (e.g., curriculum, roadmap); 2) Stakeholders' engagement schemes, especially private sector in skill development; 3) Incentives for innovation related to digital skills development and training.

Source: CSIS (2021)

Element 1.1: ICT development and technological adoption

A country's level of ICT development and adoption provides an essential insight regarding its digital skills level. A country that produces and trades more complex, sophisticated, and technological-intensive products/services demands a workforce with more advanced digital skills. One of the benefits of having a higher technological development is higher productivity, as stated by Sorbe et al. (2019). This study emphasizes the productivity benefits from digital adoption, which appear to be greater in manufacturing industries where the share of automatable tasks is more significant. In this case, there is a strong correlation among technological adoption, automatable tasks, and productivity.

A study by Chaochi and Bourgeau (2020) finds that the core ICT sector is rapidly digitalizing due to the increase in remote execution of software and applications, wireless and mobile access to digital services in industries, and the implementation of high-performance computing and machine/AI-based services. As a result, these industries have a high demand for advanced digital skills in data analytics, cloud computing, cybersecurity, and application development to develop new digital services and optimize resources. On the other hand, more traditional industries such as agriculture and construction experience a relatively low degree of digitalization and rely more on workers with only basic or intermediate digital skills. In conclusion, a country with a relatively high level of digital adoption, data-intensiveness and ICT utilization will require more sophisticated jobs and, hence, digital skills will also be in high demand.

Most importantly, ICT utilization depends greatly on access and adoption. Therefore, in this toolkit, internet penetration and mobile internet subscription are used as indicators to measure the level of consumers' access to ICT infrastructure, the backbone of digitalization and technological adoption, and its affordability. Adequate infrastructure and services are necessary conditions to bridge the digital divide, especially in developing countries and rural areas. A program in China called "Villages Connected" is an example since 80% of China's population in rural areas has low income and low education levels, this program connects around 69,000 villages (Shenglin et al., 2020). Lastly, to complete the picture, the more advanced indicators, such as the number of robots, capture the technological adoption by industries in a country.

The G20 members have a wide range of economic development levels including in their ICT sectors. Accordingly, the difference in the economic structures and ICT sector development might explain the potential difference in digital skill trends on both the supply and demand sides. For example, due to higher access to advanced technology and technology adoption in their society, firms in the US and Canada will require more advanced digital skills than those in Indonesia and Argentina. The toolkit will deep-dive into each indicator to obtain a more detailed picture.

Indicator 1.1.1 ICT trade

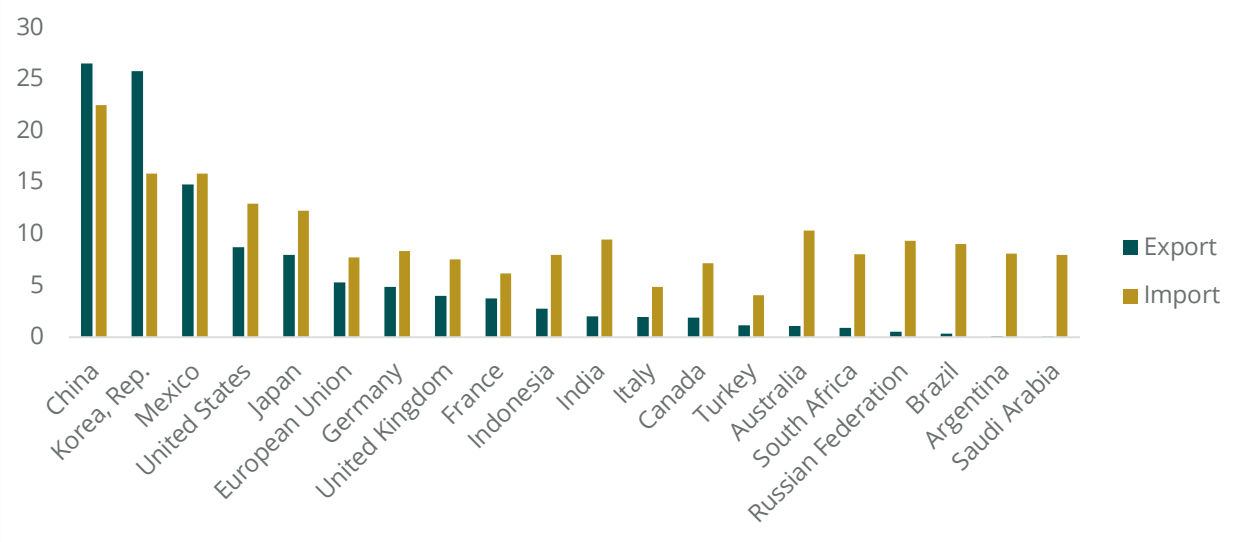
Today, ICT is among the most rapidly growing sectors in world trade. Based on the United Nations Conference on Trade and Development (UNCTAD) data from 2019, trade in ICT products accounted for around 12.5% of global goods exports and 13.4% of global goods

imports. The ICT trade indicator represents a country's capacity to trade and produce sophisticated products and services and the level of technological adoption in that country. It is defined as the total exports and imports of ICT goods and services as a proportion of total exports and imports. As previously mentioned, the development of the ICT sector also reflects the demand side for digital skills. Studies on firms' decisions regarding skill composition, technology upgrading, and exporting reveal that exporters are more likely to adopt technology and upgrade their workforces' skills level than non-exporters (Bustos, 2011; Kugler & Verhoogen, 2012).

The industry that produces ICT goods is one of the most globally integrated industries due to trends in the global value chain and offshoring activities. For example, the electronics and electrical components sector in developing countries like China has experienced substantial growth due to the production fragmentation process and the relocation of industries from advanced countries in the last two decades. In addition, market access expansion, foreign direct investment, and trade facilitation have helped China climb up the value chain and produce more sophisticated products. Xu and Li (2008) find that export expansion in China has had a negative direct effect (Heckscher–Ohlin type) and a positive indirect effect (export-induced skill-biased technical change) on skill demand and the net impact has been positive. Furthermore, a majority of foreign-owned firms have demanded more skilled labor (skill-biased technological progress).

According to the ICT goods data, China, Korea, and Mexico had the highest share of ICT goods in their total exports and imports in 2020 (Figure 4). Around 25-26% of total exports from China and Korea are ICT goods. This indicator also emphasizes international trade and the supply chain as a possible channel of firms' technological adoption. In other words, these countries are well-connected with the global value chain in the ICT sector and indicate the trend of digital skills demanded by firms. However, ICT goods alone do not reveal the whole story about a country's level of digital skills and should be complemented by the services sector side, which will become more critical.

Figure 4. ICT goods (% of total exports and imports)

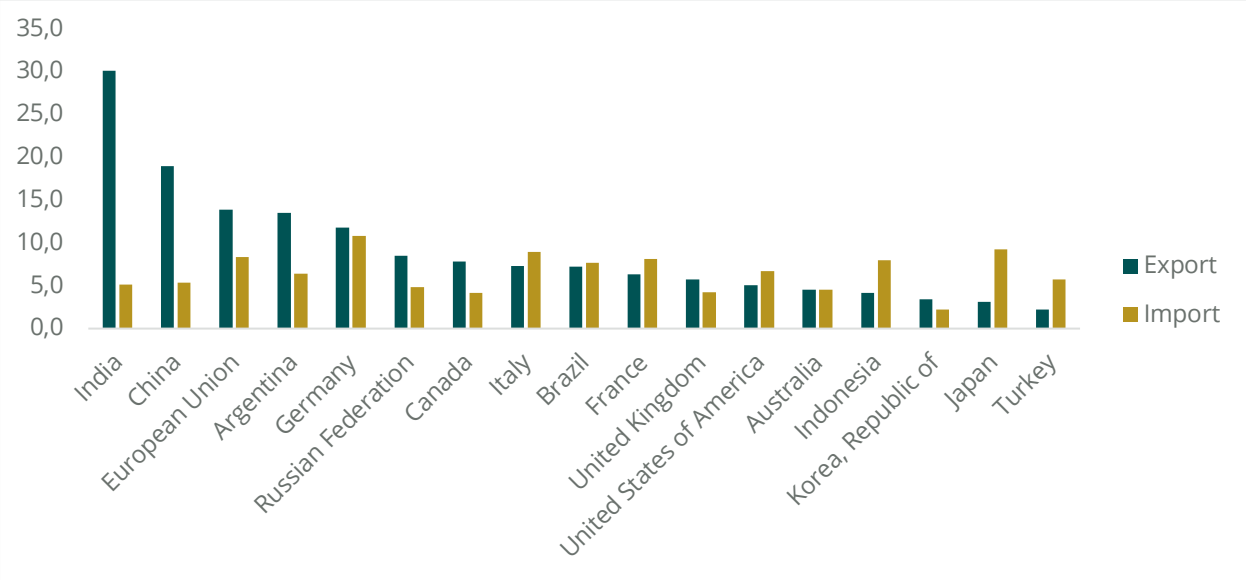


Source: UNCTADstat (2021)

According to Baldwin (2016), the trend of globalization's "third unbundling" will lower the cost of trade, communication, and face-to-face interaction significantly. This is different from the "second unbundling", which came from the ICT revolution, enabling production segmentation and offshoring activities in other countries, as previously explained in the global value chain. The third unbundling is likely to involve workers in one nation providing services in another nation—including services that today require a physical presence and allow labor services to be physically unbundled from workers.

Production fragmentation and digitalization have intensified international trade in services, especially in ICT services (e.g. telecommunications services, IT system design, and software development). In the G20 members, this sector has become more important since it comprises a large share of their trade. Therefore, this ICT services indicator provides valuable information on the importance of the digital economy and skills required in the sector. Figure 5 below shows that India, China, and the European Union have the highest share of ICT services exports. At the same time, Germany, Japan, and Italy are the top-three G20 members with the highest percentage of ICT services imports. Note that data from neither Saudi Arabia nor South Africa are available in the UNCTAD database.

Figure 5. ICT services (% of total exports and imports)



Source: UNCTADstat (2021)

Indicator 1.1.2 Access and use

This indicator represents the critical role of ICT in developing inclusive digital literacy and skills. By bridging the digital infrastructure gap, countries can create more opportunities for the hitherto unconnected population. According to the World Economic Forum (WEF) (2020), several G20 members such as India, China, Indonesia, and Brazil are among the

top-10 countries with the highest number of unconnected people.[7] In low-and middle-income countries, the World Bank (2016) finds that a 10% increase in broadband penetration accelerates economic growth by 1.38% — more than the impact in high-income countries and for other telecommunications services. Oxford Economics (2016) also calculated that each percentage point increase in mobile internet penetration created an additional US$58.1 billion in GDP and 1 million new job opportunities by 2020 in Southeast Asia.

Accelerating technological access and adoption are the backbone of the digital literacy and skills improvement strategy. Global policy coordination is needed to promote a plan that ensures digital inclusion. A forecast projects that two-thirds of the world's workforce will depend on 5G connectivity by 2030.[8] In other words, without such a plan, the digital divide will be wider and leave behind even more unconnected people. Therefore, accessible, fast, and affordable connectivity creates more opportunities and benefits from the digital economy and connects schools, community access centers, and other places of public access that can provide a platform for teaching digital skills.

An uneven spread of digital technologies could increase learning inequalities among countries, locations, genders, socioeconomic groups, and generations. It is estimated that half of the world's population still does not have access to the internet (ITU, 2018; Hernandez & Roberts, 2018). Therefore, developing a comprehensive and coherent approach to expanding connectivity should become one of the policy makers' focuses to answer the challenges from the evolving landscape for skills and jobs (OECD & IDB, 2016).

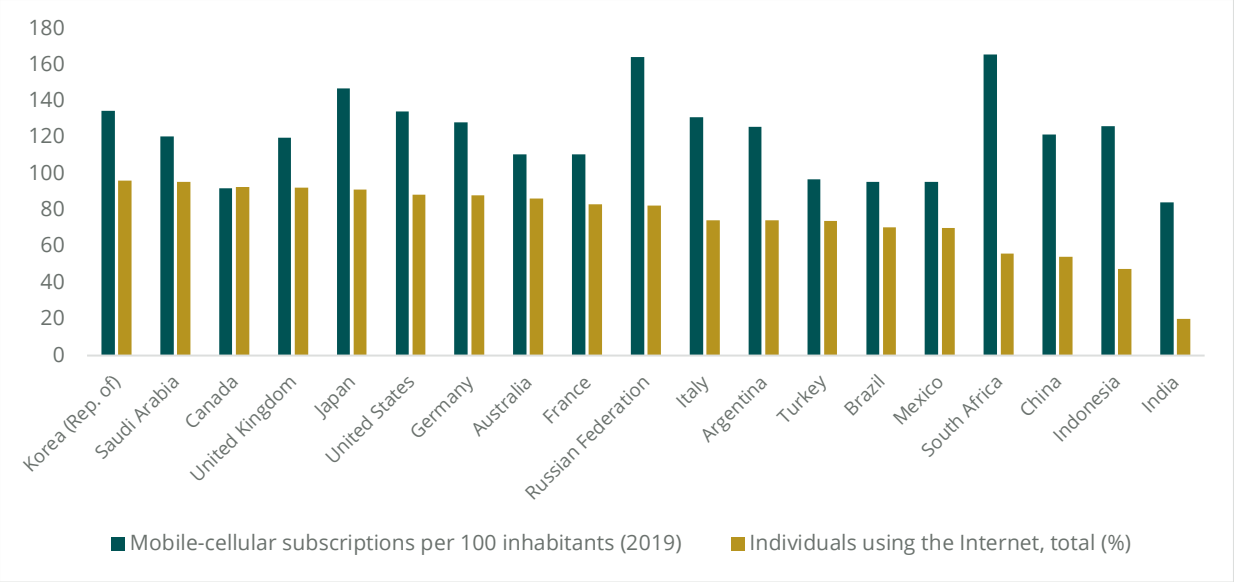
The ICT access and use indicator captures a country's ICT readiness and is retrieved from the ITU ICT Development Index, including mobile-cellular subscription per 100 inhabitants and the total percentage of individuals using the internet. According to the ITU (2010), mobile-cellular telephone subscriptions data refer to the number of subscriptions to a public mobile telephone service providing access to the public switched telephone network (PSTN) using cellular technology. It includes both the number of postpaid subscriptions and the number of active prepaid accounts (i.e., active during the past three months). In addition, it includes all mobile-cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging, and telemetry services. The internet users indicator refers to people who used the internet from any location and for any purpose, irrespective of the device and network used in the last three months. It could be via a computer (i.e., desktop computer, laptop computer, tablet or similar handheld computer), mobile phone, games machine, digital TV, etc. Access can be via a fixed or mobile network.

[7] https://www.weforum.org/agenda/2020/08/internet-users-usage-countries-change-demographics/

[8] https://www.cisco.com/c/en/us/solutions/collateral/executive-perspectives/annual-internet-report/white-paper-c11-741490.html

From Figure 6 below, the proportion of internet users in South Korea, Saudi Arabia, Canada, the United Kingdom, and Japan has already reached more than 90% while Indonesia and India are still below 50%. Meanwhile, regarding the number of mobile-cellular telephone subscriptions, South Africa, Russia, and Japan are the highest.

Figure 6. ICT access and use



Source: ITU ICT Development Index (2021)

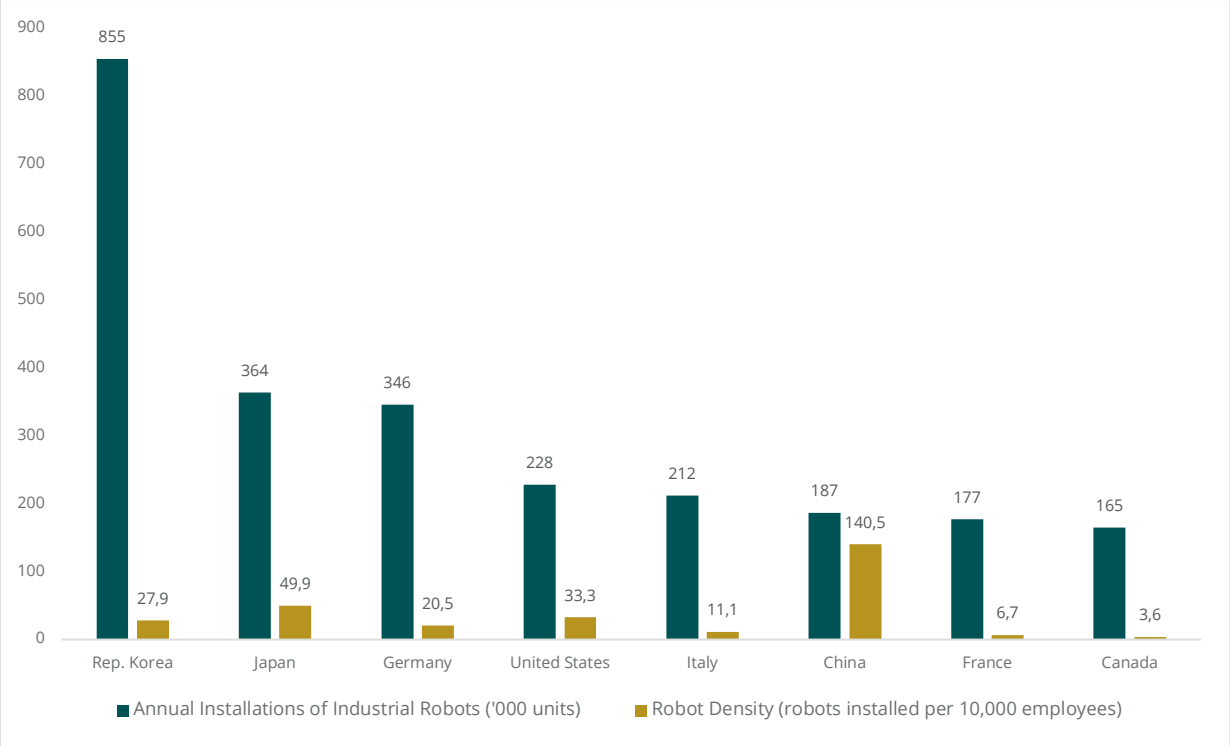
One of the indicator's limitations is that it does not show the distribution of the infrastructure and its usage. Therefore, it does not explain the whole story about the inequality between regions. For example, urban households in Indonesia are almost twice as likely to access the internet, fixed broadband, computers, and radio than rural households—clear evidence of an urban-rural, and also most likely rich-poor, digital divide (Hadi, 2018).

Indicator 1.1.3 Firm technological adoption

A growing number of studies have examined Industry 4.0 technology, such as automation and AI, and its impact on the economy. For example, on the impact of robots and their relation to labor productivity and wages, Graetz and Michaels (2015) found that robots were responsible for one-tenth of the world's GDP growth between 1993 and 2007. Furthermore, an additional robot could reduce six workers and one robot per thousand workers reduced wages by 0.5% (Acemoglu and Restrepo, 2017). Finally, using the US patent data from 1976 to 2014, Mann and Puttmann (2017) find that automation causes employment in manufacturing to fall but it increases employment in services with an overall positive effect.

One measure that is useful to track is the International Federation of Robotics (IFR) on the robots statistics that have been used extensively in the literature. The IFR definition of an industrial robot refers to ISO 8373:2012, "an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications." From the figure below, South Korea was the leader in the number of industrial robots installed in 2020, with around 855,000 units. In contrast, China has the highest robot density, with about 40 robots per 10,000 employees. Unfortunately, the rest of the G20 members' data are not accessible online.

Figure 7. IFR robotics statistics (2020)



Source: International Federation of Robotics (2020)

To measure firms' technological adoption, a national firm survey can capture the adoption level of several technologies. Basic technology such as social media and websites for sales and marketing and conference platforms for meeting purposes used by the firm. Enterprise resource planning (ERP) and customer relationship management (CRM) are regarded as a more advanced level since a company needs to invest more in both software and workers' skills. Lastly, the most advanced technologies such as cloud computing, AI, and IoT usually refer to Industry 4.0 technology. Firms that use these technologies usually already invest heavily in research and development, are also well-prepared with an adequate number of ICT specialist workers. According to the OECD database, 26.6% and 14.1% of firms in Canada and Japan, respectively, have adopted the IoT. Moreover, 7.4% firms in Italy have used AI in their operations.

No	Technology
1	Social media or online job posting platforms to advertise online job vacancies
2	Job-task related collaboration or video conferencing
3	Websites or e-commerce platforms
4	Enterprise resource planning (ERP)
5	Customer relationship management (CRM)
6	Cloud computing
7	Artificial intelligence (AI)
8	Internet of Things (IoT)

Element 1.2: ICT development and technological adoption

In skill formation and acquisition, learning and innovation are some of the most essential aspects. Therefore, measuring and tracking these factors are also vital for digital skills development. According to the OECD (2020), digital technologies can enter initial education systems at different levels such as an objective of learning for students and teachers, and supporting tools for students, teachers and management. The focus of the G20 members is to increase the adaptability of the learning ecosystem to meet 21st-century jobs and skills (OECD, 2017). In addition, strengthening the connection between education and employment has resulted in significant benefits, especially for vulnerable populations such as women and youth (Bolstad et al., 2012; Chetty et al., 2017). Thus, improving the learning ecosystem is a required factor in narrowing the digital skills gap.

A conducive and facilitative innovation climate will also support businesses' technological adoption, entrepreneurship, start-up ecosystem, and digital talent development. Therefore, the learning and innovation system should be more adaptive to answer the fast-changing future skills, especially digital skills. Under the learning and innovation ecosystem, the toolkit focuses on countries' educational institution quality and innovation measurement from the available secondary data. In addition, the toolkit will also include policy checklists on several learning and innovation policies to capture the soft infrastructure or digital skills-related policies in the country such as:

1) Digital skills and literacy introduction in basic education (e.g., curriculum, roadmap)
2) Stakeholders' engagement schemes, especially the private sector in skills development

3) Incentives for innovation related to digital skills development and training

Indicator 1.2.1 Elementary educational institution

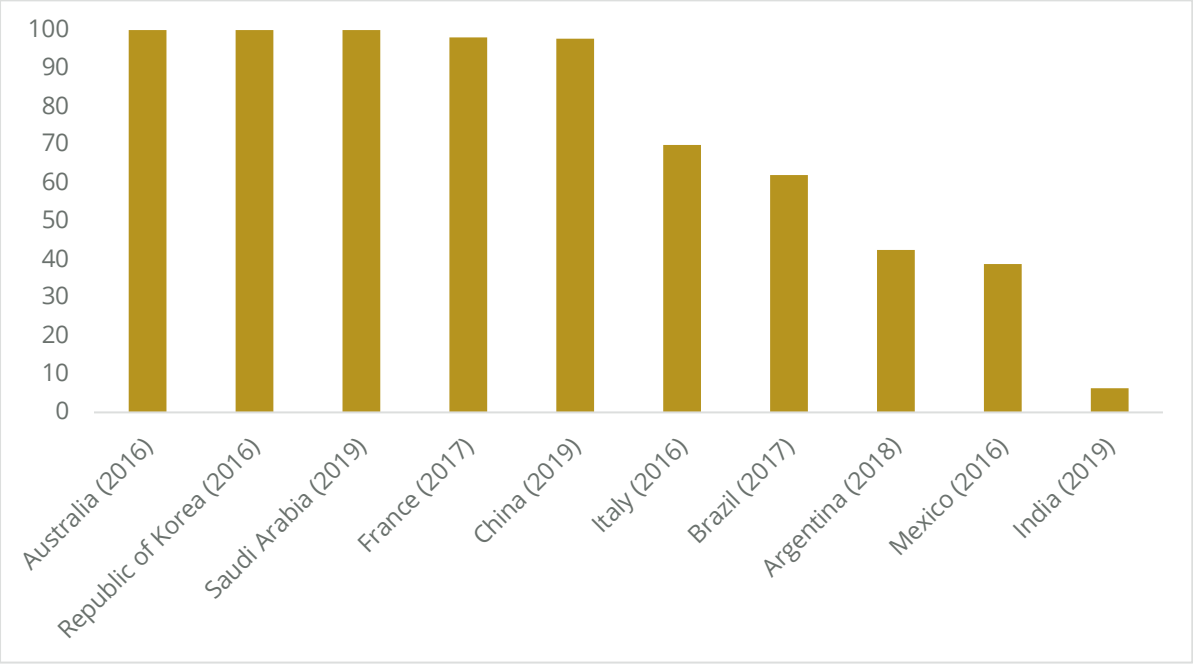
To answer the challenge of the changing skills and jobs in the future, investment in early education and K-12 are important. This period of skill formation gives the highest return to a country's human capital (Cunha et al., 2006). Therefore, the basic curriculum should aim at cultivating adaptable learners with a strong foundation in basic cognitive, creative, and digital skills. In addition, initiatives that expand access to computers and the internet do increase computer use and improve computer proficiency among students (Bhardwaj, Yarrow, and Cali 2020).

However, students' access to digital skills and literacy remains limited in developing countries. One of the indicators is the proportion of schools with internet access. For example, nearly 78% of schools in India still do not have internet facilities and more than 61% do not have computers.[9] Likewise, a survey of 270 remote primary schools in five disadvantaged districts in Indonesia found only 29% were connected to the electricity grid, and only 17% had internet access (Susanti et al. 2020). This situation puts students who live in remote areas at a disadvantage and creates another source of the digital divide. Therefore, the government must ensure internet access and quality in all schools to support digital skills development in the basic education system.

According to the UNESCO definition, internet access in school can be measured by the percentage of primary schools with access to the internet for pedagogical purposes. In other words, the internet is available for enhancing teaching and learning and is accessible by pupils. This indicator is also one of the Sustainable Development Goal 4 indicators thus the data are collected carefully, comparably, and regularly tracked to check the goal's progress. However, some G20 members' data are still not available at the UNESCO Institute for Statistics.[10] The figure below shows the difference between developed and developing countries based on the indicator. Five countries, namely, Australia, South Korea, Saudi Arabia, France, and China have nearly 100% coverage for internet access in schools.

[9] Unified District Information System for Education (2020)
[10] Based on national data, currently, just over 55 to 59 % of Indonesian schools have some form of internet connection

Figure 8. Percentage of primary schools with access to the internet for pedagogical purposes



Source: UNESCO Institute for Statistics

Indicator 1.2.2 Higher educational institution

Several companies, e.g., Apple, Google, and IBM, do not always require a university degree for their job vacancies.[11] For several specific jobs, the companies are more interested in candidates' skills and experience. Innovation and technology development acceleration has created demand for new and more advanced skills, especially in big tech companies. This trend shows that the education systems are struggling to keep pace with technological development, generating gaps in nearly every country and industry between the skills workers have and the skills employers need. According to the Asia-Pacific Economic Cooperation (APEC) businesses' perspective survey (2018), 84% of the respondents agreed that there was a mismatch between educational training and needs in the economy and it has become their main concern. Thus, the employability and relevancy of higher education should be maintained in response to digital skills challenges in the future.

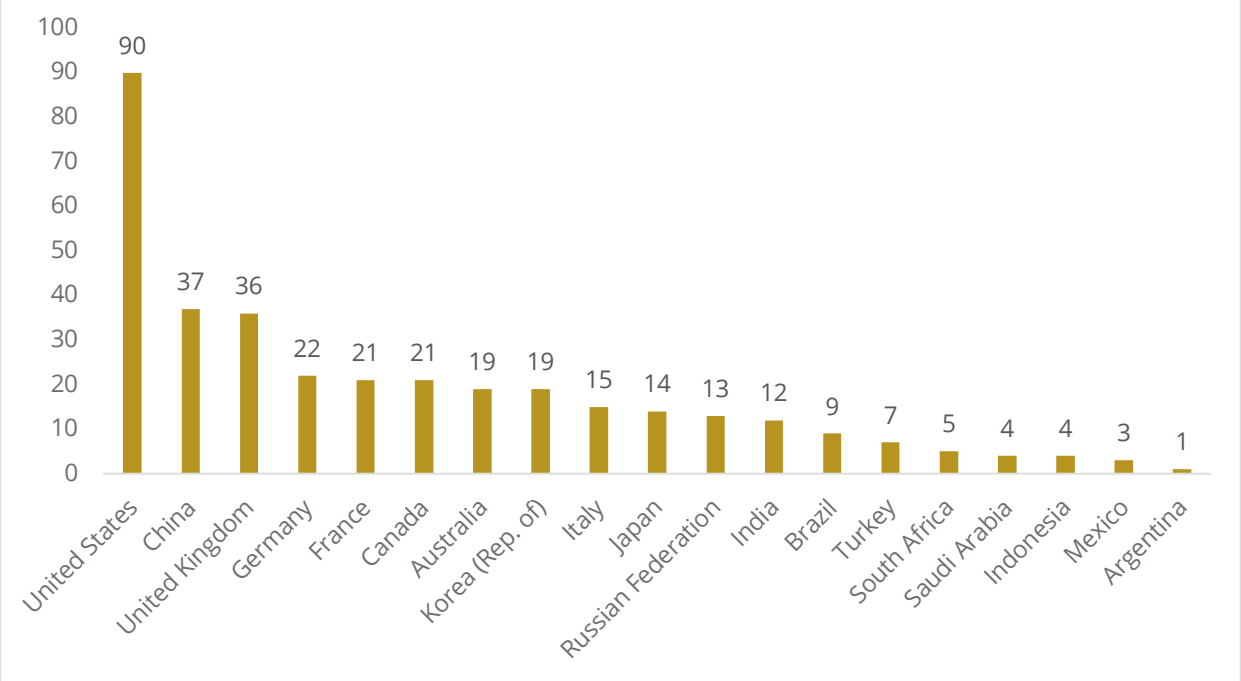
Higher education aims at equipping students with the necessary knowledge and relevant skills required to succeed after graduation. Moreover, the higher education system is also the center of excellence in producing and developing digital talent and the main driver of research and development. However, the ILO (2019) found a shortage of graduates in India and Indonesia with the specific technical and soft skills that are now required in the ICT industry. The reasons for this shortage include changes in technological trends, outdated and non-interdisciplinary education curricula, and poor instruction in

[11] https://www.cnbc.com/2018/08/16/15-companies-that-no-longer-require-employees-to-have-a-college-degree.html

mathematics, technology, and ICT in specific technical and vocational education and training (TVET) and undergraduate institutions. In addition, there is a lack of coordination between education/training institutions and other stakeholders, as already mentioned in the previous part.

This indicator measures higher education quality especially for engineering and technology. One of the rankings is the QS Top Universities that compares universities and ranks them based on several measurements such as the H-index citation, citations per paper, academic reputation, and employer reputation. Among the top 500, the United States leads the ranking with 90 universities. In other words, almost one out of five of the top-500 universities are in the US. China and the UK are in the second and third place with 37 and 36 universities, respectively. Another potential measurement is the number of STEM graduates per country. However, this indicator shows the quantity and does not reflect the higher education nor graduate quality.

Figure 9. Number of universities in the top 500 for engineering and technology



Source: QS University Ranking (2021)

Indicator 1.2.3. Patent grants by residents

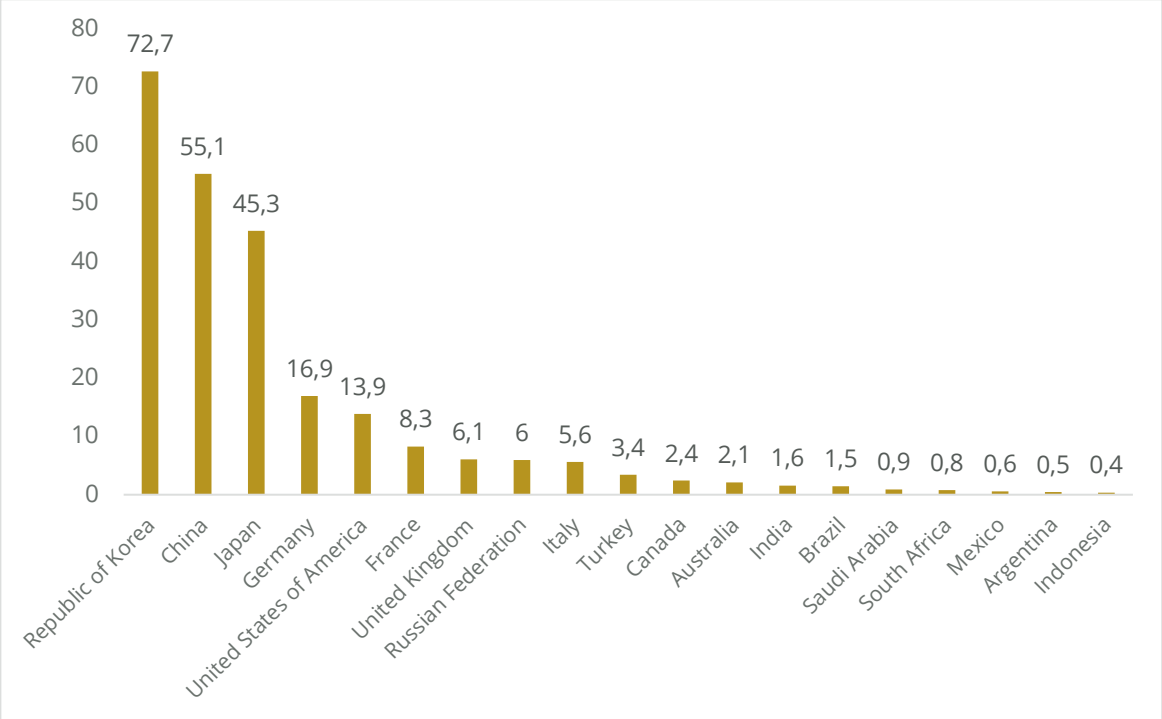
The World Development Report (World Bank, 2019) emphasizes the importance of the changing nature of work, business models, and demand for skills, as well as policy adjustment. More importantly, the equilibrium of future jobs relies on automation and innovation. Unfortunately, recent technology development brought a message of fear that automation will make labor redundant or create a jobless economy in the future. Empirical evidence shows that automation will reduce demand for less-skilled workers while the innovation process favors educated workers. However, as technology progresses, it will also create new jobs. For example, in the technology sector where

people are increasingly using smartphones or tablets, more jobs will be available for mobile app developers or software engineers. The challenge is to equip the displaced workers and the younger generation with the required skills for the new jobs in the future.

From a business perspective, several factors influence a firm's decision to invest in innovation, such as finance, human capital, innovation policy, and climate. More importantly, a country's innovation ecosystems, e.g., intellectual property rights and technology transfer, are instrumental for frontier technologies such as cloud computing, AI, and the IoT. Many of the major providers of these technologies are from the US, home to major cloud computing platforms. China is also a major producer, notably of 5G, drones and solar photovoltaic (PV). For each technology, these two countries are also responsible for 30% to 70% of patents and publications (UNCTAD, 2021).

In other words, there is a need to strengthen the science, technology, and innovation (STI) systems and industrial policies, building digital skills among students and the workforce, and closing digital divides. Therefore, it is important to include an innovation indicator, which is patents by residents from the World Intellectual Property Organization (WIPO) statistics. This indicator aims to complete the previous digital infrastructure, basic and higher education institution quality. In Figure 10, South Korea, China, and Japan lead in terms of patents/bn PPP$ GDP.

Figure 10. Number of patents by origin/bn PPP$ GDP (2019)



Source: Would Intellectual Property Organization (2020)

D. Pillar 2: Literacy

The digital divide includes not only the issues of access to connectivity but also the lack of skills and opportunities to use and understand information technology. People may be able to plug in and connect to the internet, but how effectively they can benefit from it will depend crucially on their ability to use it in a safe, secure, and productive way. Therefore, there is an imminent need to train and educate society, especially those who live in rural, remote, low-income areas, to keep up with the ever-changing technology and create an inclusive digital economic landscape.

According to UNESCO (2018), digital literacy is an ability to access, manage, understand, integrate, communicate, evaluate, and create information safely through digital technologies for employment, decent jobs, and entrepreneurship. UNESCO has developed a framework called the Digital Literacy Global Framework (DLGF) that covers six components of core digital skills namely basic operation of ICT devices, applications and the internet; information and data literacy; communication and collaboration; digital content creation; digital security and safety; and problem solving. The European Union also has a conceptual reference model published in DigComp 2.1 including five dimensions and eight proficiency levels and examples of use applied to the learning and employment field.

In 2020, Indonesia launched its National Survey of Digital Literacy to measure its digital literacy level, which is also based on the DLGF. Both frameworks are adopted in this toolkit with some adjustments and more focus on digital literacy and skills. Table 3 shows the comparison between these two frameworks.

Table 3. Digital literacy frameworks comparison

DigiComp 2.1 (European Union, 2016)	**Digital Literacy Global Framework** (UNESCO, 2018)	**Digital Literacy Index** (Indonesian Communications and Information Ministry, 2020)
1. Information 2. Communication 3. Content creation 4. Safety and protection 5. Problem solving	1. Device and software operations 2. Information and data literacy 3. Communication and collaboration 4. Safety 5. Problem solving 6. Career-related competence	1. Technology ability 2. Information and data literacy 3. Communication skills 4. Personal security 5. Device security 6. Critical thinking 7. Ethics in technology

Source: Digital Literacy Global Framework (UNESCO, 2018) and National Survey of Digital Literacy (Indonesian Information and Communications Ministry, 2020)

There are three elements in measuring the literacy pillar: 1) complementarity 2) familiarity and 3) security, which consist of a total of six indicators. These indicators will be retrieved from the surveys of individuals, which consist of self-assessment questions to reveal their digital literacy level. To further analyze the state of digital literacy in each country, the indicators will be disaggregated by gender, age groups, education background, employment status, and rural-urban to capture the inclusiveness of the digital literacy level. Table 4 shows the complete elements and indicators.

Table 4. Elements and indicators of Pillar 2

Pillar	**Pillar 2. Literacy**		
Elements	*2.1 Complementarity*	*2.2 Familiarity*	*2.3 Security*
Indicators	2.1.1 Communication and collaboration 2.1.2 Critical thinking	2.2.1 ICT familiarity 2.2.2 Data literacy	2.3.1 Device security 2.3.2 Personal security

Source: CSIS (2021)

Element 2.1: Complementarity

The complementarity element measures the ability of individuals to communicate, collaborate, and verify relevant sources of information as one of the basic literacy skills. This element is also used by all of the above-mentioned digital literacy frameworks. The first indicator, communication and collaboration, observes an individual's capacity to interact, communicate, and collaborate through digital technologies. As technology and digitalization produce faster and cheaper communication in different places, communication and collaboration skills are vital for basic digital skills.

Second, the critical thinking indicator shows the ability to fact check information and identify credible authors or sources on digital platforms. Guess et al. (2020) find that there is a limited amount of evidence on the relationship between digital media literacy and people's ability to distinguish between low- and high-quality news online. With an increasing number of information channels such as social media and news platforms that are often used to spread fake news and misinformation, a digitally literate society is expected to be able to compare and critically evaluate the credibility and reliability of sources of data, information, and digital content.

Both indicators will be evaluated by using self-assessment methods and the Likert scale to give more options based on their evaluation.

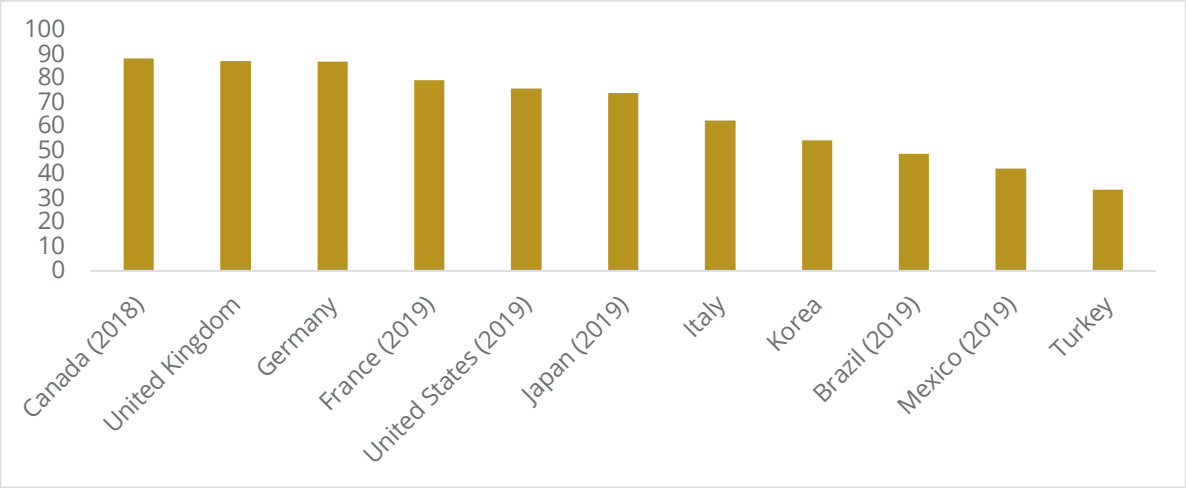
Indicator 2.1.1 Communication and collaboration

As one aspect of basic digital literacy, communication and collaboration skills are increasingly vital in daily life. According to UNESCO, communication and collaboration skills include an ability to interact through a variety of digital technologies and to understand appropriate digital communication means for a given context and to use

digital tools and technologies for collaborative processes and for co-construction and co-creation of resources and knowledge. Instant messaging for exchanging messages, cloud services for working purposes, and online platforms for video conferencing are already benefiting millions of people through easier and more affordable ways to interact with others.

Referring to the OECD ICT Access and Usage by Households and Individuals database, one of the indicators to indirectly measure communication and collaboration skill is the percentage of individuals using the internet for e-mailing for private (non-work) purposes in the last three months (Figure 11). The top-three countries are Canada (88.3%), the UK (87.4%) and Germany (87.1%). The remaining G20 members' data are not available. In Indonesia, communications activities account for 36% of average time spent online or more than other activities such as social media, leisure, and browsing (World Bank, 2021). According to the National Digital Literacy Status (2020), Indonesia scores 3.38 out of 5 in the communication and collaboration sub-index.

Figure 11. Percentage of individuals using the internet for e-mailing for private (non-work) purposes in 2020



Source: OECD (2021)

MEASURING COMMUNICATION AND COLLABORATION

Not all G20 members have a national representative survey to measure communication and collaboration skills. The most reliable way to measure people's ability to communicate and collaborate is to have a national representative test-based survey. As the second-best option, the toolkit recommends using self-assessment questions in a survey to measure this indicator. If possible, these questions should be included in a country's national survey so that it can be updated regularly. In the survey, data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups.

The statements below are examples of self-assessment questions to approach people's literacy levels in the communication and collaboration aspects such as communication through email or instant messaging and cloud services and platform-based

communication including audio and video conferencing. In addition to the ability level for each question, the range of activities also shows a higher digital literacy comprehension. Lastly, several examples of platforms and digital services providers will be given in the survey based on the country's familiarity.

Statement	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I can communicate through emails	1	2	3	4	5
I can use instant messaging or social media for exchanging messages	1	2	3	4	5
I can work with others using cloud services	1	2	3	4	5
I can make conversation (including text, audio or video calls) over the internet using platforms	1	2	3	4	5

Indicator 2.1.2 Critical thinking

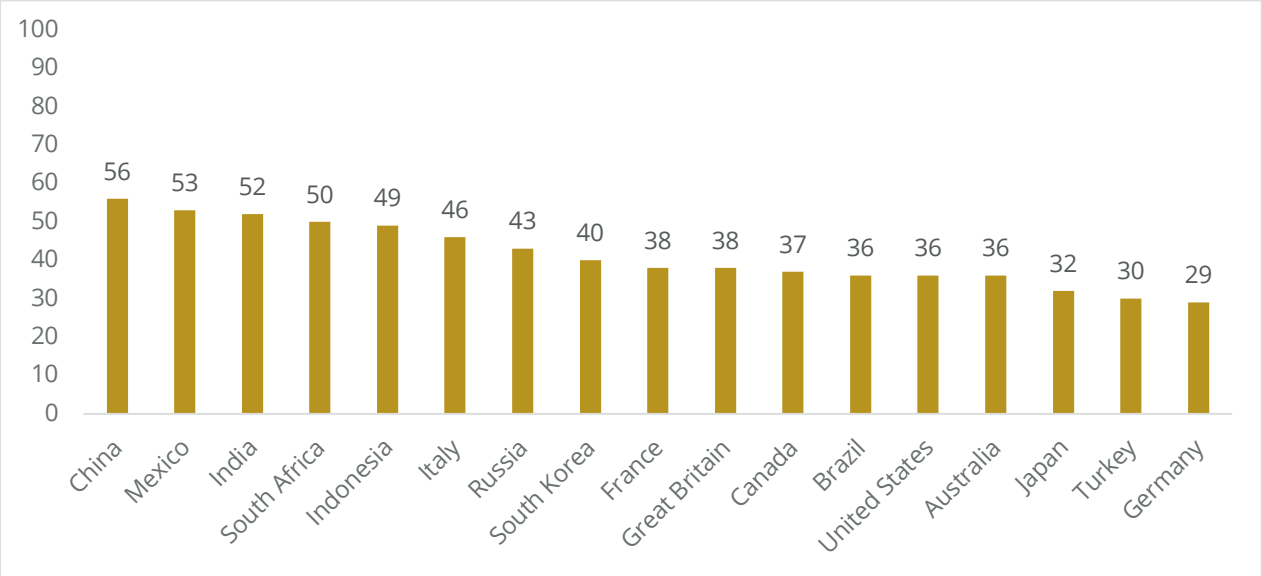
Digitalization has brought a vast amount of information from various sources. It therefore requires people to be critical with every item of information they receive from the internet. A survey by the Centre for International Governance Innovation (CIGI) in 2019 (Figure 12) shows that some countries such as China, Mexico, India, and South Africa have above 50% of respondents saying they sometimes and frequently received fake news and to have initially believed it.[12] A nationwide survey in Indonesia conducted in 2020 found that between 64% and 79% of respondents could not recognize misinformation online.[13] Moreover, amid the pandemic, researchers say at least 800 people may have died due to misinformation related to COVID-19.[14] Therefore, an improvement in critical thinking skills should be encouraged to prevent the spread of harmful fake news and misinformation.

[12] The 2019 CIGI-Ipsos Global Survey was conducted between December 21, 2018, and February 10, 2019, and involved 25,229 internet users in Australia, Brazil, Canada, China, Egypt, France, Germany, Great Britain, Hong Kong (China), India, Indonesia, Italy, Japan, Kenya, Mexico, Nigeria, Pakistan, Poland, Republic of Korea, Russia, South Africa, Sweden, Tunisia, Turkey and the United States.

[13] The survey conducted by the Communications and Information Ministry and Katadata Insight Center (KIC)

[14] https://www.ajtmh.org/view/journals/tpmd/103/4/article-p1621.xml

Figure 12. Percentage of respondents that sometimes/frequently believed in fake news initially



Source: CIGI (2020)

Fake news is perceived as more prevalent on social media and the internet than on mainstream media such as television and newspapers. In addition, a vast majority in the CIGI survey also thought that fake news is made worse by the internet and that it has had an adverse impact on their economies and political discourse. As the role of the internet and social media has become very pervasive, critical thinking skills play an important role in always rechecking and filtering the abundant information that we receive every day. The critical thinking aspect refers to the ability to analyze, compare, and critically evaluate the credibility and reliability of sources of data, information, and digital content. In general, critical thinking is important in the global knowledge economy, which is driven by information and technology. Future jobs place increasing demands on flexible intellectual skills, and the ability to analyze information and integrate diverse sources of knowledge in solving problems. Good critical thinking promotes such thinking skills and is very important in the fast-changing workplace.

There are several methods to measure critical thinking, i.e., a national representative test-based survey, knowledge-based questions, and self-assessment questions. There are advantages and disadvantages to each method, as mentioned previously. This toolkit tries to combine knowledge-based and self-assessment questions, by assessing cases of fake news. In the future, questions related to critical thinking can be considered as a part of a country's national survey so it can be updated regularly. In the survey, data disaggregation by gender, age group and rural-urban is encouraged to observe whether there is a gap between different groups.

The statements below are the combination of knowledge-based and self-assessment questions to approach people's literacy levels in critical thinking such as to see how frequently the respondent shares new sources of information, evaluates the quality of the source and their awareness of digital identity. The first four questions are the knowledge-based questions.

Statement	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
After receiving a message or seeing a post as illustrated in [*show the first example of fake news information/figure*], I immediately share it with others.	1	2	3	4	5
If I get information like [*show the first example of fake news information/figure*], I will find out where the information comes from and identify whether the source is credible or not before I share it.	1	2	3	4	5
I'm used to finding out who the author of information is to determine credibility.	1	2	3	4	5
When I talk to someone I meet online, I know how to check if their identity (name and personal information) is real	1	2	3	4	5

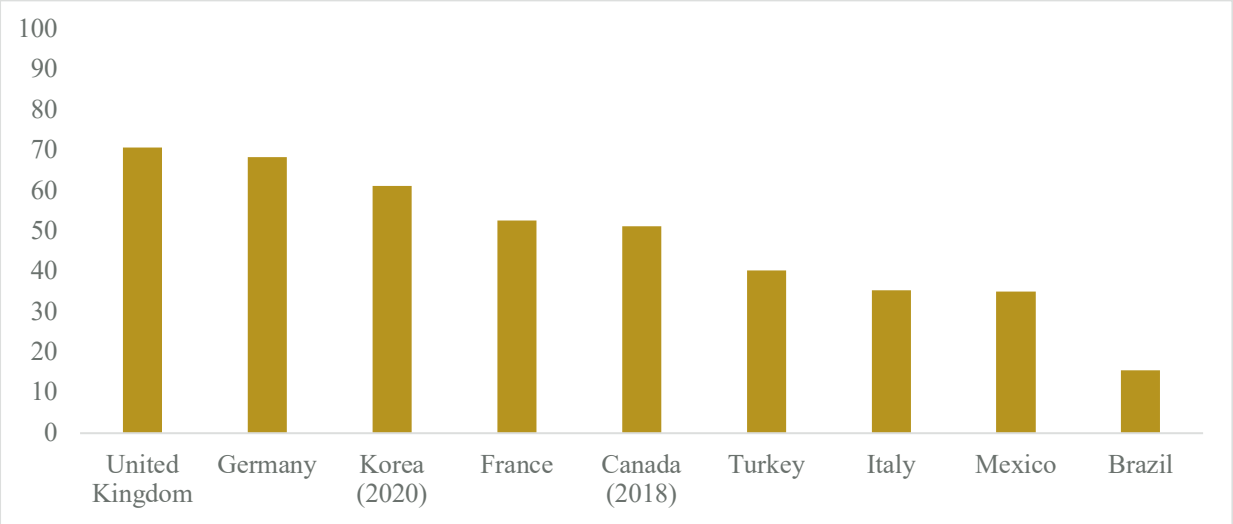
Element 2.2: Familiarity

The familiarity element conveys an individual's level of fluency in using digital technology and managing data. The ICT familiarity indicator is the first indicator that covers an individual's ability to operate basic hardware tools and technologies such as connecting to networks, downloading software/applications, and basic internet skills. The second indicator under this element is data literacy, which aims to measure individual literacy levels such as filtering and storing information, data, and other content on digital platforms. Moreover, it also captures an individual's ability to articulate information needs, to search for data, information, and content in digital environments, to access them and to navigate between them. Some questions are adopted from Van Deursen et al. (2014) and the Indonesian National Survey of Digital Literacy (2020).

Indicator 2.2.1 ICT familiarity

This indicator shows whether a person is comfortable in operating ICT devices such as Wi-Fi networks, downloading and installing applications, and browser operation as basic digital literacy for daily use. Due to a low level of digital literacy, many people may opt not to continue using technology as they cannot operate the device (Real et al., 2014). Based on OECD (2016), around one in four adults has no or only limited experience with computers or lacks confidence in their ability to use computers. From the OECD ICT Access and Usage by Households and Individuals database, one of the indicators to measure ICT familiarity is the percentage of individuals who have found, downloaded and installed software from the internet in the last 12 months. The UK has the highest proportion with 70.8% with Brazil only having 15.5% of respondents doing so (Figure 13). This striking difference supports the previous premise that governments should support more equal and inclusive digital literacy.

Figure 13. Percentage of individuals who found, downloaded, and installed software from the internet in 2019



Source: OECD (2021)

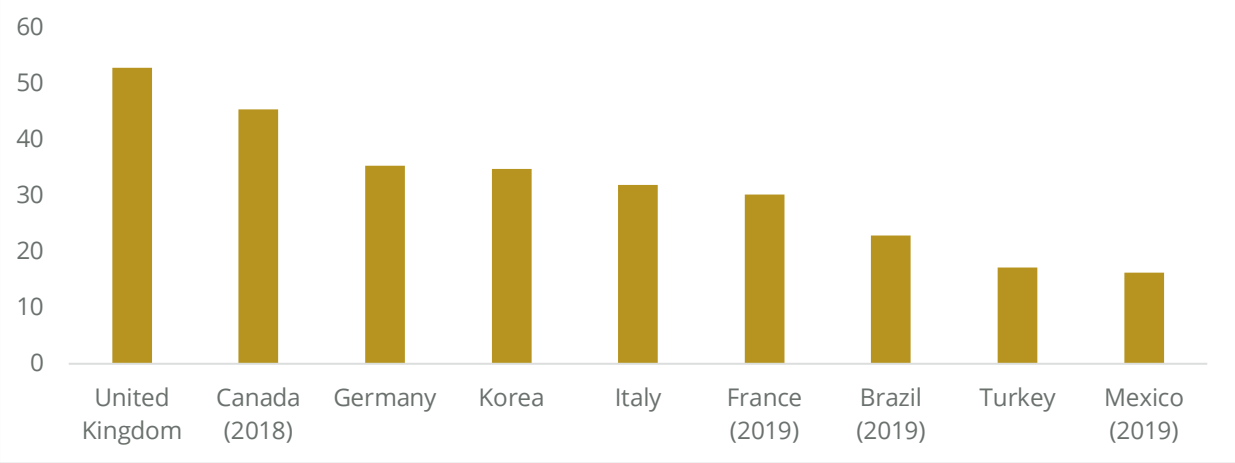
As with the previous indicators, survey questions will be used to measure the level of digital literacy by using self-assessment questions with the Likert scale from strongly disagreeing to strongly agreeing. The questions include some basic knowledge on connections (Wi-Fi and Bluetooth), downloading and installing applications, and browser operation. In the survey, data disaggregation by gender, age groups and rural-urban is encouraged to observe whether there is a gap between different groups.

Statement	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I know how to connect to a Wi-Fi network, mobile network, or Bluetooth	1	2	3	4	5
I know how to download and install apps to my mobile device	1	2	3	4	5
I know how to operate a browser (e.g. open a new tab in my browser, navigate to previous and next page when browsing, or bookmark a page on a website)	1	2	3	4	5

Indicator 2.2.2 Data literacy

Data literacy is one of the most important digital literacy components and useful not only for daily use but also for work-related tasks. A survey of more than 9,000 employees in a variety of roles found that only 21% were confident in their data literacy skills (Accenture, 2020). The OECD ICT Access and Usage by Households and Individuals dataset surveyed individuals aged 16-74 and one of the indicators related to data literacy is percentage of individuals using the internet as storage space to save files for private purposes in the last three months. The UK (53%), Canada (45.5%) and Germany (35.4%) were the G20 members with the highest proportions. The average of all countries surveyed was 41% (Figure 14). This figure is quite alarming since many developing countries are still struggling to improve their data literacy skills, which also indicates a need for bolder policy intervention.

Figure 14. Percentage of individuals using the internet as storage space to save files for private purposes in 2019



Source: OECD (2021)

The DLGF (UNESCO, 2018) defines data literacy as the ability to articulate information needs and to locate and retrieve digital data, information, and content. It also includes basic knowledge on how to store, manage and organize digital data, information and content and to organize, store and retrieve data, information and content in digital environments.

Self-assessment questions can be used to measure data literacy (UNESCO, 2018; the Indonesian Information and Communications Ministry, 2020). Ideally, a national representative test-based survey is conducted to complement the analysis. If possible, these questions should be included in a country's national survey so it can be updated regularly. Data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups. The statements below represent a respondent's online search/search engine and content/data management ability to measure their data literacy level.

Statement	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
I am aware that I can search information through online searches	1	2	3	4	5
I find it easy to decide what are the best keywords to use for online searches	1	2	3	4	5
I am able to save/store data, information, and content in digital media	1	2	3	4	5
I am able to direct/manage the search for data, information, and content according to my needs in digital media	1	2	3	4	5
I am able to upload, download or save files, and open downloaded files.	1	2	3	4	5

Element 2.3: Security

Security and safety aspects are among the most important components in the digital economy. According to the Cyber Risk Literacy and Education Index by Oliver Wyman Forum (2020), almost 95% of cybersecurity issues can be traced back to human error, such as accidentally clicking on a malicious link. Therefore, an improvement in digital literacy and awareness of personal security and privacy is expected to reduce cybersecurity threats such as identity theft and cybercrime. The total global losses due to cybercrime amount to over $1 trillion (McAfee, 2020) and are expected to increase as a result of the accelerating pace of digitalization. Therefore, basic digital literacy should consider this element to measure and track its progress in the G20 members over time. The table below exhibits the G20 members' rankings compared with 173 other ITU member states on the ITU's cybersecurity index and the top performers are the US, UK, and Saudi Arabia. Only three G20 members are not in the top 50, namely, Mexico, South Africa, and Argentina.

Table 5. 2020 Global Cybersecurity Index (GCI) Ranking

Country	Ranking
United States	1
United Kingdom	2
Saudi Arabia	2
Korea (Rep. of)	4
Russian Federation	5
Japan	7
Canada	8
France	9
India	10
Turkey	11
Australia	12
Germany	13
Brazil	18
Italy	20
Indonesia	24
China	33
Mexico	52
South Africa	59
Argentina	91

Source: ITU (2021)

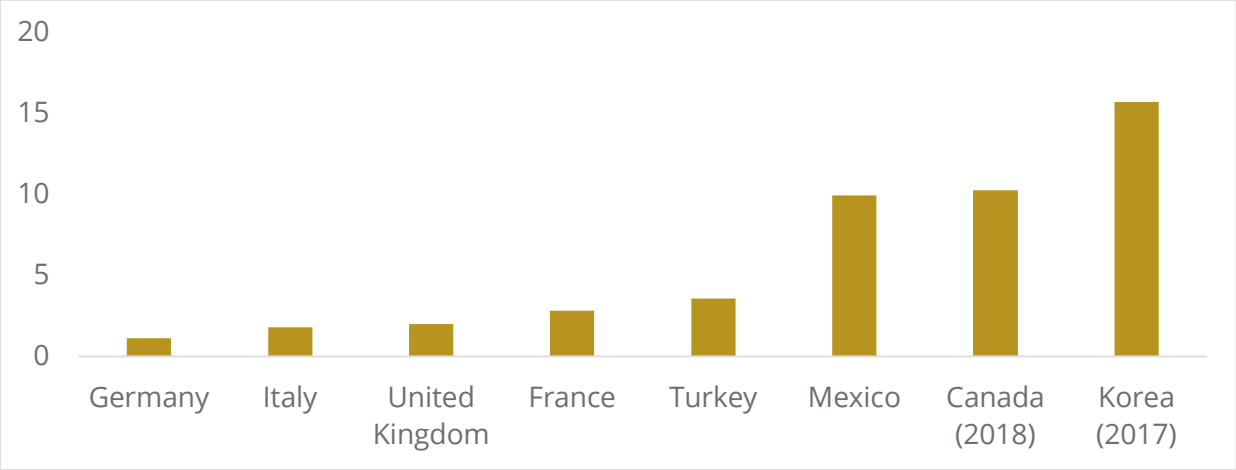
The security element in the toolkit consists of two indicators, namely, device and personal security, to measure an individual's ability to make secure passwords and identify spam/virus/malware and manage personal information on digital media. First, the device security indicator includes self-assessment questions related to protecting devices and digital content, and to understand risks and threats in digital environments, as well as to understand safety and security measures and to have due regard to reliability and privacy. The second indicator, which is personal security, shows how to protect personal data and privacy in digital environments. Moreover, the indicator also helps to understand how to use and share personally identifiable information while being able to protect oneself and others from harm.

Indicator 2.3.1 Device security

This indicator measures the ability to protect devices and digital content and to understand risks and threats in digital environments. For example, to check whether the respondents are aware about their password strength. In using digital platforms such as e-commerce, digital financial services, and social media, the ability to manage and protect devices is important since it is the key channel to personal security. Therefore, basic knowledge about how to create a strong password and how to use two-factor authentication should be beneficial to reduce cybersecurity threats.

The OECD ICT Access and Usage by Households and Individuals database provides one of the indicators to measure device security, which is the proportion of individuals who caught a virus or other computer infection, with impacts, in the previous three months. In 2019, an average 2.9% of respondents claimed that they had a computer infection. Korea, Canada, and Mexico were the highest among G20 members (Figure 15).

Figure 15. Individuals having caught a virus or other computer infection, with impacts



Source: OECD (2021)

In the knowledge-based and self-assessment questions below, there are questions on passwords, back-up, virus/malware, and two-factor authentication. In the survey, data disaggregation by gender, age group and rural-urban is encouraged to observe whether there is a gap between different groups. The statements below are the combination of knowledge-based and self-assessment questions to assess people's literacy levels in regard to device security, such as a respondent's knowledge about password and other security measures. Additionally, the toolkit also uses self-assessment questions in a survey to measure this indicator.

Statement	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
1234abcd is a secure password	1	2	3	4	5
[respondent's birth date][respondent's name] is a secure password. For example, Nesia is born on August 17 1945 so her password will be **19450817nesia**	1	2	3	4	5
21_d61tal is a secure password	1	2	3	4	5
I am used to creating and frequently changing secure passwords with a combination of numbers, letters, and special characters	1	2	3	4	5
I back up my data using a memory card, hard disk, or cloud (e.g. OneDrive, Google Drive, or Dropbox)	1	2	3	4	5
I am aware of the threat (virus, malware) to my devices (hand phone, computer).	1	2	3	4	5
I use two-factor authentication (two-step verification) for at least one of my accounts	1	2	3	4	5

Indicator 2.3.2 Personal security

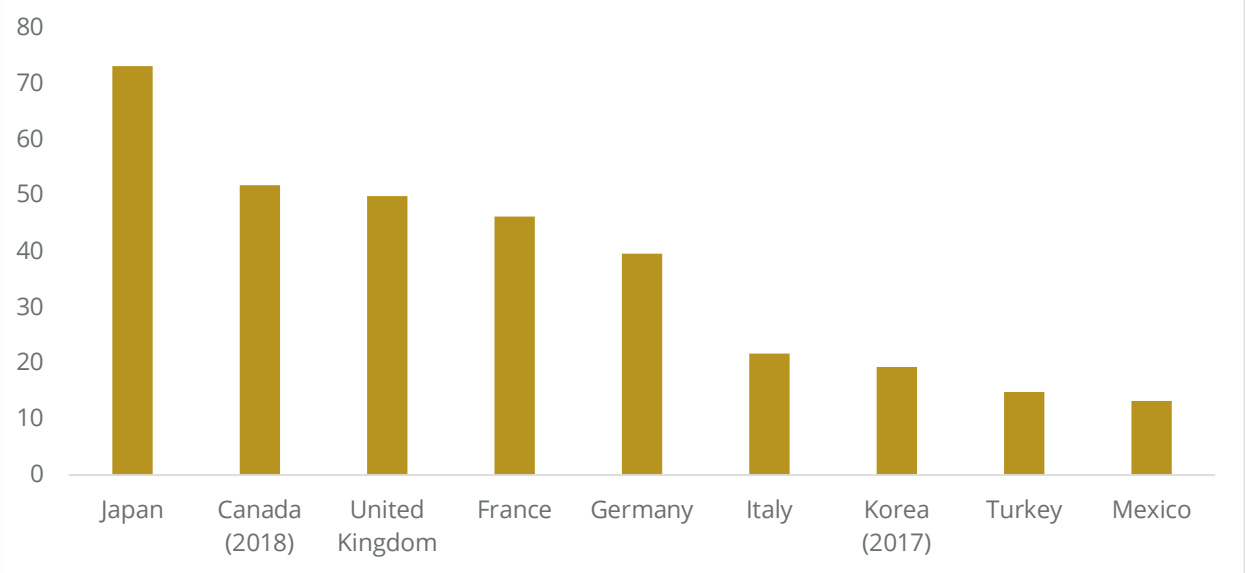
Being digitally literate in regard to communication and security awareness is important to protect personal data and privacy in digital environments, to understand how to use and share personally identifiable information while being able to protect oneself and others from harm, and in amplifying the opportunities and reducing the risks in e-commerce platform participation.

One indicator is the proportion of individuals who have experienced security incidents in the last three months from the OECD ICT Access and Usage by Households and Individuals database. A security incident is defined as catching a virus or other computer infection (e.g. worm or Trojan) resulting in a loss of information, time, or device damage, abuse of personal information sent on the internet and/or other privacy violations (e.g.

abuse of pictures, videos, personal data uploaded on community websites), financial loss as a result of receiving fraudulent messages (phishing) or getting redirected to fake websites asking for personal information (pharming) and financial loss due to fraudulent payment (credit or debit) card use.

From Figure 16, Japan, Canada, and the UK are the countries with highest proportion of people who have experienced security incidents in the previous three months with around 50% or more. This is also related to those countries' internet penetration since the more internet users a country has the higher the security risk exposure.

Figure 16. Percentage of individuals who have experienced security incidents



Source: OECD (2021)

Using an individual survey, this indicator can be measured in this toolkit by several self-assessment questions. In the future, these questions can be included in a country's national survey so it can be updated regularly. Data disaggregation by gender, age group, and rural-urban is also encouraged to observe whether there is a gap between different groups. The statements below represent respondents' privacy settings with regard to personal and location data feature sharing.

Statement	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
On social media accounts, I am able to control who can see my posts (timeline)	1	2	3	4	5
I don't upload personal data such as date of birth, address, phone number, ID number, or any information related to an identified or identifiable individual on social media	1	2	3	4	5
I can disable the option to show my geographic/GPS position in mobile apps (Facebook, Instagram, etc.)	1	2	3	4	5
I know how to report abuse on social networks if there are posts that contain negative content or are detrimental to me	1	2	3	4	5

E. Pillar 3: Empowerment

From the previous pillar, the toolkit emphasizes that an adequate level of digital literacy is important for society to take full advantage of the pervasiveness of digital technology. The G20 toolkit for measuring the digital economy in 2018 utilizes indicators related to empowering society such as technology usage, e-government, financial inclusion, and education in the digital era. These indicators have paved the path for developing digital skill toolkit indicators especially for the empowerment pillar.

In this toolkit, the empowerment pillar represents the operationalization of digital literacy and skills, which is shown by individuals' involvement in digital-related activities. The concept of a digital platform as representation of the sharing or collaborative economy serves as a framework in this pillar. Botsman (2015) defined the sharing economy as "an economic system of decentralized networks and marketplaces that unlocks the value of underused assets by matching needs and haves, in ways that bypass traditional middlemen". Uber, as one of the pioneers of the sharing economy in the transportation sector, has already accumulated 93 million customers and 3.5 million drivers serve the growing user base available in 10,000 cities across 71 countries to date.[15]

There are three main participants in a digital platform: users, providers, and the platform as intermediaries. Quite often a platform provider also acts as an intermediary as well. Then there are sellers of goods/services and buyers of goods and services. For example, a fintech company is a platform provider, as well as an intermediary and the lenders and borrowers are users. The empowerment pillar focuses on two elements, which are referred to the people-participatory dimension that can reflect digital skill development, i.e. 1) user/consumer and 2) provider/seller. The indicator for each element consists of various digital activities such as financial services, e-commerce, marketplaces, social media and e-learning platforms. The indicators in both elements consist of self-assessment questions on the intensity level and variety of digital activities.

Table 6. Elements and indicators of Pillar 3

Pillar	**Pillar 3: Empowerment**	
Elements	*3.1 User/Consumer*	*3.2 Provider/Seller*
Indicators	3.1.1 Digital finance user 3.1.2 E-commerce consumer 3.1.3 Marketplace user 3.1.4 E-learning user	3.2.1 Digital finance provider 3.2.2 E-commerce seller 3.2.3 Marketplace provider 3.2.4 Social media 3.2.5 E-learning provider

[15] https://investor.uber.com/home/default.aspx

Element 3.1: User/consumer

In terms of digital skills, the user/consumer is the key to unlocking digital economic potential, for example, in the context of empowering the community, digital literacy that is reflected in the frequency of internet use. A study by Livingstone & Helsper (2007) found that there is a correlation between the frequency of using technology and seizing online opportunities among young people. As already mentioned, the survey for this toolkit will use self-assessment questions to measure the digital skills level of users/consumers in digital activities. Four consumer activities will be discussed, namely, financial services, e-commerce, marketplaces, and e-learning platforms.

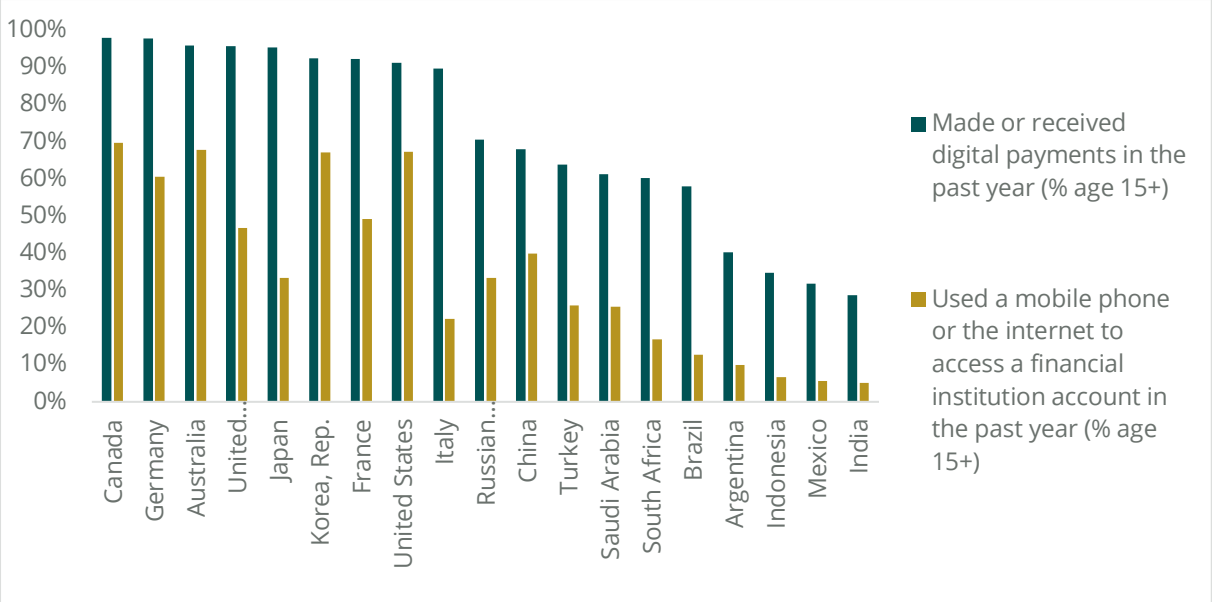
Indicator 3.1.1 Digital financial services

One of the important indicators is the level of digital financial service literacy that can be used to measure financial inclusion. There is already an agreement on "High-Level Principles on National Strategies for Financial Education" endorsed in the 2012 G20 forum. For Indonesia, this is very important since, as a study reveals, there is a gender gap in digital readiness which, if not addressed, may lead to future gender gaps in financial inclusion (Moorena, Setiabudi and Schaner, 2020). According to Morgan, Huang, and Trinh (2019), digital financial literacy includes knowledge of, and capability includes awareness of, the products, potential benefits and their risk. These products and services generally fall into four major categories:

i. Payments: Electronic money, mobile phone wallets, crypto assets, remittance services;
ii. Asset management: Internet banking, online brokers, robo advisors, crypto asset trading, personal financial management, mobile trading;
iii. Alternative finance: Crowdfunding, peer-to-peer (P2P) lending, online balance sheet lending, invoice and supply chain finance, etc.; and
iv. Others: Internet-based insurance services, etc.

Figure 17 shows two key indicators on the Global Findex Database that aim at tracking the world's financial inclusiveness. The first one is the percentage of population over the age of 15 that used a mobile phone or the internet to access a financial institution account in the past year. The second indicator is the percentage of population aged 15 and above that made or received digital payments in the past year. Among the G20 members, Canada has the highest number for both indicators. Around two out of three people in that country conduct financial transactions digitally. On the other hand, digital financial services are accessible only by a limited number of people in India, Mexico, and Indonesia. Fewer than 40% of people in these three countries are making/receiving digital payments and fewer than 10% of them can access their account digitally. This has left a window of digital opportunity to empower unbanked communities.

Figure 17. Financial inclusion indicators



Source: Global Findex Database (World Bank, 2017)

To identify the gap, it is important to develop standardized measures and start with digital financial services usage to approach the level of digital literacy and skills in a country. The digital skills toolkit can be a starting point to further analyze digital skills and financial behavior of the population. In the survey, self-assessment questions will be used and disaggregated by gender, age group and rural-urban to observe whether there is a gap between different groups. Three activities will be observed in the survey, i.e., internet banking; e-wallets; and finance and investment based on the respondents' usage intensity. Apart from the scale of intensity, a variety of activities also reflect the digital skills level in this financial services indicator.

	How often do you do this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I use internet/mobile banking	[99]	[1]	[2]	[3]	[4]	[5]
I use an e-wallet for transactions	[99]	[1]	[2]	[3]	[4]	[5]
I invest or trade financial products through an online platform	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

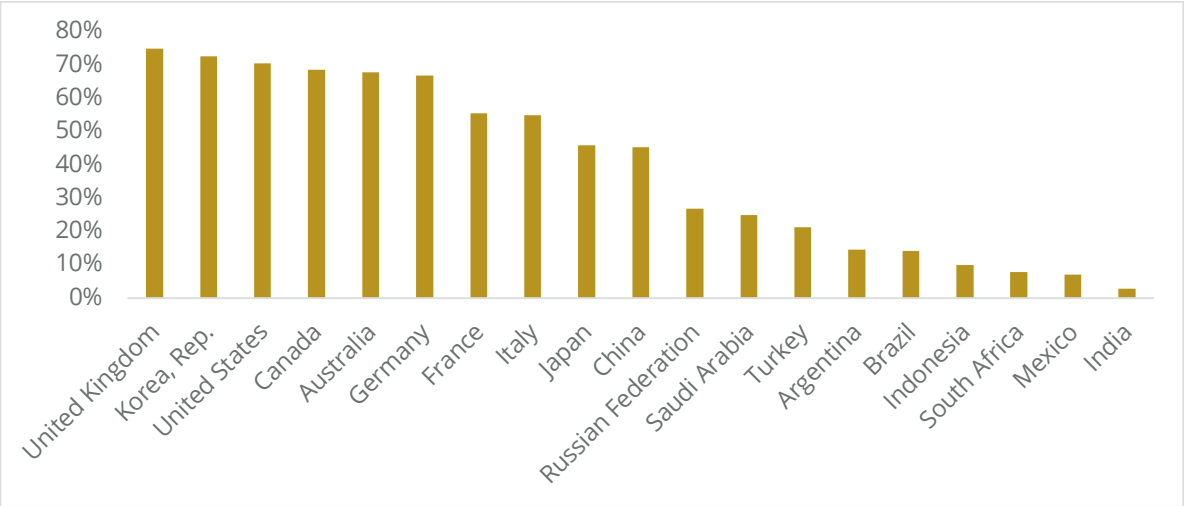
Indicator 3.1.2 E-commerce

The increasing use of e-commerce has provided substantial benefits for consumers. A greater variety of products, time saving, and lower transaction costs are some of the advantages of e-commerce from the consumer perspective. Due to the pandemic, e-

commerce users have surged in response to lockdowns and mobility restrictions. Among the G20 members, the difference in e-commerce users is huge. The extent to which people shop online ranges from 3% in India to 87% in the UK (UNCTAD, 2021). Some of the biggest e-commerce platforms are Alibaba, Amazon, Rakuten and eBay.

According to the Global Findex Database (2017), people in the UK, South Korea, and the US are the most exposed to e-commerce where more than 70% of their populations use the internet to buy online. On the other hand, the proportion of people who purchased something online in South Africa, Mexico, and India is still below 10% (Figure 18).

Figure 18. Use of internet to purchase online in the past year (% age 15+)



Source: Global Findex Database (World Bank, 2017)

E-commerce users should have basic knowledge regarding online transactions/payment, communicating with sellers, and tracking deliveries. Therefore, it is important for the users to be equipped with sufficient digital literacy and skills to optimize the benefits of e-commerce platforms. The survey approaches the level of digital skills in this indicator by asking how often respondents' use e-commerce platforms. More frequent use indicates a higher level of digital literacy in e-commerce. In addition, this indicator will be disaggregated by gender and age groups to capture additional insights about the degree of inclusivity.

	How often do you do this activity?					
	Don't Know	Never	Once	Monthly	Weekly	Daily
I buy goods and services using e-commerce platforms	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

Which of method of payment do you mostly use?	[1] Cash on delivery [2] E-wallet [3] Debit/online transfer [4] ATM transfer [5] Credit card [6] Agent [7] Others, (specify) _____

Indicator 3.1.3 Marketplaces

From the consumer perspective, one of the most important benefits of an online marketplace is to reduce asymmetric information in the market through technology. Through the marketplace, the consumer saves more time and has a greater variety of goods/services. The review and rating system also gives more information about the quality of goods and services.

Digital literacy and skills open more opportunities to utilize these platforms. For example, ride-hailing platforms have substantially improved the efficiency of consumers' mobility. A study by Cohen et al (2016) of Uber, using almost 50 million individual level observations and a regression discontinuity design, estimated that the UberX service generated about $2.9 billion in consumer surplus in four US cities. Additionally, for each dollar spent by consumers, about $1.60 of consumer surplus was generated. In Indonesia, a report estimated that Grab technology contributed around Rp 46.14 trillion in consumer surplus for the Greater Jakarta region in 2018. The consumer surplus obtained by GrabBike consumers was Rp 5.73 trillion, while GrabCar contributed Rp 40.41 trillion (CSIS & Tenggara Strategics, 2019).

To measure digital skills in using marketplace platforms, the survey is looking at the frequency of each activity in relation to the marketplace. The questions focus on five digital platform-based activities, namely, job platform; ride-hailing; accommodation; food/groceries; and health. In the survey, data disaggregation by gender, age group and rural-urban is encouraged to observe whether there is a gap between different groups.

	How often do you do this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I use ride-hailing platforms as a customer	[99]	[1]	[2]	[3]	[4]	[5]
I order food and groceries through digital platforms	[99]	[1]	[2]	[3]	[4]	[5]
I use online job platforms to find or apply for a job	[99]	[1]	[2]	[3]	[4]	[5]
I get consultations through health-tech platforms	[99]	[1]	[2]	[3]	[4]	[5]
I rented my accommodation (house or apartment) through an online platform	[99]	[1]	[2]	[3]	[4]	[5]

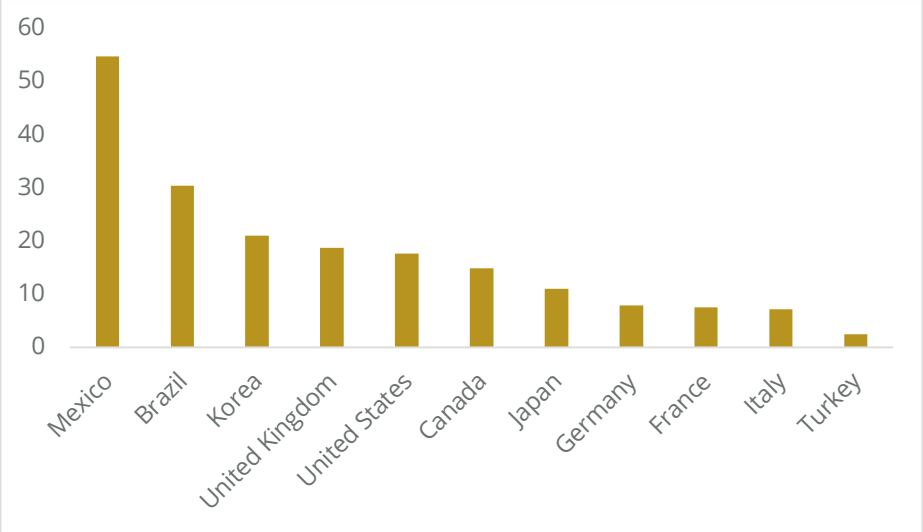
Note: the survey questions include several examples of top digital platforms in the country

Indicator 3.1.4 E-learning

According to the OECD, online learning (often referred to as e-learning) refers to the use of digital materials to support learning. Some of the benefits of e-learning are accessibility, scalability, and affordability. However, these benefits come with requisite conditions i.e., good computer or mobile devices and reliable internet access to ensure the quality of the learning process. Due to school closures and mobility restrictions, e-learning and education technology platform use has increased rapidly since the pandemic.

The notable e-learning platforms are EdX, Coursera, Udemy, and Khan Academy provide free and paid-for courses. These marketplaces provide a wide range of services from self e-learning and interactive learning to assignment/test preparation. Distance learning is delivered primarily over the internet, combining social media and web 2.0 services for a collaborative and personalized learning experience, anywhere and anytime via desktop and mobile computing devices. Many universities also participate in these platforms and additionally, by using recent technology such as Massive Open Online Courses (MOOC), a university can also provide on-demand courses, degrees or certificates for retraining mid-career employees. Figure 19 depicts the percentage of individuals using the internet for online courses in any subject in the last three months in several G20 members.

Figure 19. Percentage of individuals using the internet for online courses in any subject



Source: OECD (2021)

To measure the digital skills in regard to e-learning platforms, the toolkit approaches this indicator using two self-assessment questions, i.e., free and paid-for e-learning courses. This indicator can also be analyzed based on the individuals' digital literacy level. The premise is that digitally literate people will tend to use e-learning platforms. In addition, data disaggregation by gender, age group and rural-urban is encouraged to observe whether there is a gap between different groups.

	How often do you engage in this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I take free courses on online learning platforms	[99]	[1]	[2]	[3]	[4]	[5]
I take paid-for courses on online learning platforms	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

Element 3.2: Provider/seller

The core business idea of the digital platform involves unlocking the value of unused or underutilized assets. With a proper level of digital literacy and skills, a massive opportunity for potential income and jobs will be created. For instances, the exponential increase in e-commerce and peer-to-peer lending has created new jobs, businesses, and income-earning opportunities, which have the potential to boost household income, lift

people out of poverty, and increase the resilience of rural communities. The key is how to equip society with adequate digital literacy and skills to seize this potential.

Having the essential know-how to use digital media effectively and efficiently is indeed a precondition for benefiting from what the internet has to offer. At the same time, it is a precondition for protection from the harms or negative consequences of the internet. According to PricewaterhouseCoopers's (PWC) 2016 survey of ride-sharing platforms, 8% participate as 'users' and only 1% as 'producers'. In the case of home-sharing, the figures are 6% and 1.4%, respectively. In other words, it is harder to participate as a provider in a sharing economy and one of the reasons is that it requires a higher skill level, especially digital skills. For example, to be a seller on an e-commerce platform, one needs a comprehensive knowledge of products, digital payments, digital marketing, and logistics. In addition, digital literacy in regard to data literacy and personal security are also important.

As with the previous element, the provider/seller element covers five digital platform-based activities, i.e., financial services, e-commerce, marketplaces, social media and e-learning. To measure the individual digital skills level, the toolkit uses self-assessment questions on the intensity/frequency of each digital empowerment activity.

Indicator 3.2.1 Digital financial services

Digital financial services open an opportunity to reduce or eliminate financial constraints and gain investment returns. For example, equity crowdfunding could provide an important additional channel of capital to an entrepreneur who lacks access to sufficient capital. A study by the University of Indonesia shows person-to-person (P2P) lending helps SMEs to scale up their business, eventually helping them to qualify for larger bank loans in Indonesia. Online sellers that borrowed from P2P lending platforms were able to increase their income by four times higher than the initial average income.[16]

To measure digital skills in e-learning platforms, the toolkit approaches this indicator using three self-assessed questions: personal credit, business credit, and investment. This indicator can also be analyzed based on the information on individual digital literacy levels. In addition, data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups.

[16] https://www.feb.ui.ac.id/blog/2020/07/04/lembaga-demografi-feb-ui-diseminasi-hasil-penelitian-fintech/

	How often do you engage in this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I receive credit for personal purposes from online platforms	[99]	[1]	[2]	[3]	[4]	[5]
I receive credit for business purposes from online platforms	[99]	[1]	[2]	[3]	[4]	[5]
I offer loans through peer-to-peer lending platforms	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

Indicator 3.2.2 E-commerce

According to Amazon's reports, 200,000 sellers worldwide had over $100,000 in sales in 2018, which increased by 12% to 225,000 in 2019. Likewise, Chinese e-commerce platform Alibaba had over 150,000 sellers in 2019. The accelerated internet penetration in the world will push the e-commerce market and transactions further. However, ICT infrastructure, digital literacy, and knowledge are among the most challenging factors that lead to low seller adoption of technology, especially in developing countries (Kotelnikov, 2007). Moreover, Jahanshahi and Zhang (2013) found that in India, security and privacy issues were the main barriers faced by sellers in adopting e-commerce. Meanwhile, a survey study of a sample of 600 firms in three big cities in Indonesia—Jakarta, Bandung, and Surabaya—found that most sellers benefited from using online platforms to sell their products. Since joining e-commerce platforms, sellers have experienced increases in sales and profits, as well as the number of consumers they can reach.

The statement below is the self-assessment question to assess people's digital skills level as e-commerce sellers. This indicator can also be analyzed based on the information on the individuals' digital literacy level. In addition, data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups.

	How often do you engage in this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I sell goods and services using e-commerce platforms	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

Indicator 3.2.3 Marketplaces

Marketplace platforms have inherent incentives to acquire low-income users both to maximize network effects and to populate the service providers' side of their platforms (e.g. drivers, vendors, and other types of provider). Some platforms provide gig work or selling opportunities that can enable the poor to make significant income at sometimes large multiples of what they are able to make in other occupations for which they are qualified. A study of 99,600 Mexican Uber drivers shows that many of them were previously unemployed but then reported earning $42 to $52 per day as drivers or nine to 11 times the daily minimum wage in Mexico City (Eisenmeier, 2018). In Indonesia, a survey also found that GrabBike driver partners' average monthly incomes grew by 124% from Rp 2.1 million to Rp 4.6 million after joining Grab. In comparison, the national average minimum wage in Indonesia was Rp 2.5 million in 2019 (CSIS & Tenggara Strategics, 2019).

The questions consist of five digital platform-based activities related to job platform, ride-hailing, accommodation, food/groceries, and health. In the survey, data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups.

	How often do you engage in this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I provide ride-hailing services through platforms as a driver	[99]	[1]	[2]	[3]	[4]	[5]
I sell food and groceries through platforms	[99]	[1]	[2]	[3]	[4]	[5]
I use job platforms to advertise job vacancies	[99]	[1]	[2]	[3]	[4]	[5]
I provide health consultancy services through online platforms	[99]	[1]	[2]	[3]	[4]	[5]

I rent out the accommodation I own (house or apartment)	[99]	[1]	[2]	[3]	[4]	[5]

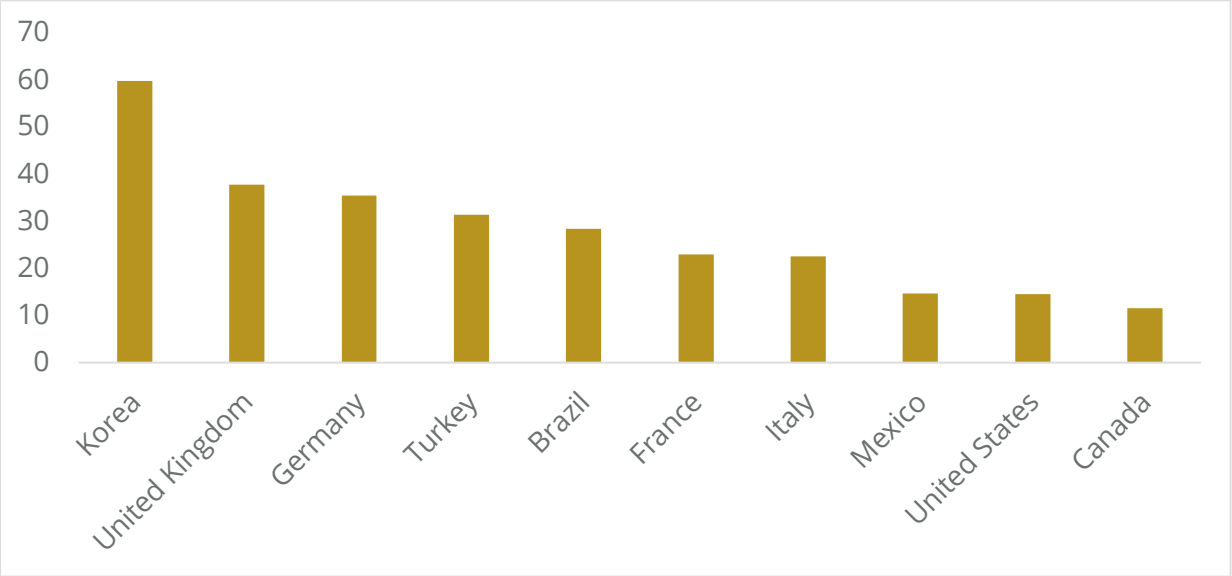
Note: the survey questions include several examples of top digital platforms in the country

Indicator 3.2.4 Content creation and social media

Content creation is an emerging digital skill nowadays along with the near-ubiquitous use of sharing websites/platforms. Digital content ranges from newsletters, digital marketing materials, and brochures, to briefs and social media. In producing high-quality content on social media, certain essential digital skills are needed such as photo/videography and editing, digital marketing, and user-engagement skills. Some of the platforms e.g., YouTube are commonly used by content creators to generate income, for example, advertising revenue, membership, and product endorsement.

From the OECD ICT Access and Usage by Households and Individuals database, one of the indicators that can be used to measure digital skills is the percentage of individuals using the internet for uploading self-created content on sharing websites in the last three months. The number gives a preliminary sense of digital skill levels in creating content especially on social media across the G20 members. South Korea is significantly more active than the rest of the group in creating digital content, accounting for almost 60%. From a different survey, in Indonesia, around 81% of internet-using adults reported knowing how to compose and upload media (video, photos, etc.) on the internet (World Bank, 2021).

Figure 20. Percentage of individuals using the internet for uploading self-created content on sharing websites (e.g. YouTube) in 2019



Source: OECD (2021)

To measure digital skills in social media content creation, the toolkit approaches this indicator using two self-assessment questions. The first one is on selling goods/services and the second is on endorsing goods/services through social media. From this indicator, the toolkit can also reveal the relation between content creation skills and an individual's digital literacy level. Finally, data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups.

	How often do you engage in this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I create and edit graphics, photos or videos for digital content	[99]	[1]	[2]	[3]	[4]	[5]
I create digital content on social media	[99]	[1]	[2]	[3]	[4]	[5]
I sell products through social media	[99]	[1]	[2]	[3]	[4]	[5]
I endorse products/services through social media	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

Indicator 3.2.5 E-learning

This indicator captures individual digital skills in providing e-learning services. Teachers, tutors, and educators are increasingly with the trend of the e-learning and ed-tech boom. One of the reasons noted earlier is the pandemic. To participate as teachers or tutors, having a degree and experience are not sufficient. Digital literacy and skills are increasingly important for teachers/tutors to use digital platforms effectively. For example, skills in using video conferencing, online discussion platforms, communication, and collaboration.

Thus, the survey captures this e-learning indicator from the providers' perspective by using a self-assessment question. The respondent is asked whether they have been involved and been paid for providing online courses/classes. Data disaggregation by gender, age group, and rural-urban is encouraged to observe whether there is a gap between different groups.

	How often do you engage in this activity?					
	Don't Know	Never	Only Once	Monthly	Weekly	Daily
I provide paid-for classes/courses online	[99]	[1]	[2]	[3]	[4]	[5]

Note: the survey questions include several examples of top digital platforms in the country

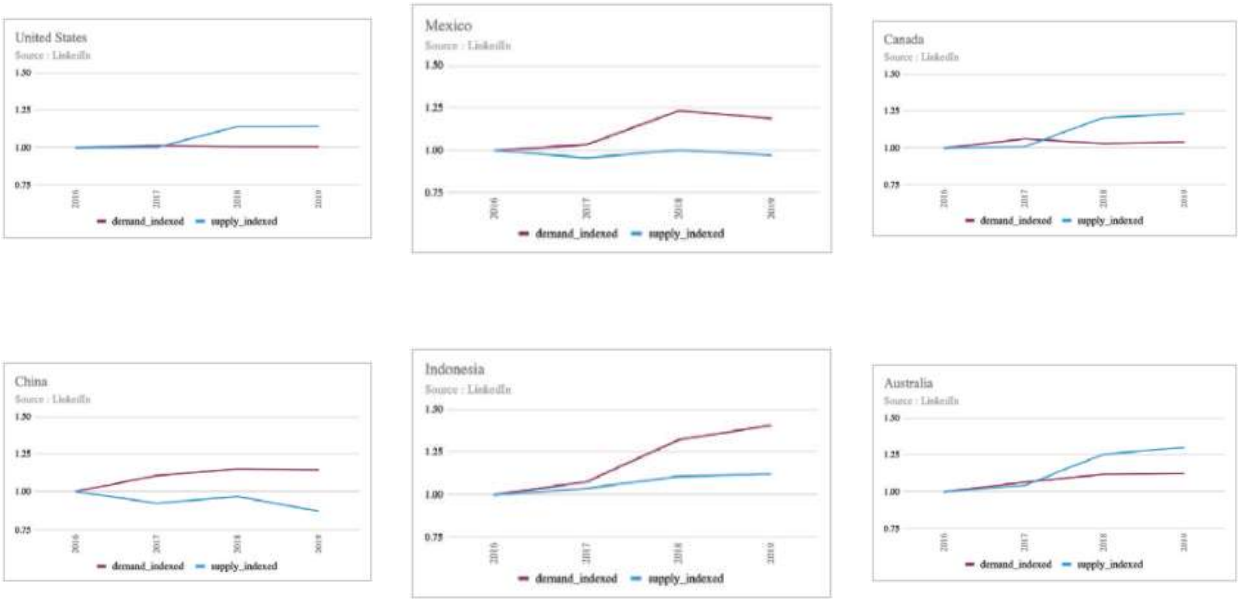
F. Pillar 4: Jobs

Pillar 4 focuses on job-related digital skills. Digitalization will create new tasks that demand new skills (Acemoglu and Autor, 2010). Thus, digital skills development should follow the digitalization progress. Digital technologies are now being used in all types of jobs, also in economic sectors not traditionally related to digitalization e.g., farming, health care, vocational training, and construction (European Commission, 2017). On the other hand, digitalization may destroy some jobs. Using the conceptual framework from Autor et al., (2003), Chang & Huynh (2016) in the ILO's study (2016) it was found that the key industries at high risk from automation in ASEAN member countries include hotels and restaurants, the wholesale and retail trade, construction, and manufacturing.

Moreover, using job-posting data to look further at the demand side of digital skills, Burning Glass and Bertelsmann-Stiftung (2020) found that the types of jobs or occupations with the highest requirement for digital skills in Germany are web developers, web technicians, database designers, and administrators, and systems administrators. Similar results were also found by Muro et al., (2017), software developers, computer systems analysts, and financial analysts are the types of jobs with the highest need for digital skills in the US.

Possessing the knowledge related to digital skills that is needed currently and in the future will significantly assist the matching process in the labor market to close the gap between supply and demand in digital skills. APEC's study (2020) shows an increasing gap between supply and demand of digital skills in Indonesia; this conclusion is drawn from LinkedIn's database and more than 1 billion job postings. The gap arises because the increase in job postings for work requiring digital skills is not met by a similar increase in workers and prospective employees that possess these skills. This indicates that technology grows at a much faster pace than the required new digital skills. Similar patterns also occurred in China and Mexico based on LinkedIn data (Figure 21).

Figure 21. The proportion of members with digital skills (supply) and proportion of job posts requiring digital skills (demand) gap



Source: APEC (2020)

Given the above explanation, it is important for the toolkit to measure digital skills on both the supply and demand sides in order to understand the drivers of demand for digital jobs, as well as the supply of available skills to perform those jobs. It also allows an analysis of the digital skills gap for further investigation by analyzing the characteristics of digital skills required and supplied. The analysis can be conducted qualitatively and/or quantitatively from both sides, for example, most-demanded digital skills (indicator 4.1.1) can be paired with most-supplied digital skills (indicator 4.2.2.). Digital skill training indicates the need of firms to upskill or reskill their workers, which may occur for a variety of reasons, such as upskilling due to new technological developments. The findings can provide recommendations for a government to map and develop specific training or education for digital skills needed by businesses. This pillar is important in providing a connection between supply and demand for digital skills and occupation-level analysis and is a novel aspect of the toolkit.

In some literature, discussions on the effects of digital technology on the labor market are usually carried out at the sectoral and occupation levels. This strategy is reasonable given that it is easier to implement and simplify. This toolkit adopts the sectoral and occupation levels in analyzing both demand for and supply of digital skills. The jobs pillar consists of two elements to be measured using a number of indicators (see Table 6). The indicators will be retrieved from various sources of data. Most indicators of the demand for digital skills are from the firm-level survey and the supply of digital skills indicators come from the individual survey. Some indicators also use secondary data such as national statistics and job platform data. The analysis of indicators in this pillar can be expanded based on firm size, firm ownership, and sector, as digitalization is correlated with various business backgrounds and needs.

Table 7. Elements and indicators of Pillar 4

Pillar	**Jobs**	
Elements	*4.1 Demand for Digital Skills*	*4.2 Supply of Digital Skills*
Number of Indicators	4.1.1 Most-demanded digital skills 4.1.2 Firm digital skill training 4.1.3 Most digital occupations 4.1.4 Degree of automation and degree of remote working	4.2.1 Proportion of workers who use internet at work 4.2.2 Most-supplied digital skills 4.2.3 Job-related digital skills level 4.2.4 Digital skills training

Source: CSIS (2021)

In this pillar, occupations are classified based on the International Standard Classification of Occupations (ISCO), which match with the most-demanded occupations in the job platforms data. The toolkit also accommodates for broad categorization of occupation (including popular occupations outside the digital skills), for example: managing director - chief executive, and commercial sales representative. Beblavy et al. (2016) studied the demand for digital skills in the US using a sample of about 2 million job vacancies. They found that 35% of vacancies request one or more IT skills. Moreover, demand for IT skills ranges from rare to universal, depending on the occupation. Alternatively, this toolkit allows for specific categories of digital skills only for relevant digital skills, such as software developer and AI. But the variation of digital skill level among those occupations cannot be captured.

This toolkit adopted UNESCO (2018) and ITU (2018) definitions of skill level and cover basic, intermediate, and advanced skills for work. This toolkit adopts O*NET to define the tasks, so they are comparable across countries. The tasks are classified by specific work activities that can be unique for each occupation (O*NET Online, 2021). Some popular examples or software can be added, so the firms or individuals easily understand the questionnaire. The complete list of tasks is available in Appendix 3.

Element 4.1: Demand for digital skills

The World Bank (2021) asserted that digital skills (such as programming, technology design, and system analysis) were among the 10 least in-demand skills in Indonesia, since these skills were not the most required in the World Bank study's sample of occupations (Indotask). It also shows that efforts to adopt technology are not widespread or can only be observed in limited specific occupations; hence, they do not stand out in an aggregate result. This is interesting because these digital skills, which we believe are critical for

technological adoption and readiness for Industry 4.0, are usually more in demand in growing sectors.

McKinsey (2018) predicted that demand for technological skills will increase 60% in hours worked from 2016 to 2030. Meanwhile, demand for physical and manual skills and basic cognitive skills will decline by 11% and 14%, respectively. Burning Glass Technologies (2021) found that more than eight in 10 middle-skill jobs (82%) in the US currently require digital skills, a 4% increase since 2014. The growing need for digital skills is quite versatile and can be applied to several sectors. If a job wants to adopt digital technology, it requires workers with certain digital skills. This can also be used as an indicator of the development of labor demand in the future.

The shape of demand for digital skills in each country differs depending on their current economic condition, economic structure, innovation policy, and demography. A closer look at the more-advanced digital skills is needed to address this problem. Hence, this needs to be addressed in the toolkit survey.

Indicator 4.1.1 Most-demanded digital skills

The most in-demand occupations indicate that companies are gravitating toward talent with certain levels of digital skills. There are several sources of this indicator, including job platform data (such as: LinkedIn), and business surveys. It is measured at country and occupational levels.

For the job platform data, according to Indeed (2021), top skills in demand in the US are cloud computing and AI. Indeed, the digital transformation means new opportunities for those new skills. Burning Glass and Bertelsmann-Stiftung (2020) studied the growth of demand for several digital skills in Germany from 2014-2018. The most significant increase in demand for digital skills was computer skills (17.3%), followed by computer programming skills (15%) and online communication tools (12.5%). The trends are similar to the trends in developing countries (such as Indonesia, see Table 7) and the global trends; the top-10 most in-demand jobs for 2021 relied heavily on digital capabilities, including software development, data analytics, digital marketing, and graphic design, WEF (2021). Moreover, the growth of most-demanded digital skill should be highlighted. Burning Glass (2017) asserts that 82% of middle-skill jobs are now digitally intensive, a 4% increase over the past two years.

Table 8. Top skills by countries in 2021, based on job platform data

Country	Top demanded digital skills
Indonesia	1. Data analytics 2. Software development 3. Digital marketing 4. Artificial intelligence 5. User experience design (UX design)
US	1. Cloud computing 2. AI

	3. Mobile app development 4. Video and audio production 5. UX design

Source: Indonesian data are from Grabjobs.com, 2021; US from Indeed, 2021.

For a firm survey, this method is more or less similar to the job platform data by identifying most-demanded digital skills from job vacancies. But the data need to be collected directly. The advantages of a firm survey are that they are more detailed and information can be tailored to the research questions. The main disadvantage is that it is more costly. On the other hand, job platform data are not available for all countries, and it depends on the job platforms whether they publish the data regularly or not. This toolkit provides the sample question for a firm survey:

Matrix II: "How important are [digital skills] to the performance of the [occupation]?"

The analysis of most-demanded digital skills can be done in the aggregate level across occupations, it can be expanded by considering various characteristics such as, business sector, enterprise scale, and required education level.

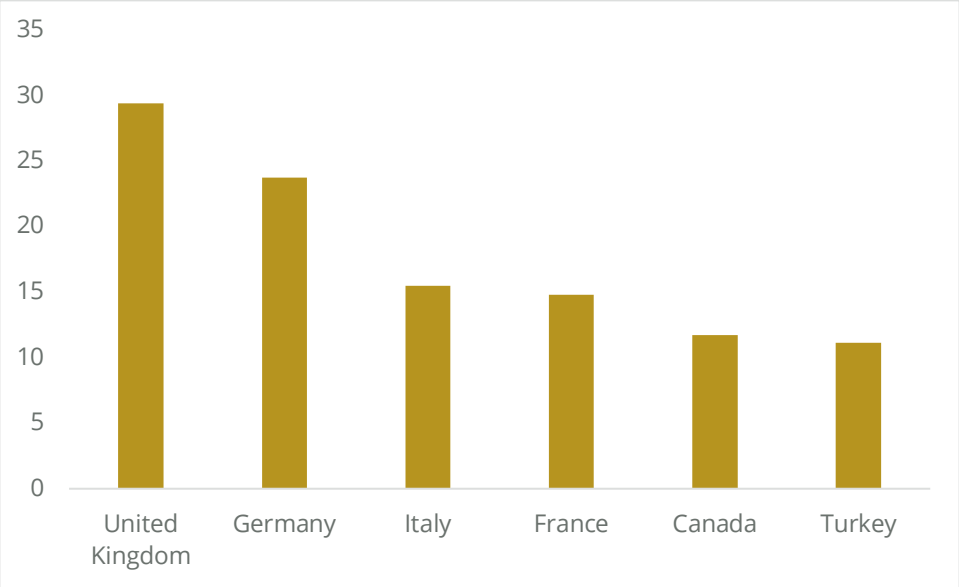
Indicator 4.1.2 Firm digital skill training

Rodríguez-Moreno and Rochina-Barrachina (2019) assert that good business practices include access to internal capital markets or to external finance; research and development and investment in training, and ICT use. These investments affect positively firms' productivity and mark-ups. Their influence on mark-ups operates, in general, through efficiency and prices. Finally, there is evidence about demand conditions to boost knowledge-related investments and mark-ups.

The OECD (2019) stated that training costs can be particularly substantial to support the transition of workers in occupations at risk of automation to better-quality for more secure jobs. Governments, along with employers and individuals, should contribute to funding these costs so as to position everyone to seize the benefits of the digital transformation. Digital skills training can be used as an indicator of the existence of a digital skills gap. There is a hypothesis that if a firm conducts digital training programs, it implies the firm needs to equip and/or upgrade its workers with required digital skills for a certain occupation. Furthermore, offering skills training is strongly correlated to better labor performance and greater organizational learning effectiveness.

Yet, according to the OECD ICT Access and Usage by Businesses database (2021), only one out of four businesses in selected OECD countries provided ICT training to their workers in the last year. The UK has the highest proportion of businesses that provided ICT training (around 30%), followed by Germany (23.7%), Italy (15.5%), and France (14.8%), as shown in Figure 22.

Figure 22. Percentage of businesses that provided training to develop ICT-related skills of employees in the previous year



Source: OECD (2021)

In addition to the OECD data above, there are several indicators to measure a firm's training, such as the company's spending on employee training and e-learning from the Industry Report published by the American Society for Training and Development (ASTD). Again, the main disadvantage of secondary data (such as the OECD and ASTD) is that data are not available for all countries. A firm survey can be used to collect the data directly with some of the advantages and disadvantages as explained previously. It is also possible to explore the causes or reasons why a firm has never held digital skills training. It is interesting to explore training providers (not only the private sector as employers but also the government), as well as the source of training funding.

These are sample questions from the firm digital training indicator:

- *Has the firm provided training related to intermediate digital skills for employees in the last three years? (Q30)*
- *Has the firm provided special training for ICT specialist workers in the last three years?*
- *How many workers received the training? (Q31)*
- *Is there a need or plan to conduct [specific digital skills training] for the type of work [specific occupation]? (Matrix IV)*
- *Why has the firm never held training related to digital skills? (Q32)*

From the questions above, indicators can be developed by considering data and more relevant indicators, for example, percentage of firms that provided ICT training; percentage of firms that provided ICT training by ownership; percentage of firms that provided ICT training by firm or business size; percentage of workers that received digital skill training; percentage of workers that received digital skill training by firm or business

size; most common digital skill training; most common digital skill training by occupation; and most common digital skill training by business sector.

Indicator 4.1.3 Most digital occupations

The focus of this indicator is on intermediate and advanced digital skills. Beblavy et al. (2016) asserted that the intermediate level can be found in medium to high skill occupations. This suggests that skills such as handling various types of MS Office software – by far the most commonly demanded skill - is an 'entry ticket' to mid- and high-level jobs. Meanwhile, advanced digital skills are not present across most occupations but limited only to a small number of jobs. Moreover, the advanced skills requested and their frequency differ significantly across different types of occupations, precluding generalization. In the meantime, Burning Glass Technology (2016) found that specific digital skills (such as Adobe Photoshop for graphic designers and computer programming and networking for IT professionals) are not solely required in the technologically intensive sector, but also in demand across all sectors of the economy; these specific digital skills are required in 28% of low-skill jobs, 56% of middle-skill jobs, and 68% of high-skill jobs.

This indicator is derived from the firm survey based on the selected occupation and digital skills tasks, in a form of a matrix. The respondents will select relevant occupations that are available in the firm and assess the importance and level of digital skills needed in each occupation. The result will be classified into intermediate and advanced digital skills.

Basic digital skills: Office suite, project management, internet search, email & e-calendar skills

Intermediate digital skills: video creation and editing, graphics / photo imaging skills, accounting and financial analysis software skills, Sales, Marketing, and CRM skills, Enterprise Resource Planning software skills, Business intelligence software skills.

Advanced digital skills: Analytical/scientific statistical software skills, Programming language skills, Application & web development skills.

Sample questions:

Matrix II
Intermediate digital skills:
How important are the skills of video creation and editing to the performance of the job/occupation of graphic and multimedia designer?
[1] Not important
[2] Of low importance
[3] Slightly important
[4] Moderately important
[5] Very important
[99] Don't know

Advanced digital skills:
How important are statistical software skills to the performance of the job/occupation of managing directors and chief?
[1] Not important
[2] Of low importance
[3] Slightly important
[4] Moderately important
[5] Very important
[99] Don't know.

Some possible indicators that can be obtained are: the digital skill classification (basic-intermediate-advanced skills) by technological adoption rate, occupation, and firm size and ownership. It is also possible to perform a more detailed analysis of ICT specialists (advanced digital skill level), in terms of the proportion of ICT specialists by sector and firm size.

Indicator 4.1.4 Degree of automation and routine task intensity

Advanced technologies require people who understand how they work and can innovate, develop, and adapt. The COVID-19 pandemic has accelerated the transition into the age of Industry 4.0. Automation is expected to contribute up to $15 trillion to global GDP by 2030. However, it has a negative effect at the same time. Automation accelerates the shift in skills that both firms and the workforce need. It is estimated that around 44% of workers with limited education will be at risk due to automation by the mid-2030s, PWC (2018).

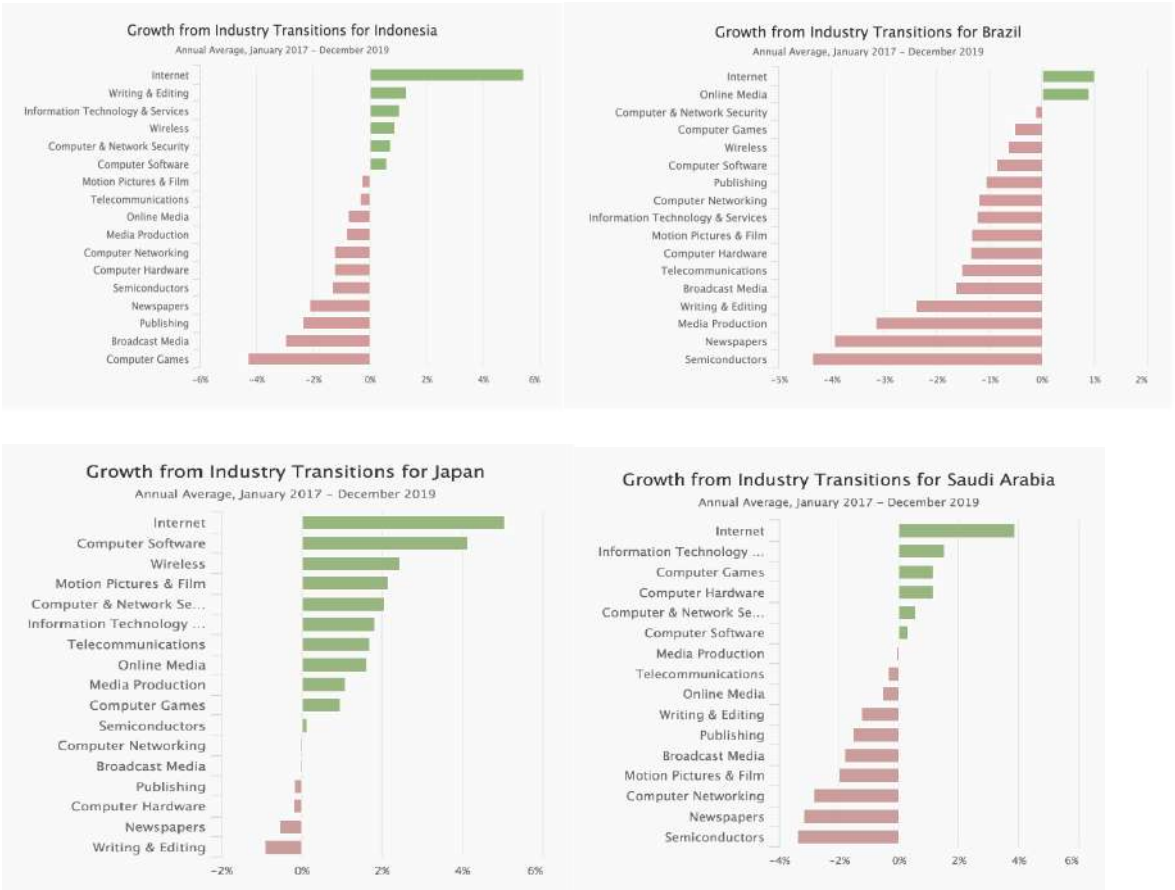
The Institute of Labor Economics (IZA) in 2019 argued that automation has led to a polarization of labor markets with a declining share of middle-paid, routine-intensive occupations and a rising share of both high- and low-paid jobs. Meanwhile, Rants (2016) highlighted that workers typically adjust to changing technological endowments by focusing on those tasks that machines cannot perform. The reason is that new technologies may substitute for certain tasks on the job, but they typically also

complement others. Targeted training and qualification measures may help workers to switch to expanding occupations and prevent rising job inequality in the future.

This indicator can be retrieved from job platform data or national labor force surveys. Data from both sources can be used to estimate the trend of job loss and job creation due to automation and digitalization. Based on the World Bank – LinkedIn database, the trend of industry employment shift, in particular the information and communication sector, is similar in developed and developing countries in 2017-2019 period. The internet is the top one, i.e., the sector that has the highest employment creation. In contrast, the newspapers sector experienced negative growth or job losses, as shown in Figure 23.

Besides that data, the firm level survey can determine the degree of automation and routine task intensity by asking relevant questions directly. A plot graph can be used to present the data.

Figure 23. Industry employment shifts in selected G20 members, 2017-2019



Source: The World Bank – LinkedIn database, 2021. Accessed from: https://linkedindata.worldbank.org/data

Sample questions:

Do you agree with these statements?

a) Most of the tasks in this position require data entry, verifying accuracy of data, or calculations.
b) Most of the tasks in this position require sorting, picking, or assembling things
c) Most of the tasks in this position require setting up, monitoring/controling, or operating machinery or equipment
d) Most of the tasks in this occupation can be done remotely (working from home)
e) Most of the tasks in this occupation can be automated (tasks can be codified/programmed) using technology available today

Answer:
1: Disagree, 2: Slightly disagree, 3: Neither agree nor disagree, 4: Slightly agree, 5: Agree; 99: Don't know.

Element 4.2: Supply of digital skills

Along with the assessment of demand, the assessment of the current supply of digital skills should also be completed. Digital technology is transforming the way people work, and the skills they need for work. It is estimated that by 2022, almost two-thirds of all jobs will require some form of secondary education or training (Alderman, 2019).

Most people currently believe that digital skills are important, and knowledge of computers is one of the keys to success for today's workers (Pew Research Center, 2016). It requires significant changes to educational systems and an increased provision of on-the-job training to maximize the benefit of digitalization. In addition, digitalization is correlated with various socioeconomic factors, including higher frequency of employing those with an academic qualification, higher salaries, and male-dominated occupations. Thus, the analysis of indicators in the toolkit can be expanded by those factors.

Indicator 4.2.1 Proportion of workers who use internet at work

The OECD survey (2016) found that more than 60% of people in the majority of OECD countries reported that they did not use the internet daily for sending emails or searching information for work-related purposes. And 24.5% of respondents did not have a computer-related task at work. Thus, the proportion of workers who use the internet at work remains an important indicator. According to Eurostat (2021), the proportion of workers using the internet increased in the EU during 2011-2020, from 43% to 56%. A similar trend occurred in other G20 members such as France, Germany, and Italy as indicated in Table 8.

Table 9. Use of computers and the internet by employees (% of total employment)

	2011	2015	2020
France	46	53	61
Germany	52	52	59
Italy	36	41	53
EU	43	48	56

Source: Eurostat, 2021
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_ci_cm_pn2&lang=en

There are several sources of data available to measure this indicator. Firstly, one of the secondary data sources is the OECD's Programme for the International Assessment of Adult Competencies (PIAAC) database, which reflects ICT task intensity of jobs (see Appendix 4). Secondly, using available national survey data such as labor force surveys. Lastly, this indicator can also be included in the individual survey.

Sample questions for the individual survey:

I work with a computer, laptop, or tablet
a. All/almost all the time: between 75% and 100% of the working time
b. Most of the time: between 50% and 74% of the working time
c. Some of the time: between 25% and 49% of the working time
d. Only a little of the time: less than 25% of the working time
e. None of the time: 0% of the working time

Do you use IT applications/software in your job? Yes/No

Indicator 4.2.2 Most-supplied digital skills

This indicator identifies digital skills most commonly found among the workforce. The routes for the supply of digital skills are mainly via education and training delivered by education or training institutions. However, the rapid development of social media such as YouTube also helps people to learn digital skills independently. As Kind and Evans (2015) asserted, engagement with social media can be done in parallel with engagement in the learning process over time, to the extent that online social networking fosters feedback and collaboration. The use of social media and online networking platforms is a key to continuously learning in today's information-sharing society. Social media development also encourages people to acquire various digital skills including video editing and content creation.

This indicator comes from an individual survey where the respondents are expected to fill the list of the digital tools or skills that will be provided. Similar to most-demanded digital skills, most-supplied digital skills can identify the top digital skill or most common skills acquired by the workforce (e.g., office suite and project management software, video creation and editing, and graphics/photo imaging, and internet search). The analysis of most-supplied digital skills can be expanded by considering an individual's educational background, gender, age category, income, industry/sector, and occupation. For example, an individual working as a financial manager must have certain digital skills to perform the job, including office suite and accounting and financial analysis. However, they may also have video creation or editing skills, not necessarily related to their job, but as a hobby.

Sample questions:

Digital Skills:
How frequently do you use office suite and project management software (Microsoft Word, Sheets, Power Point, Google Drive, SharePoint)?

a. All/almost all the time: between 75% and 100% of the working time
b. Most of the time: between 50% and 74% of the working time
c. Some of the time: between 25% and 49% of the working time
d. Only a little of the time: less than 25% of the working time
e. None of the time: 0% of the working time

How frequently do you use digital content creation in social media (Instagram, TikTok, Snapchat)?

a. All/almost all the time: between 75% and 100% of the working time
b. Most of the time: between 50% and 74% of the working time
c. Some of the time: between 25% and 49% of the working time
d. Only a little of the time: less than 25% of the working time
e. None of the time: 0% of the working time

Indicator 4.2.3 Job-related digital skills level

Based on the same information for most-supplied digital skills, the skills will be classified into basic, intermediate and advanced skills. Basic digital skills enable us to function at a minimum level in society. They are foundational skills for performing basic tasks, and there is growing consensus that basic digital functioning corresponds to foundational literacy. Intermediate level is defined as the ability to configure general digital tools to produce and consume digital content or enhance digital tools through basic programming skills. And advanced skills are those needed by specialists in ICT professions, ITU (2018).

Thus, the basic skills cover office suite and project management software, as well as internet searches, email, and e-calendar. Intermediate skills cover video creation and editing, and graphics/photo imaging; digital content creation on social media; accounting and financial analysis software; and software for sales, marketing, and CRM. Meanwhile,

advanced skills are related to ERP software; business intelligence and data analysis; analytical/scientific and statistical software; programming language for general purposes; and application and web platform development software.

The questions are similar to the most-supplied digital skills. Indicators to be explored include: proportion of individuals with intermediate digital skills (% of workforce); proportion of individuals with advanced digital skills; proportion of intermediate skills by education level/gender/occupation/age; and proportion of advanced skills by education level/gender/occupation/age.

Indicator 4.2.4 Digital skills training

As digital technology reshapes business models and firms' organization, the skills required to perform these tasks become more important. Changes in the task set associated with the increasing use of ICT tend to be larger for people in low-skilled occupations than for those in middle-skill and high-skill occupations. The need for re-skilling is likely to be larger for those people that educational and training systems have more trouble reaching (Influence and Policy, 2018). People have already realized the importance of training to perform their jobs, as Pew Research Center (2016) asserted that adults with higher levels of education see a greater need for ongoing training.

Banga and Te Velde (2019) identify the delivery channels of digital training, i.e., formal education in schools and universities or non-formal TVET, and employer-led training. Commonly, schools and non-formal TVET cover basic to intermediate digital skills levels, while employer-led training aims at the upskilling or reskilling of the workforce. Some G20 governments provide funding for digital skills, for example the government of Indonesia has launched a pre-employment card program, known as Kartu Prakerja, which aims at reskilling and upskilling the workforce. The government provides the funding and training is provided by the private sector; among the digital skills the training offers in the programs are digital marketing, video editing, and website development.

An individual survey is used to collect the information. The result produces indicators to be explored such as, proportion of individuals that have received digital skill training; proportion of individuals that have certificates of digital skill training; the proportion of sources of funding; and the proportion of online and offline training.

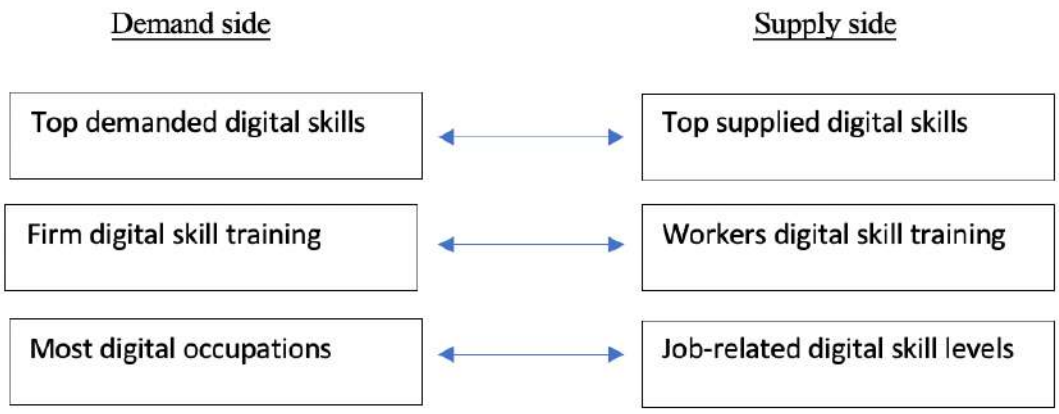
Sample questions:

1. Have you received digital skill training in the past three years?
2. Please list the digital training that you have completed
   a) Did your employer provide the training?
      - Yes, it was free
      - No, it was provided by the government for free
      - No, it was provided by a training provider (non-government) for free
      - No, I paid for it
   b) Did you receive a certificate from the training?
      - Yes, it is still valid
      - Yes, but it has already expired
      - No
   c) Was this training conducted online? Yes/No
   d) Did the training occur in the last year? Yes/No

G. Further analysis: Supply and demand for digital skills analysis

The ability of companies to harness the growth potential of new technologies might be hindered by skills shortages. Indonesia's Occupational Tasks and Skills (2020) asserts 55% of global companies worldwide state that skills gaps in local labor markets are the most important barrier to the adoption of new technologies. According to the WEF (2020), only 61% of interviewed global companies in Indonesia reported being able to find workers with the required skills to fill their vacancies, compared with 71% in China. Moreover, 22% of employers in Indonesia tried to hire workers and found it difficult to do so due to a lack of skills or applicants. Meanwhile, APEC (2020) concluded that there is an increasing gap between supply and demand of digital skills in Indonesia, China, and Mexico, as mentioned previously.

The analysis of supply and demand allows us to study the existing skills gap. A skills gap occurs when the skill levels of workers are insufficient to meet the requirements of their current job (McGuinness and Ortiz, 2015); a skills gap can be analyzed in terms of quantity and quality of skill. Furthermore, the resulting shortage will ordinarily put upward pressure on wages, thereby increasing the quantity of knowledge workers supplied while decreasing the quantity of workers demanded. In contrast to traditional economic analysis, wages are not rising, and the skilled labor shortage is not dissipating. Rather, the skills gap is growing (Whittaker and Williams, 2016). Skills gap analysis is conducted by matching supply and demand indicators, as follows:



Direct assessment of businesses can complete the analysis by assessing the difficulty in filling a certain position/occupation and whether a lack of digital skills is a constraint in hiring, the analysis can be conducted using a matrix as shown in the table below.

	Occupation	Number of samples for Occupation Analysis (N) (Total number)	Number of people needed in vacancy (Total number)	Difficulty level in hiring (1-5) (Average rate)	Applicants' lack of digital skills required as one of the constraints in hiring (On average)
1	Managing directors and chief executives	x	x	x	x
2	Financial and insurance managers	x	x	x	x
..	etc.				

Finally, another important indicator of a skills gap is wages, an expansion in the number of digital skills demanded causes digital skill shortages, which lead to wage rises. A significant increase in wages for certain occupations, relative digital skills or the relation to other occupations (not related to digital skills) may indicate a skill shortage or skills gap has occurred.

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Appendix

Appendix 1. Summary of relevant digital skills/literacy definitions

Literature	Description
UNESCO (2018)	The proposed framework that is heavily used in many studies to measure basic digital skills. UNESCO, in general, developed its framework on top of the European Commission's Digital Competence Framework for Citizens (DigComp 2.0). It defines digital literacy as the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies for employment, decent jobs, and entrepreneurship. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy, and media literacy. The Indonesian Communications and Information Ministry developed one study that implemented the UNESCO framework to measure digital literacy in Indonesia (Kominfo, 2020).
ITU (2018)	The ITU identifies three types of digital skillsets. Basic: Foundational skills for performing basic digital tasks covering hardware (computers), software (MS Office), online operations (search engines, social networks, etc.) and communication media (cellular and internet network). Intermediate: Ability to configure general digital tools to produce and consume digital content or enhance digital tools through basic programming skills (eg; knowledge of programming, spreadsheet manipulation). Advanced: Involves design and programming of new digital tools and features, from knowledge acquired through advanced formal education. Skills include those involving artificial intelligence (AI), big data, coding, cybersecurity, Internet of Things (IoT), and mobile app development usually needed by specialists in the ICT sector.
OECD (2016)	Classifies the digital skills into three clusters, which are ICT generic skills, ICT specialist skills, and ICT complementary skills. ICT generic skills stand for the skills that are effective for daily work such as using word processors, accessing websites, and communicating by e-mail. ICT specialist skills are the skills to program, develop applications, and manage networks. Lastly, ICT complementary skills are the skills to perform multiple and aggregated tasks such as problem solving, cognitive (reading, writing, and numeracy), team management, as well as collaboration skills. The report finds that ICT complementary skills are crucial as they can support ICT skills productivity hence they should be included to measure the level of effectiveness of ICT skills in certain countries.

World Bank (2020)	The framework divides digital skills into a digital competent workforce and digital literate citizens. Specifically, the digital competent workforce part includes skills for ICT professions and skills for a broad range of occupations. While digital literate citizens include the skills to leverage digital technologies and services in daily activities and the skill to facilitate learning, civic engagement, and health outcomes. It also ranks digital skills in three proficiency levels based on the ICT intensity as many non-ICT professions have started to require more specialized digital competencies. Those ranks are basic level proficiency, intermediate level proficiency, and advanced level proficiency.
European Union (2016)	DigComp 2.1 introduced eight proficiency levels and examples of use applied to the learning and employment field. The DigComp Framework has five dimensions which are 1) Competence areas identified to be part of digital competence; 2) Competence descriptors and titles that are pertinent to each area; 3) Proficiency levels for each competence; 4) Knowledge, skills, and attitudes applicable to each competence; 5) Examples of use, on the applicability of the competence to different purposes. DigComp also maps out four proficiency levels such as foundation, intermediate, advanced, highly specialized: 1. Foundation (Levels 1 and 2): Can deal with simple tasks that involve remembering content and instructions but also requires some guidance to execute 2. Intermediate (Levels 3 and 4): Can independently deal with well-defined, routine and non-routine problems that involve understanding content 3. Advanced (Levels 5 and 6): Can deal with and provide guidance to others on different tasks and problems that involve applying and evaluating content in complex situations 4. Highly specialized (Levels 7 and 8): Can resolve complex problems with few or several moving pieces, guide others, contribute to professional practice and propose new ideas to the field The DigiComp framework is broken down into five competency areas, each with a specific skill: 1. Information: Browsing, searching, and filtering; Evaluating; Storing and retrieving 2. Communication: Interacting through technologies; Sharing information; Engaging in online citizenship; Digital collaboration; Online etiquette; Managing personal digital identity

	3. Content creation: Developing; Integrating and re-elaborating; Copyright and licensing; Programming 4. Safety and protection for: Personal devices; Personal data and digital identity; Personal health; The environment 5. Problem solving: Technical issues; Expressing needs and identifying technological responses; Using digital tools; Identifying digital competence gaps

Source: Compiled by CSIS (2021)

Appendix 2. List of occupations

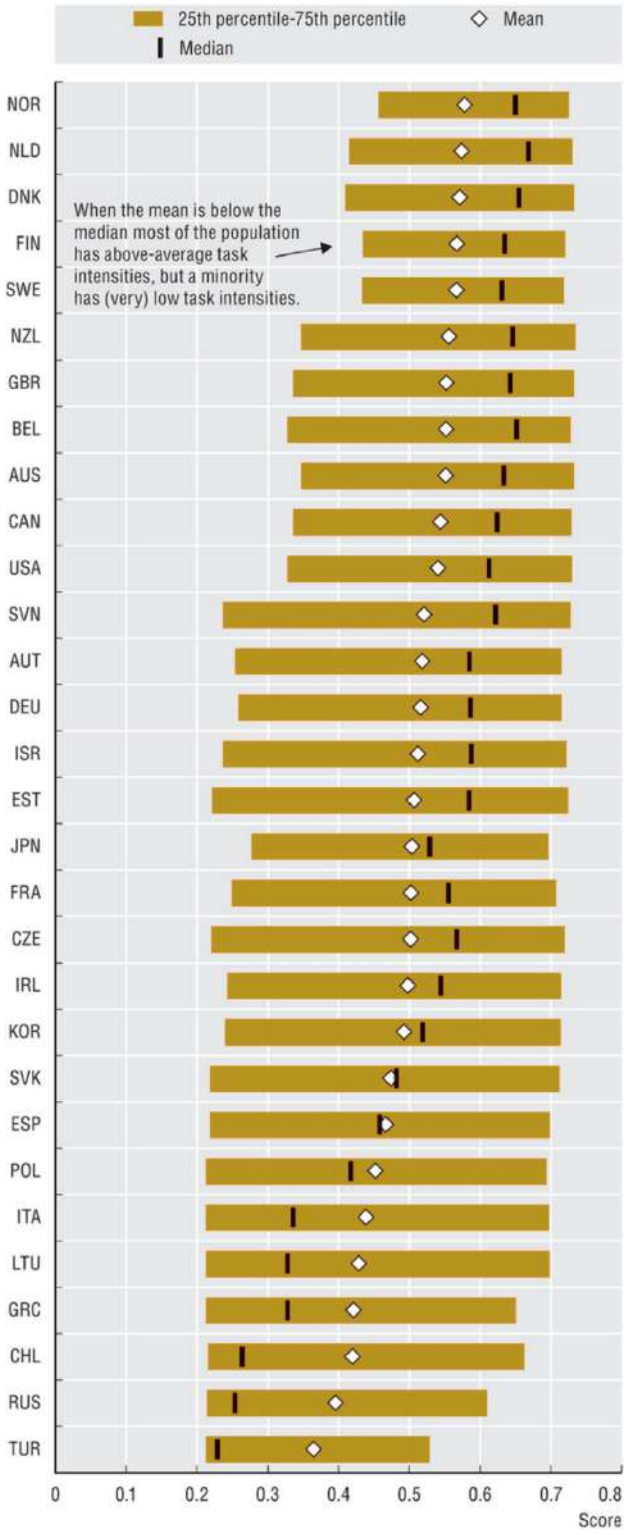
No	Type of Job / Position
Manager	
1	Managing directors and chief executives
2	Financial and insurance managers
Professional	
3	Industrial and production engineers
4	Civil engineers
5	Graphic and multimedia designers
6	Financial analysts
7	Advertising and marketing professionals
8	Software developers
Technicians and associated professionals	
9	Technicians and associated professionals
10	Commercial sales representatives
Clerical support workers	
11	General office clerks
12	Secretaries (general)
Craft and related trades workers	
13	Craft and related trades workers
Plant and machine operators, and assemblers	
14	Plant and machine operators, and assemblers
Elementary occupations	
15	Elementary occupations

Appendix 3. List of tech skills

1	Office suite and project management software (Microsoft Word, Sheets, Power Point, Google Drive, SharePoint)
2	Internet search, email, and e-calendar (Google Chrome, Microsoft Outlook, Google Calendar)
3	Video creation and editing, and graphics/photo imaging (Adobe Creative Cloud, Adobe Flash, Microsoft Visio, SmugMug Flickr)
4	Digital content creation on social media (Instagram, TikTok, Snapchat)
5	Accounting and financial analysis software (Sage 50 Accounting, Tax Software, Delphi Tech, Oracle E-business suite)
6	Software for sales, marketing and customer relationship management (CRM) (Google adwords, Salesforce, HEAT, Oracle Eloqua)
7	Enterprise resource planning (ERP) software (SAP, Microsoft Dynamics)
8	Business intelligence and data analysis (Impromptu, Tableu, Oracle)
9	Analytical/scientific and statistical software (SPSS, Minitab, SAS)
10	Programming language for general purposes (Python, R, Ocaml)
11	Application and web platform development Software (HTML, Java, Apache HTTP server)
12	Other digital skills, specify_____

Source: O*NETAppendix X: ICT task intensity of jobs, 2012 or 2015

Appendix 4. ICT task intensity of jobs, 2012 or 2015: Interquartile range, median and mean values



Source: OECD calculations based on the OECD Programme for International Assessment of Adult Competencies (PIAAC) Database, June 2017

Note: On average, workers in Nordic countries and the Netherlands perform jobs that have a higher ICT-related task content than jobs in other countries.

Appendix 5. Broad vs narrow definitions of digital skills

Aspect	Option A: Broad Definition	Option B: Narrow Definition
Use of analysis	To measure G20 countries' level of competencies in the digital era and capture the general pattern in skills transformation. To design a specific program, a further research is needed in each country.	To identify specific skills gap to help policy makers formulate certain program in order to address gap. The result of toolkit analysis is expected to help regulators directly design the required program.
Depth of analysis	The toolkit will not describe in detail the conditions and statistics of each specific task, job, and occupation. Example: capturing the overview of citizen skills in using technology, **both** for livelihood and develop the technology itself.	The toolkit will deep dive into skills needed in certain task, job, and occupation. Example: focus on measuring the competence of citizens in developing technology (using ICT as an engine to innovate) **or** using technology in daily life (e.g. work or commerce)
Indicators	Indicators that measure digital skills in a broad definition are, in general, available in global databases, such as PISA scores, number of internet users per country, etc. Unfortunately, this only provides a piece of surface-level information. Using broad definition means the survey will have a limited number of questions since there is no need to dig deeper on specific skills.	Since it uses a narrow definition of digital skills, more specific indicators are needed to obtain more in-depth information. This information may not yet be available in national or international databases, so it is crucial to extract more information from surveys. Consequently, the questions in the questionnaire, for both individuals and companies, maybe longer. The length of the questionnaire can also affect the cost of the survey. Example: How many people in the country are familiar with the data management system? How many people have a data analyst certification?
G20 countries level of acceptance	As the previous toolkit (Digital Economy Toolkit 2018) was built on existing indicators and methodologies and was well-received by G20 countries, a toolkit using a broad definition might have higher political support considering the various stages of technological development among G20 countries. Broad definition enables countries to track progress over time and identify skills gaps in general.	Using narrow definition means we need to decide which part is further examined, whether digital skills in livelihoods or digital skills in advancing ICT. The focus of every country might be different, and hence, it might influence their support to implement this toolkit. The preventive action is working closely with G20 officials in intensive consultation when developing this toolkit, however, this strategy will be more time-consuming.
Resources allocation	More information is available so that resource allocation is more efficient.	More focused resources are needed. As specific information regarding the narrow definition of digital skill is limited, more resources are needed to explore the issue.

Source: compiled by CSIS (2021).

Appendix 6. List of occupations/positions

Manager	
1	Managing directors and chief executives
2	Financial and insurance managers
Professional	
3	Industrial and production engineers
4	Civil engineers
5	Graphic and multimedia designers
6	Accountants
7	Financial analysts
8	Advertising and marketing professionals
9	Web, multimedia, and software developers
Technicians and associated professionals	
10	Technicians and associated professionals
11	Commercial sales representatives
12	Computer network and system technicians
Clerical support workers	
13	General office clerks
14	Secretaries (general)
Craft and related trades workers	
15	Craft and related trades workers
Plant and machine operators, and assemblers	
16	Plant and machine operators, and assemblers
Elementary occupations	
17	Elementary occupations

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