

# From Access to Mastery: Conceptual Framework and Assessment of Digital Skills in Indonesia

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## Abstract:

This paper proposes a conceptual framework to measure digital skills in a developing country context, with application using novel primary data. Digital economy holds the promise of unlocking economic opportunities, particularly for geographically challenged populations. However, whether the digital economy would be a bane or a boon for households, and whether it will promote greater economic equity and growth, depends on the skills to use digital technology productively. Despite the massive rollout of internet connectivity, there are limited means to monitor and track progress in improving digital skills and literacy, particular in developing countries. Focusing on Indonesia, this paper introduces a novel framework to assess adults' digital skills and its application using nationally representative primary survey data. The paper reveals several important insights. First, digital skills remain very low among adult population in Indonesia, potentially undermining the impact of improved internet connectivity in the last few decades. Second, among internet-users, most have skills for general use, such as communications, whilst only a small share has specialized skills (e.g., work-related, productivity software, or programming language). There is also heterogeneity in digital skills across different demographic groups. Finally, we found that higher-level of digital skills are a precondition for adopting digital technology for productive uses. This paper highlights the importance of monitoring progress in advancing digital skills and integrating skill components within the broader policies to boosting the country's digital economy prospect. The paper concludes with insights and an exploration of policy implications relevant to broader development country contexts.

Keywords: Digital skills; Skills; Digital economy; Labour markets; Human capital.

JEL Classification: J24, 014

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## 1. Background

In the rapidly evolving digital landscape, *digital skills* have become essential for individuals and businesses to harness the full potential of digital economy. Digital skills enable effective internet usage, fostering opportunities that drive economic growth and development. As highlighted in initiatives like the European Digital Agenda for 2020-2030, the acquisition and enhancement of these skills are crucial for participating in and benefiting from the digital economy.<sup>2</sup> Many developed and emerging countries have experienced rapid growth in digital technology and a strong growing base of internet users. Digital technology (DT) and the internet have reshaped how society works, consume goods and services, and engages in social interaction. The COVID-19 pandemic further underscored the importance of DT in ensuring delivery of public goods and services when mobility was severely restricted. However, merely increasing the use and access to digital technology and the internet does not necessarily lead to more productive outcomes. The level of digital skills is essential for productive use and for managing risks such as safety concerns and fraud associated with online interaction.

Despite the recognized importance of digital skills, the concepts and measurements of digital skills are often limited to developed country contexts (e.g., Van Deursen et al. 2014). Empirical implications are emerging yet similarly limited, with prominent examples from the European Union as illustrated in OECD (2016) and Vuorikari et al. (2022). Whilst the existing literature provides a fundamental backbone of conceptualization of digital skills, the narrow focus leaves a gap in understanding the current landscape of digital skills in developing countries, which are experiencing rapid growth in digital economy. More importantly, there has been limited empirical applications that examine the determinants of digital skills.

To address these gaps in the literature, this paper proposes a conceptual framework and application to examine the current state of digital skills and their determinants in a developing country context, focusing on Indonesia as a country case study. With a strong growing base of internet users, Indonesia sets to be one of the giant players in digital economies in Southeast Asia (World Bank, 2021). Despite the high level of digital penetration in Indonesia (133% of mobile and 56% of internet penetration) (Hootsuite, 2019), the extent to which digital technology is used for productivity-enhancing activities is a concern. Based on Indonesia's flagship household socioeconomic survey (SUSENAS 2019), the highest rates of internet use among Indonesian users are for communication for communication through chat applications and social media (87.2 percent), entertainment purposes such as online games and video streaming (62 percent) and searching for information such as news (70 percent). However, usage for economic activities remain relatively low, e.g., selling (5.1 percent) and accessing digital financial services or fintech (6.5 percent). Furthermore, the ICT Development Index 2023 ranks Indonesia at 111 out of the 176 countries, far below the neighboring countries including Malaysia (ranked 63th) and Thailand (ranks 78<sup>th</sup>) (Bodrogini, 2018). As such, assessing digital skills among Indonesian population is crucial to understanding how to leverage its growing digital infrastructure for economic development, enhancing productivity, and ensuring the country's competitive edge in the regional digital economy.

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<sup>2</sup> Digital agenda for Europe (EU, 2020). <https://www.europarl.europa.eu/factsheets/en/sheet/64/digital-agenda-for-europe>

The paper relies on the Digital Economy Household Survey, a novel primary data specifically designed to collect information on digital economy and technology among DT and internet users in Indonesia (Setiawan and Tiwari, 2022). Building upon earlier work on digital skill, the paper proposes a framework for a developing country such as Indonesia (built upon previous works). This paper also assesses the determinants of individual digital skills, examining how different factors – such as education, working sector, experience, and digital infrastructure – affect various levels of digital skill. The heterogeneity in digital skills and the extent of which different factors lead to variation in digital skill across different part of the country are also discussed.

Four key findings emerged from this study. First, digital skills remain very low among adult internet users in Indonesia, despite their importance in shaping ICT device and internet use for productive uses. Second, the majority of digital technology (DT) users are ‘generalist’, using DT for general purposes such as communication through emails as well as online chats. On the contrary, the share of adults with digital skills in specialized activities (e.g. use of software for work-related productivity, programming language) remains very limited. Third, advanced digital skills are associated with better connectivity, higher levels of education, primary working age (25-54 years old), being male, and better equipped with ‘soft skills’ (inter- and intra-personal skills). Lastly, a higher level of digital skills remains a precondition of DT adoption for productive uses.

Overall, the findings from this paper shed a light on the current state of digital skills among the adult population in Indonesia and the heterogeneity in digital skills across the different parts of the country. These would contribute to the broader literature human capital development – specifically in how digital skills correlate with the different aspects of human capital, as well as growth and development – specifically on how the different set of digital skills may shape employability and quality of jobs in digital economy era. More importantly, our findings underscore significant policy implications for bridging the digital divide in Indonesia. Ensuring an inclusive transition from basic access to mastery of digital technologies is crucial for supporting the country’s ambition to become the largest player in the region’s digital economy. Our findings build on the existing literature, which primarily focuses on labor-oriented digital skill assessments using general datasets (e.g., SMERU et al. 2022, CSIS, 2022). While these studies offer valuable insights, our research provides a more nuanced analysis by relying on a primary survey specifically designed to assess digital skills in the general population. Additionally, we incorporate a thorough and robust analysis of the determinants of digital skills, addressing aspects that are often overlooked in previous studies. Policy recommendations include modernizing the national education curriculum to reflect changing skill requirements and providing digital skills training in the workplace. Digital skills are essential to ensure that no one is left behind in seizing economic opportunities from the expanding digital economy.

The remainder of the paper is structured as follows. Section 2 reviews the existing conceptualization and measures of digital skills and their relevance to economic productivity. Section 3 provides the proposed framework for measuring digital skills, along with the methodology and dataset used for the analysis. Section 4 presents the main results on: (i) digital skills among the adult population in Indonesia, (ii) heterogeneity in the level of digital skills across demographic groups and regions, and (iii) determinants of digital skills. The paper concludes by

discussing the policy implications of the findings and providing a summary of key insights, along with potential applications to broader developing country contexts.

## **2. Conceptualizing Digital Skills**

The conceptualization and measurement of digital skills are crucial components of the growing literature on the digital economy and inclusive policy, characterized by evolving focuses and measurement approaches. Broadly, the existing conceptualization of digital skills falls into three different orientations: (i) operational-focused (ii) social-functioning, and (iii) labour and economic growth-oriented.

### **Technical Operational-focused**

Early discussions on digital skills concentrated on the technical aspects of using digital technology. This strand of literature defines digital skills as the fundamental abilities needed to *operate digital technologies*, such as using computers, mobile phones, and the internet. Despite the broad range of digital technologies, digital skills within this framework often have a narrow focus, specifically on using and navigating the internet for information searches (e.g., Krueger, 2006; Hargittai & Hsieh, 2012). Measurement of digital skills in this category often unidimensional and adopts a binary approach, such as the ability to connect to the internet, turn mobile phones on and off, or ability to use internet search engines to find information. However, focusing solely on digital skills as the ability to physically operate digital technology overlooks the growing and significant role of digital technology in enabling participation in modern society.

### **Social-Functioning orientation**

The second strand of discussion offers a more comprehensive perspective, emphasizing that digital skills are an essential element enabling full participation in modern society. This broader view suggests that digital skills extend beyond physical and technical proficiency with digital technologies and the internet. The focus is on the ability to leverage technology and the internet to enhance one's societal engagement and participation (Calvani et al., 2012; van Dijk & van Deursen, 2014; Helsper et al., 2014). This includes using the internet and social media for communication and collaboration, interacting and sharing through digital platforms, and engaging in social activities via digital tools. Communicating through digital technologies also requires the ability to generate content. Some argue that the ability to comprehend and use online digital content is also an important aspect of digital skills (e.g., van Dijk & van Deursen, 2014; Helsper, 2008). Another crucial aspect is also the ability to safely use and navigate DT and the internet, which involves protecting personal devices and maintaining data privacy.

Digital skills are therefore often measured as a combination of various competencies rather than a single dimension. The objective is in leveraging digital technologies for social inclusion and societal participation. Leading examples include the European Union Digital Competence Framework (DigComp) (EU Commission, 2022) and UNESCO Digital Literacy Framework (UNESCO 2018). These frameworks encompass several aspects of digital skills, such as information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. A broader conceptualization of digital skills, emphasizing social inclusion and participation, can

provide a useful framework for assessing not only the level of digital skills but also the role of digital technologies in fostering inclusive development.

### **Labor and economic growth orientation**

More recently, the conceptualization of digital skills has shifted towards a labour and economic growth perspective, arguing digital skills as essential future labour skills necessary for productive use in a digital economy (OECD, 2024). In this context, digital skills are often associated with the use of DT and internet to enhance productivity of the labour force and to transform economic activities. International organizations are often among strong advocates of this concept. For instance, UNESCO (2018) defines digital literacy as the "ability to access, manage, understand, integrate, communicate, evaluate, and create information safely through digital technologies for employment, decent jobs, and entrepreneurship." Under their framework, UNESCO considers six competency areas: information and data literacy, communication and collaboration, digital content creation, safety, problem-solving, and career-related competencies. Similarly, the European Union defines digital skills more broadly, encompassing more than basic or operational skills of ICT devices (EU, 2014, pp. 4-5). Digital skills involve the confident and critical use of information society technology for work, leisure, learning, and communication (.ibid).

In addition, OECD (2016, 2022) also highlights the importance of digital skills in transforming the way society live, work, and learn; demonstrated by the fast development of artificial intelligence, robotics, or information and communication technologies.<sup>3</sup> Similarly, ADB in their recent report proposes digital skills as a set of competencies ranging from basic, intermediate, and advanced disruptive digital skills, which enable individuals to use technology and platforms on the job (ADB, 2022). According to their framework, digital skills range from the basic understanding of simple technologies used on the job to more advanced skills involving the development and use of new technologies that disrupt or transform traditional economic activities (e.g., artificial intelligence and robotics). This employment and growth-centric conceptualization of digital skills is particularly useful for understanding the importance of digital skills in ensuring full participations in the rapidly growing digital economy.

The conceptualization and assessment of digital skills are crucial because they help prepare future labour force to adapt with the evolving job and skill landscape, thereby strengthening a country's competitiveness and economic growth (Bejakovic and Mrnjavac 2020; Vasilescu et al., 2020). The COVID-19 pandemic has demonstrated the fundamental role of digital technologies, which have adversely impacted workers in hard-hit sectors (OECD, 2022; ADB, 2022). This adverse effect is more pronounced in low-income regions where the digital divide persists, with only one in 26 jobs being feasible to perform from home (Sanchez et al., 2020). With digital economy currently accounts for 25 percent of the global economy, there is an increasing demand for individuals with advanced digital skills (Cobo et al., 2023).<sup>4</sup> In 2023, the UK government identified 7.5 million people, or 18 percent of UK adults, as lacking digital skills, estimating a potential economic loss of £63 billion per year (Lewis et al., 2024). Boosting digital skills and inclusion has become part of the UK Digital Strategy. (UK Department for

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<sup>3</sup> OECD Digital skills. <https://www.oecd.org/en/topics/sub-issues/digital-skills.html>

<sup>4</sup> Cobo et al (2023). The Vital role of digital skills in building inclusive, smart, safe, and sustainable digital economy

Science, Innovation, and Technology, 2017). In most EU countries, digital occupations have been on the rise, requiring a mix of high-level technical and advanced cognitive skills (OECD, 2022). In light of this, EU launched the Digital Skill Indicator (DSI) to assess and monitor policy target to have 80% of the EU population to have at least basic level of digital skills by 2030 (Vuorikari et al., 2022). In developing country contexts, a recent survey by ADB (2022) indicates fast growing industries such as digital health or e-learning, and development of smart cities would largely depend on digital talents (ADB, 2022). Therefore, the measurement and analysis of digital skills are important as they help identify subgroup populations lagging in these areas and inform labour policies to enhance workforce preparedness, thereby avoiding potential economic losses in the future.

While there is no consensus on definitions of digital skills, there is a growing recognition of the need to measure digital skills as a multidimensional concept crucial for individuals' societal and economic participation. The EU's Digital Skills Indicator (DSI) assesses digital competencies across 27 countries, using a survey-based approach to evaluate 21 digital skills in five main areas.<sup>5</sup> The data reveals large variations in digital skills, with only 9% of Romanian workers having more than basic skills compared to 61% in Finland (CEDEFOP, 2023). Other reports have adopted similar methods to identify digital skills gaps across different demographic and socioeconomic groups (Helpers et al., 2020; LLOYDS, 2023). Recent studies increasingly analyse digital skill levels among workers. For instance, the UK Consumer Digital Index reports that 25% of the UK population has low digital capability, and 18% lacks fundamental digital skills (Lewis et al., 2024). On a global scale, UNESCO's Digital Literacy Global Framework (2022) proposes a method for measuring digital literacy as part of SDG monitoring. This framework, developed from ICT frameworks in 47 countries and through extensive consultations, identifies seven key areas: devices and software operations, information and data literacy, communication and collaboration, digital content creation, safety, problem-solving, and career-related competencies.

Understanding digital skills as a multidimensional concept helps tailor strategies for individuals' societal and economic participation. While existing frameworks offer a solid foundation, there is a need for further empirical research, particularly in developing countries, to adapt these models to specific local and socioeconomic contexts. Our paper builds on various digital skills frameworks and presents application and empirical evidence in a developing country context, Indonesia, which we detail in the next section.

### **3. Methodology and Data**

#### **3.1. Measurement of digital skills**

This paper measures digital skills using a social-functioning approach. We define digital skills as a set of competencies in using digital technologies (DT), such as the internet and ICT devices, to enhance participation in societal and economic activities. Our framework draws from leading digital skill models, including the EU DigComp 2.0 (2022), UNESCO (2022), and the OECD Skills for Digital Transition (2022). While these frameworks provide a robust theoretical foundation, our paper operationalizes them in the context of developing countries through empirical application, as explained below.

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<sup>5</sup> The five main digital competencies include: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving.

Our measure of digital skills encompasses six components: (i) basic operation of ICT devices and the internet, (ii) information and data literacy, (iii) communication and collaboration, (iv) digital content creation, (v) digital security and safety, and (vi) problem-solving. These competencies align with the social-functioning-based framework of digital skills (e.g., UNESCO 2022; EU DigComp 2022). This assessment provides a benchmark for the extent of digital skills in Indonesia and helps identify specific competencies that need improvement. In practice, our measurement employs a survey-based approach to assess digital skills. The survey collects self-assessed information from individuals on the six areas of digital skills, using 24 indicators to measure these competencies. Each competency area includes four questions as detailed in Table 1 below. The questionnaire uses a Likert scale with values from 1 to 4 (1 – “not true,” 2 – “somewhat true,” 3 – “true,” 4 – “very true”). We categorize individuals as possessing a skill if their responses fall between 2 and 4 and as lacking the skill otherwise. Section 3.2 provides explanation on the data.

Table 1. Indicators of digital skills

Digital skill dimension	Indicators
Operation of ICT devices and internet	<ul style="list-style-type: none"> <li>▪ operating ICT device</li> <li>▪ connecting to internet</li> <li>▪ opening browser or application</li> <li>▪ installing applications</li> </ul>
Information and data	<ul style="list-style-type: none"> <li>▪ using browser or search application</li> <li>▪ information search using keywords</li> <li>▪ comparing information from different sources</li> <li>▪ saving information from online search</li> </ul>
Communication and collaboration	<ul style="list-style-type: none"> <li>▪ communication through instant messaging</li> <li>▪ online discussion</li> <li>▪ use of email</li> <li>▪ working together using sharing platform</li> </ul>
Production of digital contents	<ul style="list-style-type: none"> <li>▪ composing or uploading media on the internet</li> <li>▪ copy and forward information from online media</li> <li>▪ developing own website and put copyright</li> </ul>
Digital security	<ul style="list-style-type: none"> <li>▪ limiting access to personal information</li> <li>▪ identifying phishing information</li> <li>▪ read data privacy policy</li> <li>▪ setting strong password on device</li> </ul>
Problem Solving	<ul style="list-style-type: none"> <li>▪ search products/services online</li> <li>▪ software updates</li> <li>▪ online transaction</li> <li>▪ online banking use</li> </ul>

This approach provides a comparative advantage in analysing digital skills among the general population in low- and middle-income countries, such as Indonesia, due to its focus on both technical and substantive measures of digital skills. While traditional frameworks may emphasize digital skills pertinent to formal and high-complexity occupations like software development and artificial intelligence, this perspective often overlooks the informal sector workers who dominate the employment landscape in many developing nations. By concentrating solely on high-quality employment, the digital competencies of a significant portion of the population are underestimated. Adopting a more holistic framework that integrates both technical skills and the non-technical abilities necessary for effective technology use can enhance participation in the connected economy, especially for those who are often

marginalized. This comprehensive view of digital skills not only accounts for the technical aspects but also highlights the non-technical skills crucial for societal participation. By focusing on inclusion, this conceptualization underscores the importance of engaging individuals in the economic, political, and social activities prevalent in society, ensuring that digital advancement is inclusive and accessible to all.

### **3.2. Data and estimation strategy**

#### **Digital Economy and Household Survey (DEHS)**

Our analysis is based on Digital Economy and Household Survey (DEHS) 2020. DEHS survey collects a set of households and individuals' information with the goal to deepen understanding on the role of digital technology (ICT device and internet) and digital economy in Indonesia.<sup>6</sup> The survey consists of nine modules, which collect in-depth information on the various aspects of digital technology and digital economy, including internet connectivity, digital skills, adoption of e-commerce and digital services, as well as socio-economic characteristics (Setiawan and Tiwari 2022). The survey, conducted in 2020, covers 3,063 households, and is nationally representative. The data represent variations in both demographic and geographic characteristics of the population.<sup>7</sup>

The analysis in this paper focuses on analysis of digital skills and their determinants for adults age 15 years and above who are ICT devices and internet users. Assessment of digital skills mainly rely from Module 2 on internet access and use, which collects detail information on access (i.e., internet connectivity and ownership of ICT devices), ICT uses, as well as a specialise module on digital skills and competencies. Our sample is individuals who were eligible to respond this module – that is internet and ICT device users, and represents 65.5 million ICT users in the country with survey weight applied. Our data represents the geographic and demographic characteristics of internet users as captured in the Indonesia's socioeconomic flagship survey (Table A1 in Annex provides summary of our main sample).

#### **Estimation strategy**

Our objective is to estimate digital skills level among adults' population and to examine the different factors at play in shaping and explaining the variations in digital skills across demographic and socioeconomic groups. There are two components of analysis in this paper.

*Assessing digital skills* – The main analysis in this paper is to estimate the level of digital skills among Indonesian adults. We employ descriptive statistics to establish this fundamental picture. Our main measure is the proportion of individuals categorised to have skill in each of six areas of competencies. Recall that each area (or dimension) of digital competencies represented by four set of skills indicators. To establish if one has digital skill at the dimension level, we employ aggregation method and take the average score to determine their skill. Although our survey allows

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<sup>6</sup> Digital Economy Household Survey 2020 can be accessed through the World Bank Mirodata Library:

<https://microdata.worldbank.org/index.php/catalog/4602>

<sup>7</sup> Despite being representative at the national-level, DEHS can't be aggregated at the island-regions level. The data collection didn't reach the intended sample size to be representative beyond the national level, due to early termination in light of the COVID-19 pandemic (Setiawan and Tiwari 2022).



to construct a sophisticated measure of digital skills, such as construction of a composite index, we refrain in doing so as it beats the concept of digital skills as a multidimensional concept and sets of competencies (ref.)

*Determinant of digital skills* – The second question in our paper seeks to assess the determinant factors of adults’ digital skills in Indonesia. We employ a Logit model to estimate the association of a set of factors contributing toward individuals’ digital skills, as captured in the following equation.

$$DigitalSkill_{ij} = \beta_0 + \beta_1 Connectivity_{ij} + \beta_2 Softskills_{ij} + \beta_3 Individuals_{ij} + \beta_4 Households_{ij} + \beta_5 Geography_{ij} + \varepsilon_{ij}$$

where the main outcome of interest in our model is *DigitalSkill<sub>ij</sub>*, a binary variable indicating whether individual *i* have the ability to perform digital skill *j*. Our model estimates two primary determinants of digital skills: *connectivity* and individual’s *soft skills*. Recognizing that digital skills are context-dependent, we also account for differences in personal and household characteristics, as well as geographical locations. Below, we detail our rationale for the model.

### *Connectivity*

Digital skills depend on both the breadth and depth of access to digital technology and internet connectivity. Therefore, our model examines whether *Connectivity* – defined as the quantity and quality of digital technology and internet access – is a significant determinant of adults’ digital skills. We measure the quality of internet by factors such as the average upload and download speeds of a household’s internet connection and the presence of at least a 4G network in the area. Meanwhile, access to and quantity of digital technology and internet usage are measured by the number of household members using the internet and ICT devices, household expenditure on internet services, and individual mobile phone credit. We generate these variables from DEHS module 1 on households’ connectivity and module 2 on individuals’ access to digital devices and internet connectivity.

### *Soft skills*

Beyond technical access, soft skills play a crucial role in effectively leveraging digital technology (ILO, 2023; OECD, 2024). The literature acknowledges the importance of workers possessing a combination of technical and socio-emotional skills to adapt to the rapidly evolving digital environment (OECD, 2016; 2019). Soft skills, such as analytical and critical thinking, problem-solving, and communication, enhance individuals’ ability to work effectively with technology (Polakova et al., 2023). Therefore, our paper examines whether variations in adults’ digital skills are explained by differences in a set of soft skills among internet users in Indonesia. We assess two categories of soft skills: intra-personal and inter-personal. These are represented by a total of 16 questions or indicators. Intrapersonal skills include self-direction, creativity, critical thinking, and a growth mindset, measured by eight sets of questions. Interpersonal skills encompass communication, collaboration, leadership, and a growth mindset. These measures of soft skills follow the standard conceptualization for future jobs and the digital world as outlined by the OECD (2017, 2019) and ILO (2021, 2023), and are available from DEHS Module 2.

### *Socioeconomic and demographic characteristics*

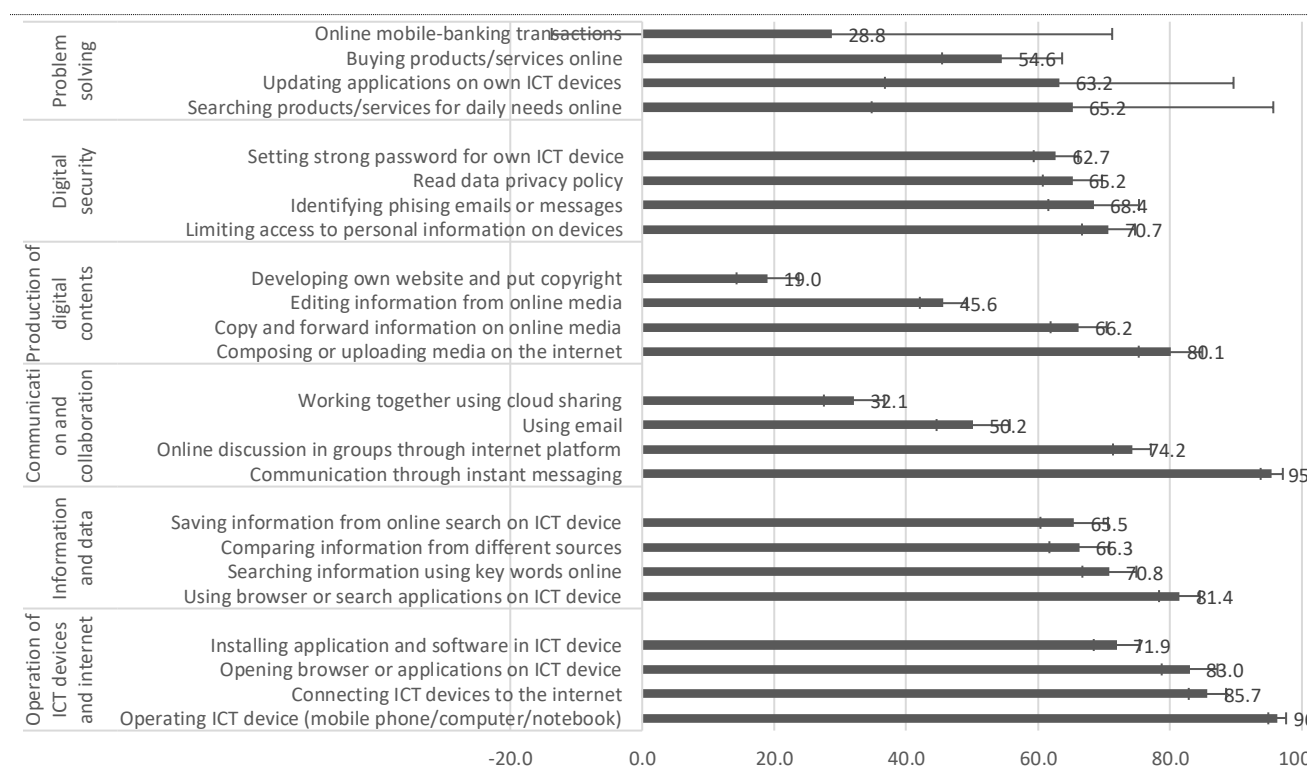
This paper also investigates the role of socioeconomic and demographic characteristics in determining adults' digital skills. This includes information on: (i) individual characteristics (gender, employment status, education level, age group); (ii) household characteristics (dependency ratio, number of household members using the internet and ICT devices, socioeconomic status measured by expenditure quantiles); and (iii) geographical variations (measured by dummy variables denoting five main island regions and urban-metro classification, which capture population density and economic development of respondents' residence). This information is primarily drawn from DEHS Module 1 (General Information) and Module 2 (Internet Access and Use).

## 4. Results

### 4.1. The level of digital skills among internet users in Indonesia

Our results provide a benchmark and an overview of the digital skills landscape in Indonesia. Based on the survey results, there is strong evidence that most Indonesian internet and digital technology users are capable in a variety of digital skills, from physical operation of internet, phones, and laptops to communication and engaging online. However, we observe a significant gap in digital skills, especially those requiring higher levels of complexity and those that are part of future skills in demand necessary to succeed in the digital economy. In this section, we detail our results through a descriptive analysis of each of the six components of digital skills (Figure 1).

Figure 1: The proportion of individuals with digital skills



Source: DEHS 2020, Authors' calculation.

Note: The figure show the proportion of individuals who responded to have digital skills.

*Operating ICT device and internet:* One foundational digital skill is the ability to operate ICT devices and connect to the internet. The results indicate that Indonesian internet users have a strong command of ICT and internet

operations. A significant share reported comfort with operating various ICT devices (96.3 percent) and connecting them to the internet (85.7 percent). Many respondents could also perform more complex tasks such as installing software and applications (72 percent) and using browsers on their devices (83 percent).

*Information and data:* Another crucial aspect of digital skill is the ability to use digital technology and connectivity to search for and utilize information and data. The survey results confirm good command over online search capabilities among Indonesian internet users. Slightly over 80 percent of respondents claimed the ability to use browser or search applications to collect information on their devices, while slightly over 70 percent could use various keywords for online searches. However, not all internet users are comfortable with more challenging tasks such as comparing information from different sources (66.3 percent) and saving information on devices (65.5 percent). This implies a potential obstacle for Indonesian internet users using digital technology for more productive purposes.

*Communication and collaboration:* DEHS data revealed that Indonesian internet users are highly proficient in online communication via instant messaging, a finding consistent with Indonesia's high number of mobile phone subscriptions. A majority also reported confidence in conducting discussions online (70 percent). Despite proficiency in online communication tools, there is a notable gap in digital skills for collaboration in more formal settings. Only half of the respondents reported the ability to use email effectively, and just over a third had experience collaborating using cloud-sharing platforms and similar technologies. If this gap in digital skills is not addressed, it could hinder productivity and limited opportunities for securing high-skilled occupations.

*Production of digital contents:* Consistent with a strong base of internet and social media users in the country, 80 percent of respondents reported the ability to compose and upload media online, and around 66 percent were familiar copying and sharing online information. However, the majority lags in more complex skills, such as creating and editing online source (46 percent), and there is a lack of awareness regarding copyright protections. This would expose internet users to risks of not protecting their personal data and original content.

*Digital Security:* Just as it is important to apply copyrights to one's content, it is crucial for digital technology and internet users to be aware of and able to protect their devices and personal information. According to DEHS, only slightly more than 60 percent of Indonesian internet users know how to set a strong password on their devices, and less than two-thirds read data privacy policies when browsing online. Such skills are essential for safeguarding internet users and preventing them from becoming victims of online fraud. Indeed, digital security is an increasing concern. Indonesia has a high incidence of cybercrimes, as demonstrated by the largest cyberattack to date in 2024, which compromised the national data centre. An \$8 million ransom was demanded for data release, leading to personal data leaks and disruptions in key public services (Reuters, 2024). Similar attacks had impacted other government agencies (ibid). These fatal and frequent occurrence of cyber-attacks highlights the lack of robust digital infrastructure and regulations for data protection and security, as well as a minimal understanding of digital hygiene practices among different layers of internet users, as shown by our finding.

*Problem Solving:* According to the ILO (2023), transversal digital skills, such as problem-solving and teamwork, which enable the meaningful use of digital technology at work and have high portability across different jobs and sectors, are crucial for the digital economy and the future of work. However, our results show users

comfortable using digital tools for problem-solving were not as numerous, with only slightly more than 65 percent reporting experience using the internet for searching products or services, and slightly more than half knowing how to make online purchases. This is surprising given the widespread availability of giant online shopping platforms such as Tokopedia, Shopee, and Alibaba. Most notably, less than a third knew how to use digital tools for mobile banking, highlighting a gap in advanced digital skills among Indonesian users.

In summary, our results show that Indonesian internet users are generally comfortable using digital technology and internet for less complex tasks, such as operating ICT devices, searching for information online, and online communication. However, there are significant gaps in digital skills required for advanced tasks deemed to be an important part of future in-demand skills, including producing original digital contents, awareness and practice of digital hygiene, and digital finance transactions. These findings highlight the digital skills gap among adults in Indonesia, indicating that more than half lack the fundamental skills to fully benefit from the digital economy, while only a significant minority can perform a variety of functions using digital tools, with good digital hygiene practices.

#### **4.2. Heterogeneity in digital skills across different demographic groups**

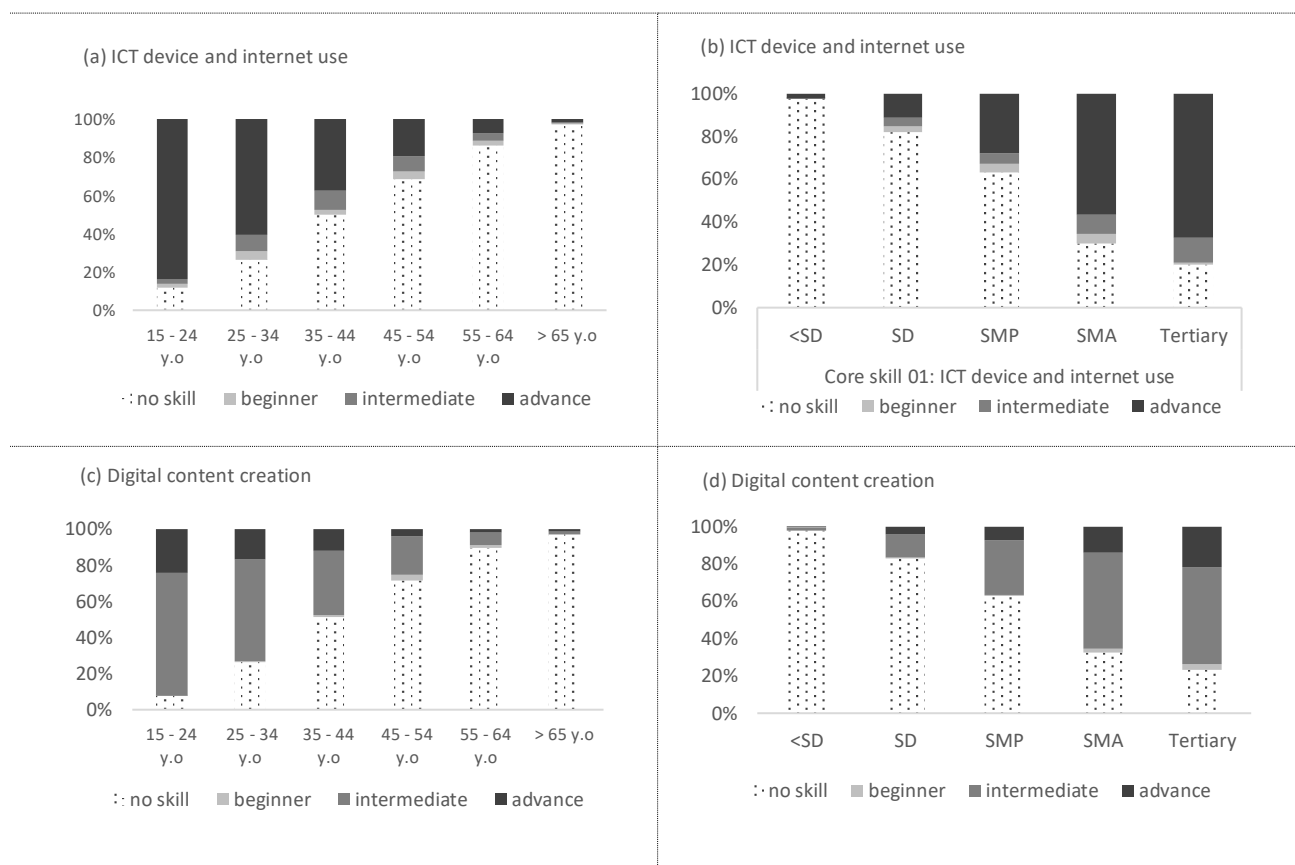
The second major finding of our result demonstrates significant variations in digital skills across demographic and socioeconomic groups. These variations are characterised by three main factors as we discuss below.

First, heterogeneity in digital skills is mostly significant in populations across different age groups and education level. Younger and more educated individuals tend to possess higher levels of digital skills (Figure 2). As shown in Figure 2 (panel a and c), the share of advanced users in DT use significantly decreases with age. A similar trend is observed in other components of core digital skills. The findings suggest that younger Indonesians (particularly those between 15-34 years old) tend to have higher levels of digital skills compared to older adults. Nearly all elderly Indonesians (>65 years old) lack digital skills. Digital skill levels are also found to be associated with education: the share of advanced DT users increases as education levels rise (Figure 2, panel b and d). For instance, a higher proportion of advanced DT users is found among those with upper-secondary (approximately 60 percent) and tertiary education (70 percent) (Figure 6, right bar chart). Nearly 70 percent of advanced DT users in the country have at least upper-secondary education. This suggests that education is an important precondition for acquiring higher levels of digital skills.

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Figure 2: The variation in digital skills by age-groups and education levels

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Source: Authors' calculation based on DEHS 2020.

Note: The figure show the proportion of individuals with different level skills in ICT device and internet use and Digital Content creatio, by age-groups and education-level. Although the figure only shows for two types of digital skills, similar patterns observed for the other four elements of digital skills.

Second, an urban-rural disparity persists in digital skills. We found that rural areas have a relatively higher proportion of individuals with no digital skills. Peripheral and non-metro rural areas consistently have a higher share of individuals with no digital skills, ranging from 60-70 percent across all components of skills. For instance, 40 percent of individuals in core urban areas have no skill in ICT and internet use, which is one-third less than what is observed in rural areas. The results are intuitive, given that urban areas have higher concentration of advance DT users. Interestingly, the variation in digital skills is less pronounced when examining the distribution of skills across island-regions. This suggests that the variation in digital skills may be linked to 'depth' of digital technology connectivity, with rural areas being less connected than the urban areas.

Third, a gender gap also characterizes the disparity in digital skills among respondents, with males consistently having a higher share of users with advanced skills across all components of digital skills. The share of females with no digital skills ranges from 60-65 percent – roughly 10-15 percentage points higher than the male counterpart. Additionally, the share of advanced users among females is consistently lower than among male respondents. Among females with no digital skills, most have had no prior access to digital technology. This suggests gaps in digital skills between males and females Indonesian and lagging connectivity among females.

These results could lead to several implications: 1) The level of digital skills possession is linked to young adults with tertiary education that possibly working in a white-collar job, where more complex digital tasks are

required; 2) Formal education remains an important channel to hone and train digital skills among young internet users, with implications for their labor market outcomes; 3) The gap in digital skills is less prominent across island-regions but persists across urban-rural divides where internet quality may vary, as last-mile connectivity remains a significant challenge in Indonesia. This shows that while access to connectivity might increase the probability of digital technology adoption, quality connectivity is essential to support development of digital skills, as a more complex and advanced digital task usually requires better internet connection (for example, using a chatting app require less bandwidth compared to editing documents in an online shared word processing app). We further confirm our results in section 4.4 where we examine the associations of these factors with varying digital skills among respondents.

### **4.3. Readiness of DT and internet users to excel in digital economy**

As we have discussed the significance of digital skills in enhancing individuals' participation in economic activities, our paper also addresses a critical policy question: Do digital technology (DT) and internet users in Indonesia possess the skill set necessary to effectively use these tools to excel in future jobs and the digital economy? This aligns with the argument that future labour markets will require more than just ICT skills to thrive. The OECD (2016) highlights the importance of complementary skills, ranging from advanced digital skills that boost productivity to socio-economic skills that facilitate collaboration. To explore this, we examine: (i) the current patterns in the use of the internet and digital technology by activity types, (ii) the capability in work-related digital skills, and (iii) the variations in socioemotional skills among DT and internet users in Indonesia. Several key findings emerge, as we discuss below.

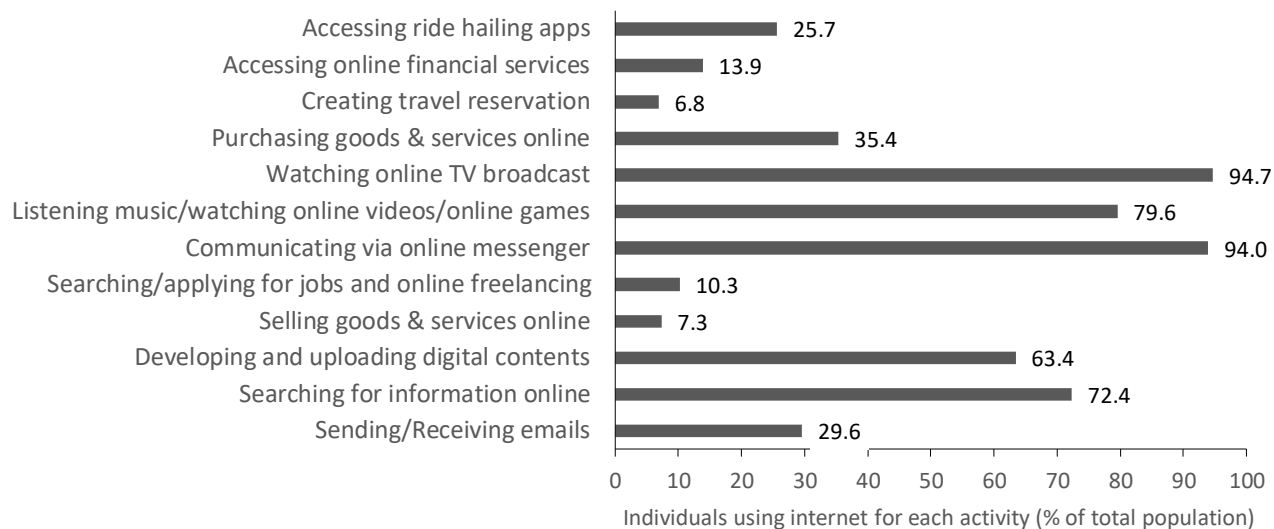
#### **Types of online activities among internet and digital technology user**

Our findings indicate a limited use of digital technologies for productivity-enhancing activities. The most popular activities among digital technology users are online entertainment and communication. Nearly 95 percent of respondents use online messaging, internet music and video streaming, and online gaming (Figure 3). On the contrary, digital technologies are infrequently used for activities that could potentially boost productivity. For instance, only 14 percent of users engage in online financial services, 10 percent use them for job searches and applications, and 7 percent for selling goods and services. These findings suggest an early indication of the underutilization of digital technology and internet for productive purposes among Indonesian internet users. More importantly, excessive use of the internet and digital technology for entertainment (e.g., social media, online streaming, games) found to be associated with decreases in work productivity, psychological wellbeing, and quality of daily life (Duke and Montag, 2017; Dhir et al., 2018).

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Figure 3: The share of individuals using internet by types of activities

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Source: DEHS 2020, Authors' calculations.

### Capacities in work-related digital skills

Recent technological advancements have shifted the demand for skills toward higher levels of digital proficiency, essential for boosting work productivity. The readiness of the current workforce for a digital world depends on whether they possess these skills. The OECD (2016) has identified key skill sets for the digital world, including operating emails, using the internet for job searches, working with productivity software (e.g., spreadsheets, word processors), programming, and conducting online discussions. The DEHS collects data on the frequency of use of these skills over the past year to assess skill levels, following OECD PIAAC survey (OECD, 2016). A few key findings emerged, as we discuss below.

First, our results reveal limited use of digital skills in work settings. We found that only about 20 percent of respondents reported using the internet and digital technology for emails. The percentage is even lower for activities requiring specialized ICT skills, such as using spreadsheets (14 percent), word processors (15 percent), and programming (8 percent). This is unsurprising, as these specialized skills are often niche, specific to certain job roles, and typically require a higher level of expertise. These findings suggest that the majority of adults lack the necessary skill set to thrive in the digital economy, which may lead to missed opportunities, particularly in responding to qualified job market demands (WEF 2018).

Second, we observed significant variations in digital skills relevant to boosting productivity among internet users in Indonesia. Similar to our earlier findings, younger adults (15-24 years old) are more likely to have these skills and use digital technology and the internet to support their work and productivity, with frequency of usage declining as age increases. This finding aligns with evidence from OECD countries, where younger individuals (ages 25-34) are more equipped with problem-solving skills in technology-rich environments compared to older age groups (ages 55-64) (PIAAC, 2015). Additionally, we found that higher usage of digital technology in work settings is more prevalent among those with higher educational attainment, reinforcing the idea that education is a key factor in developing advanced digital skills.

## Soft-skills among digital technology and internet users

As argued in the literature, succeeding in digital economy will require not only ICT skills but also socioemotional and soft skills. We looked at the differences in two types of skills: *intra-personal skills* and *inter-personal skills* and examine their differences between respondents with and without digital skills. Our findings support the argument where individuals with digital skills are more likely to possess the soft skills necessary for using digital technology effectively, as summarised below.

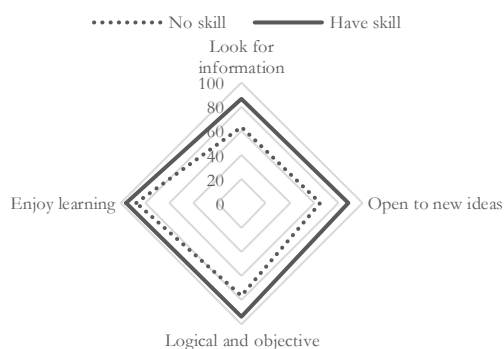
**Intra-personal skills:** Growth mindset and critical thinking are the most common intrapersonal skills among respondents, with 95% of those with digital skills possess a growth mindset (i.e., enjoy learning), nearly 25% higher than those with no digital skills (Figure 4, panel a). Additionally, respondents with digital skills are more likely to possess multiple intra-personal skills (defined as having three or more). Open-mindset is the least common, with only 66 percent of unskilled respondents and 80 percent of high-skilled respondents has this skill.

**Inter-personal skills:** Problem-solving and collaboration are the most common inter-personal skills, with 75-96% of respondents reporting to have these skills (Figure 4, panel b). Communication is less common, with only 47-62% of respondents perceiving themselves as skilled communicators. This finding correlates with the relatively low use of digital technology for communication, as only 13% of Indonesian households with internet access use it for online chats and calls. Also, respondents with digital skills are more likely to have inter-personal skills compared to respondents with no digital skills, particularly in communication and collaboration.

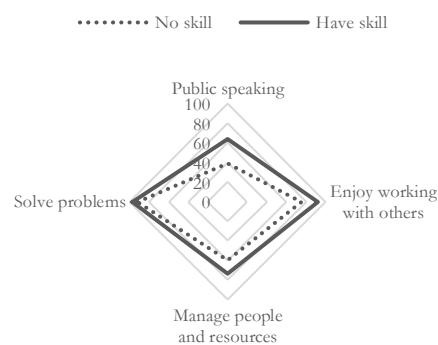
The findings underscore the strong association between high levels of digital skills and enhanced intra- and inter-personal skills, particularly in growth mindset, critical thinking, communication, and collaboration. These soft skills are essential not only for the productive use of technology but also for success in work environments. Therefore, improving digital skills among Indonesians will require efforts to enhance both access to and the effective use of digital technology, along with the development of key soft skills.

Figure 4: Intrapersonal and Interpersonal skills among internet users in Indonesia

(a) Intra-personal skills among internet users



(b) Inter-personal skills among internet users



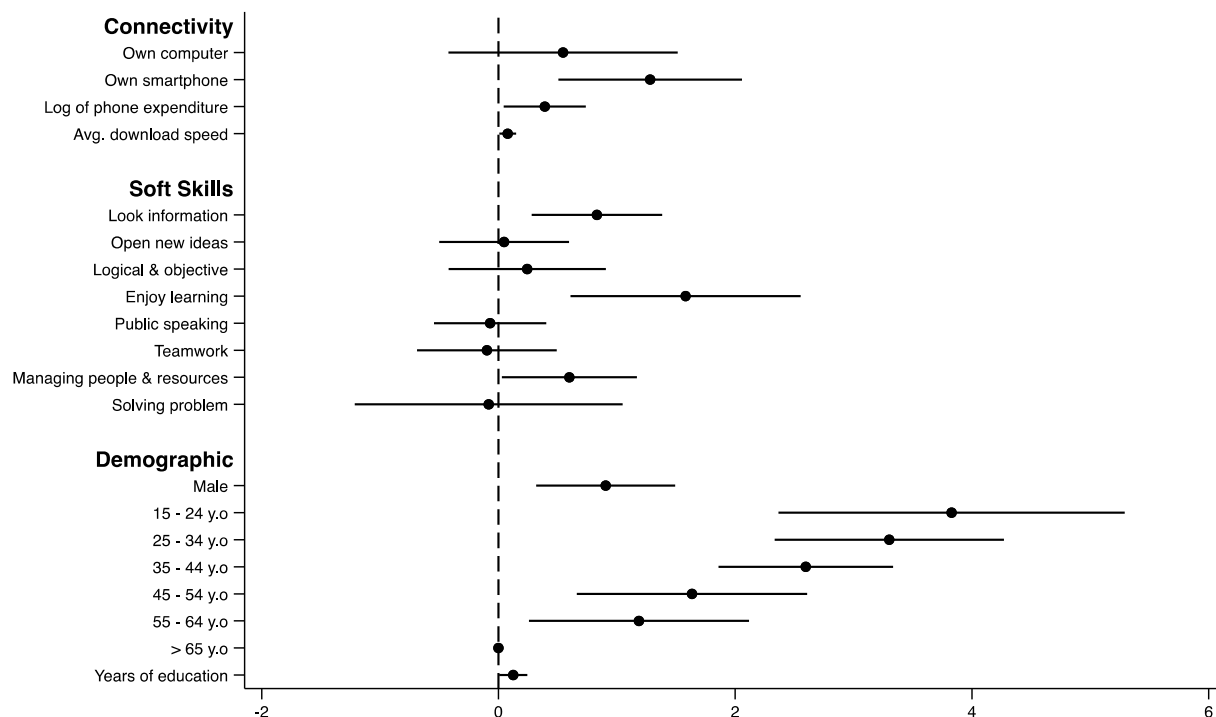
Source: DEHS 2020, Authors' calculations.



#### 4.4. Determinants of digital skills

Figure 5 presents the odds ratio estimates from the logit model, examining the factors contributing to the heterogeneity in digital skills among Indonesian digital technology and internet users. Overall, our findings align with the descriptive patterns characterizing the digital skills of individuals discussed earlier. Several key results stand out, as detailed below.

Figure 5: Estimated odds ratios for digital skills determinants using logit model



Source: DEHS 2020, Authors' calculations.

Note: The figure plots odds ratio from Logit model as described in section methodology. The dependent variable is a binary variable indicating if individual possess the skill to use ICT and internet. Covariates shown are few selected determinants of digital skills. Table A2 in the Annex presents the full results for five other aspects of digital skills.

**Connectivity:** First, both the quantity and quality of connectivity significantly influence individuals' digital skills. We found that individuals who own smartphones are 1.3 times more likely to possess the skills to use and operate ICT and the internet for information search. Interestingly, the result is not statistically significant for computer ownership, which may be due to computers still being a luxury for many Indonesians. Additionally, within-household connectivity plays a role; when more household members share ICT devices, an individual's digital skills are likely to decrease. We also found that internet quality, as measured by average download speed, increases the probability of having ICT skills by 4.7 to 7.8 percentage points, depending on the specific digital skill observed (Annex, Table A2).

**Soft Skills:** Our results also support the arguments outlined by the OECD's "Skills for the Future" (2016), which emphasize the importance of socioemotional and/or soft skills in effectively using digital technology. We examined eight types of soft skills and found that having a growth mindset and leadership skills (the ability to manage resources and people) are positively correlated with the likelihood of possessing digital skills. For instance,

individuals with a growth mindset are approximately 1.6 times more likely to have digital skills compared to those who do not value continuous learning. Leadership skills also increase the likelihood of having digital skills by 60-93 percent, varying across the six digital skill elements. These results are statistically significant and consistent across the six elements of digital skills examined in this paper (Annex, Table A3).

**Demographic characteristics:** Our findings indicate that males and younger demographic groups are better equipped with digital skills. There is a significant gender difference in digital skills, with males being 50% to 90% more likely to possess digital skills compared to their female counterparts. Additionally, we confirm the patterns observed in our descriptive analysis, where younger individuals are more proficient in digital skills, with the likelihood decreasing as age increases. For instance, those in the 25-34 age group are 2.3 times more likely to have skills in digital security compared to individuals aged 65 and older. These findings align with those from OECD countries, as shown in the PIACC 2019 survey. Moreover, our results also highlight a spatial disparity in digital skills, with individuals residing in urban areas being more likely to possess digital skills.

## 5. Conclusion

In this paper, we developed a framework to measure and analyze the digital skills of adult digital technology and internet users, focusing on Indonesia as a case study. This framework and dataset represent the first comprehensive effort to assess digital skills among the adult population in Indonesia. Our analysis of the determinants of these skills reveals several critical insights.

Connectivity, both in terms of device ownership and internet quality, significantly influences digital competencies. Specifically, smartphone ownership and higher internet speeds are positively associated with individuals' digital skills. Moreover, socioemotional or soft skills, such as a growth mindset and leadership abilities, are strongly linked to higher digital proficiency, underscoring the importance of these skills in the digital economy. Demographically, males and younger individuals are more likely to possess digital skills, with proficiency declining noticeably with age. Additionally, our findings highlight a spatial divide, with urban residents being more likely to possess digital skills compared to their rural counterparts. These results emphasize the multifaceted nature of digital skill development and the need for targeted interventions to address gaps in connectivity, soft skills, and demographic disparities.

Furthermore, our examination of Indonesian users' readiness to thrive in the digital economy shows concerning results. The majority primarily use digital technology and the internet for entertainment rather than for economic and productivity-enhancing activities. This suggests that improvements in digital connectivity have not yet fully translated into economic and productivity gains across all segments of the population. Indeed, earlier studies have also raised similar issues, whereby Indonesian workers lack advanced digital skills crucial to enhance their productivity at work (SMERU, University of Oxford, and UNESCAP, 2022).

Our study leads to several policy implications. First, digital inclusion and literacy must be integral to the human development agenda. Mastery of digital technology is as crucial as providing equitable connectivity. Second, the development of a comprehensive digital skills framework is essential for assessing and monitoring progress. This framework should encompass formal education, vocational training, and on-the-job training, supported by

robust digital infrastructure, educational investments, and an enabling policy environment. Although Indonesia's 2021-2024 Digital National Roadmap promises to address these issues, the specific conceptualization and measurement of digital skills within this roadmap remain unclear. Third, Indonesian users generally lack the advanced digital skills necessary to thrive in the digital economy. Therefore, the digital skills framework should integrate training in future skills in demand, particularly socioemotional and soft skills such as leadership and a growth mindset. Finally, government programs aimed at improving digital skills must consider disparities and target efforts to address the urban-rural and gender gaps in digital skills.

Overall, our findings contribute to the existing literature in several ways. Our data and analysis provide one of the first comprehensive assessments of digital skills in a developing country context, offering a benchmark for comparison with other regions. By analysing the determinants of digital skills, our paper highlights the importance of not only access but also the quality and mastery of digital technology. Additionally, our examination of the extent to which digital technology is used for productivity-enhancing activities adds a new dimension to discussions on the economic aspects of digital technology adoption. While our paper provides an in-depth analysis of the supply side of digital skills, further research is needed to understand the demand side. As governments work towards developing inclusive digital policies, it will be important to investigate the effectiveness of digital skills policies and initiatives in improving outcomes in the future.

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