

# **The Impact of Human Capital on Digital Literacy Index**

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## **Abstract**

Human capital is becoming an increasingly important factor in rural economic development. Economic research, however, has not provided clear empirical support for the relationship between human capital investment and economic growth. This paper applies to stock and flow concepts to human capital and suggests an operational approach for using stock and course concepts to analyse the impact of human capital investments through education on economic growth. This paper has two main goals. First, assess and measure gaps in human capital stock in this country. It shows how effectively the different regions improve human capital stock and how long it will take to bring developing countries up to date with current levels of human capital in industrialized countries. In contribution to the occupation of human capital economic growth, the proposed employment decomposition method growth is also affected by the development of human capital gross output per worker. The proposed method introduces job growth broken down by job growth elasticity. Assume employment growth increases with human capital elasticity will decrease, making the economy less labor-intensive, leading to higher economic growth. The proposed method emphasizes micro links between human capital and the labor market. This work aims to examine the relationship between human capital and economic development. The study analyzes datasets from previous works, reviews previous literature, and draws some conclusions on human capital and economic growth. The paper summarizes articles on human capital in terms of the theoretical framework of economic growth theory, the neo-classical growth model, the Solow growth production function, the new endogenous theory, and empirical evidence on the

relationship and causal link between human capital and economic growth. Assessing the literature on human capital and economic growth will serve as a comprehensive literature guide to policy formulation and implementation in the short and long run of developmental goals for any region.

## **Keywords**

human resource, human capital, digital literacy index, training program, labor-market, internet outcomes, and digital competencies.

## **1. Introduction**

Human capital is a concept used by social scientists to denote personal characteristics that are believed to be helpful in the production process. It includes employee knowledge, skills, know-how, health, and education, to name a few. For example, companies can invest in human capital through education and training to improve quality and production levels (Will 2019). For his conceptualization and modelling work with human capital as a critical factor, the 2018 Nobel Prize in Economics was co-awarded to Paul Romer. He founded modern innovation-driven approaches to understanding economic growth. The concept emphasizes that in many cases, human capital is accumulated specific to the nature of the task (or, skills required for the task), and the human capital accumulated for the task is valuable to many firms requiring transferable skills. This concept can be applied to job assignment, wage dynamics, tournaments, promotion dynamics inside firms, etc. Digitization and the gradual transition of the economy to the digital plane have recently become one of the priorities of economic development in most countries. New technologies create new opportunities for action and change all previously used activities, often even the overall structure of society; expected contribution to economic modernization, competitiveness development, improvement of living standards, and overall standards of welfare. Digital transformation affects all areas, including education. The outdated education system is the inability to produce graduates with the required qualities will be a serious problem, which in turn affects all other areas of functionality. The downside is that relatively large regions of the world lack a digital skills population. It usually refers to older generations and socially disadvantaged groups, but there is a big difference in this. High levels of digital skills can also be observed in the younger generation. However, the obstacles are not only that education systems persist in outdated form, but critical human-related areas are underfunded capital development and innovations that depend on it. Different governments' ways to support this key area in the future vary widely, especially within Europe when comparing Western European countries with Central and Southeastern European countries (Angrist et al. 2021).

Digital plays an important role in human interaction in society. Almost every individual has a dependency on technology. This phenomenon occurs almost all over the world, including Indonesia, which is a developing country with rapid growth in internet users. The average Indonesian spends nearly 8 hours surfing the internet (Kominfo 2020). Especially on social media, they spend an average of 3 hours 26 minutes. This reflects that people's social life is very dependent on the internet. Almost every aspect of life experiences digital technology intervention, especially socioeconomics (Pagani and Pardo 2017). Since its emergence, digital technology has slowly shifted conventional human relationship patterns and formed new social interaction patterns and systems based on digital (Olsson et al. 2020). Furthermore, social media has now become a new space for social interaction in human life (Bjonestad et al. 2020). Its existence, which allows conversations to be carried out without knowing space and time, has become a new arena for questioning opinions, ideas, battles, and issues (Back et al. 2019). So that the high internet penetration requires its users to adjust themselves so that social values do not degrade. Digital literacy is an important piece in realizing order in relations between citizens both in cyberspace and in the real world. The fact is that technological progress has not been matched by the social adaptability of society. This is reflected in the emergence of negative phenomena on social media such as cyberbullying, buzzers, hoaxes, social climbing, and various new crimes that have emerged digitally (Hee et al. 2019) (Indah and Zuhdy 2018) (Park and Rim 2020).

Technology advances in the 21st century and emerges a new way to get things done, not only in formal working activities but also in daily activities. One product of this advance is digital media. It changes how every aspect works, from hardcopy to paperless, from book to tablet, and from physical interaction to virtual collaboration. The Internet is no longer a complementary tool but a primary need in this era. This dynamic new world requires new comprehension and communication skills, as well as new codes of conduct, to ensure that these powerful media and technologies are used responsibly and ethically (Common Sense 2009). United States President Obama said that education delivery for kids nowadays is held in 20th-century schools when they should be prepared for 21st-century jobs. Education and technology are inseparable. He understood that our future leaders must have strong digital

technology skills and an unshakable ethical foundation underpinning their behavior in the digital world. An initiative master plan within ASEAN scope to promote economic integration toward FTAAP used ICT 1 as a hub to connect every participant country to create a single market. Strategic thrust no.5 to achieve this is human capital development in ICT (ASEAN 2015). This strategy is aligned with the need for technology-based education in order to prepare the Indonesian competitive workforce ready for 21st-century jobs.

Coming to the 21st-century, we enjoy the advantages of data, information, and knowledge on one hand, but on the other hand, we are also perplexed by the information overload, information explosion, false information, and misuse of knowledge (Jiva 2013). The convergence of portable personal technologies, unfiltered access to information, and user-generated content profoundly impact how this generation era grows and learns. There are more threats coming from content shared through gadgets, such as violence, cyberbullying, sexting, online predator (Burt 2010), and moral-value paradigm shifting. Digital literacy education is an approach to answer this digital era challenges, FTAAP agendas, and overcome problems related to digital media and ICT utility. Building consistency in the behaviour of using digital media wisely needs an understanding of what, why, and how the utilization must be held. Knowledge plays a causal role in attitude-behaviour consistency. This is the reason why digital literacy education should be conducted using a learning system embedded with knowledge management with the purpose to guide learners to achieve knowledge understanding so that it can lead to attitude-behaviour consistency. Previous explanations about the importance of digital technology in education, FTAAP agendas, problems and threats relying on digital media utility, and digital literacy education are background problems explored in this research paper.

One of the steps the government has taken is the implementation of the "Merdeka Belajar" program. This program is an effort initiated by the government to overcome the low absorption of industry in the workforce of higher education graduates in Indonesia (Siregar et al. 2020). This is because the school curriculum does not link and match the needs of the industrial world. Therefore, this program is designed to shorten the gap. Students are given more experience-based learning by directly joining the industry. The goal is to make students understand the real conditions of the working world. Furthermore, the estuary of this program is to prepare and build human resources to welcome a golden Indonesia in 2045 (Wahdani and Burhanuddin 2020).

## **2. Literature Review**

### **2.1. Unravelling Digital Literacy Concepts**

Digital literacy, skills, and competencies: what's the difference? The conceptual difference in digital skills, literacy, and abilities. These terms have different meanings but are often used as synonyms to define ability as "the ability to apply knowledge and skills in a variety of situations such as work, leisure, and study (Ala-Mutka et al. 2010). According to the work of van Deursen, literacy refers to certain competencies and knowledge, whereas skills refer to the more technical aspects of these competencies and knowledge. In his dissertation on Internet skills, distinguishes between four types of practice-oriented skills: (1) operational skills, or the so-called 'button knowledge' that refers to the operational manipulation of computer and Internet software and hardware; (2) formal skills, or the ability to understand and use formal characteristics of computer and Internet, such as hyperlinks or move between Internet pages; (3) information skills, or the skills required to search, select, handle and critically evaluate Internet and digital media contents; and (4) strategic skills, or the capacity to use the Internet to one's personal advantage. In his later work on Internet skills, fifth and sixth types of skills, namely communication skills and content creation skills, were added to refer to the skills needed to participate in online networks, online communication strategies, and the practical skills needed to create and distribute content on the Internet. Knowledge, skills, and abilities are distinguished. Knowledge is defined as "the body of facts, principles, theories, and practices related to the field of work or research". Skills are defined as "the ability to apply that knowledge," but abilities are considered "the proven ability to use that body of knowledge and skills for personal growth." Therefore, digital competencies are considered a more practical and measurable outcome of media, information, or digital competencies. "Digital capabilities are the perceptions, attitudes, and abilities of individuals who properly use digital tools and equipment to identify, access, manage, integrate, and manage digital resources, assessing, analyzing, and integrating new ones. Build. Create media expressions in the context of knowledge, and concrete living conditions, communicate with others and look back on this process to enable constructive social behaviour. " However, this interpretation of digital capabilities also highlights the overall complexity of the various types of skills that can be classified as digital skills. The above definition refers to aspects ranging from media content integration, rating, analysis, and even mere access to more complex elements. When considering digital skills, competencies, or competencies, it is important to consider not only conceptual differences but also overall complexity and multifaceted nature.

## **2.2. Digital Literacy Terminology**

Although the definitions of digital literacy share some common elements, at present, there is no overall consensus on the skill sets or knowledge base that might fully characterize the overall scope of digital literacy. The term and concepts related to digital literacy have emerged from prior conceptualizations and terms such as computer literacy, information literacy, and network literacy. Currently, the term digital literacy is being applied to, e-literacy, digital competency, and multimodal literacy which all describe different aspects of fluency in reading and navigation of digital materials (Beetham 2022).

## **2.3. Internet and Gadget Utility in Indonesia**

Indonesia has more than 43 million Facebook accounts and 19 million Twitter accounts as of January 2012 and has entered the digital era with a surge of about 400% in just one year. Regarding this fact, it is predicted that the number of devices in Indonesia will exceed the number of Indonesians. With the increasing trend of gadget utilities, internet access is becoming more dynamic and practical. According to a survey by the PEW Research Center (2013), data on smartphone ownership in Indonesia reaches 18% the ages of 18-29 and 9% the ages of 30-49 (Wike and Oates 2013) These statistics show that Indonesian people are already adopting digital technology in gadgets, especially internet-based digital media accessed via mobile phones. Digital literacy associated with the usefulness of digital devices can be rated as medium to high. In addition to this feature, gadget users need to understand how to use digital technology wisely.

As already mentioned, the progressive digitization process has led to the transition of various organizational forms to economic activity. Therefore, it is necessary to modernize the education system in order to train people with the necessary qualifications for new professions. Given the close relationship between ongoing digitization and Industry 4.0, the concept of Education 4.0 comes to the fore. This includes four aspects: professional education, financial education, economic education, and digital education (Sima et al. 2020). The education system of each country is gradually reformed and enriched with new elements. Nevertheless, the enormous potential of digital technology to improve education remains largely undeveloped (Abdovakhidov et al. 2021) New technologies not only facilitate and accelerate access to information and facilitate its processing and storage, but also bring new elements to the educational process. If desired, the entire education process can be moved to virtual space and run using specific tools without impacting the level. However, there are concerns that the quality of education provided in this way is inadequate during the ongoing Covid-19 pandemic. In the long run, consider whether such an implementation will reduce the level of knowledge and skills of the student. Concerns about quality degradation are natural and need to be addressed, but the enormous benefits that such training can provide cannot be overturned. Universal access for everyone. In situations where the pandemic forced people to minimize social contact, online connectivity was a factor that allowed the ongoing process to continue smoothly. Whenever possible, all activities have been moved to this mode. The transition to new working conditions was initially a challenge for both parties. In many cases, it was a challenge not only for training providers who did not have the necessary ICT equipment but also for recipients who were forced to learn how to use ICT for a short period of time. Until now they have rarely used it. The crisis caused by the pandemic is accelerating the pace of implementation of digitizing elements in society and is seen as one of the few positive aspects. Under his influence, many services offered over the Internet were previously perceived as minor by most people but have become very necessary.

There is some debate about unused technical possibilities when it comes to digitizing educational systems, but some studies argue that the efforts associated with digitizing individual processes should not be exaggerated. Before we can take advantage of new trends, we need to set our goals to be achieved so that we don't use technology in areas where we don't need it at all. Implementations need to take into account the needs of teachers and students in particular, as well as the opinions of other professionals such as psychologists and IT specialists. We recommend that you step through the rollout process to give new users enough time to get used to the new way of working. This is the only way to achieve the expected results from the implementation of digital technology. Had the pace of their implementation been disproportionately fast, it would likely have created a wave of resistance and negative attitudes from potential users.

The importance of digital technology will gradually increase in all manufacturing and non-manufacturing sectors of the economy. This will put increased demands on the higher education system in particular, as higher education is expected to generate human capital, which will be crucial for the future socio-economic development of individual

countries (Ershova et al 2021). All developed countries are aware that the higher the level of education within a society, the more efficient economic performance, and thus the income and quality of life in the country is increasing. Therefore, investing in higher education and closely related research and development or innovation areas is becoming a priority. Even today, however, it is possible to meet with opinions that deviate from the majority and do not attach such great importance to education. For instance, already in the second half of the 20th century, Randall Collins diverged from the thesis of the interaction between economic growth and increasing the level of human capital, thus creating room for controversy as to whether innovation is a source or a consequence of countries' economic progress. He argued that even a high level of formal education brought nothing to the economy, but on the contrary, the fast pace of economic development in recent times has generated sufficient resources to invest in education, and therefore those two categories are often mistaken to be related. According to him, the increase in the number of people with a university degree is a consequence and not the cause of the economic boom in individual countries. However, the world development trends show that Collins's view cannot be fully accepted, as those countries that put great emphasis on the quality of education and adapt education systems to new requirements are among the most successful and progressive ones. Of course, these countries must have a number of other conditions in place, closely linked to each other, first of all, within the potential usage of their people.

Even today, there is a situation where the two mentioned facts are met. Monitoring investment in human capital and adapting the education system to the new demands that arise from the digital transformation of society is an important issue. These processes have a decisive impact on labor market performance. Attention focuses primarily on possible risks. The issues highlighted are the deepening of social inequality, and the inadequate ability of some groups of workers to develop digital knowledge and skills, to the extent that the digital economy creates the conditions for developing human potential, as automation and robotics are carried out in most of the production process (Davydova et al. 2020). Labor market modernization should take all these facts into account and aim to improve information transparency, mobility, IT skills, and the realization of human potential. In the long run, digitization is expected to reduce labor demand, increase atypical employment patterns, and widen wage gaps within occupations. This is one of the reasons why we need to emphasize flexibility to motivate potential employees. In addition to the changing conditions associated with labor market performance, attention must be paid to the adjustment of the social security system to these new situations, and in this context, the concept of unconditional basic income becomes technological unemployment. It must be considered as a solution to tackle (Jepsen et al. 2021). Technological unemployment seems to be the biggest threat to the digital economy, but it is difficult to predict how much it will occur. There is already a lot of unemployment in certain sectors, and forecasts show that the pace of unemployment is even faster. However, these predictions should be made with caution. The mere potential of automation and digitization has many economic, legal, and other regulatory constraints, with a significant time delay between the discovery of new technologies and their widespread adoption in the global economy. Technological unemployment is a threat, but it does not necessarily mean unemployment. This is also evidenced by the development of many developed countries. Recently, many jobs have been replaced in certain sectors of the economy, but many new jobs have been created in other emerging and more promising sectors. It is precisely these changes that are changing the structure of individual economies, which should be a reason to point out the need to prepare people with new qualifications for the labor market.

In Indonesia, education in digital literacy and ICT skills is conducted in the school's IT curriculum for technical skills and in informal blogs or portals for general knowledge of ICT. Learners in ICT-rich environments need to be independent learners and are inevitably forced to adapt to the complexity of the ICT environment. However, its implementation is constrained by the limited quantity and quality of ICT infrastructure, and Indonesia's economic problems are complicated by the lack of public awareness and knowledge of ICT. There are several initiatives dedicated to ICT education for Indonesian citizens, including digital literacy materials. The first is ICTWatch2, whose main purpose is to raise the skills and awareness of citizens in order to enable negotiation and use of the Internet and the Web. Digital literacy is the ability to understand and use different forms of information from multiple sources when presented via a computer, especially on the Internet (Knobe & Rankshear, 2006). Gentikow expressed another opinion in 2015. Digital literacy means using digital technology, communication tools, and networks to access, manage, integrate, evaluate, create, and act as public knowledge. In other words, digital literacy concerns the ability to adapt to both operational and functional technology while preserving social value. Operating ability is an essential skill in digital literacy where people understand how technology works. Operational capabilities are fundamental because we only know technology at this level. The next level is functional skills, knowing and understanding how a technical system works and its features and benefits. The final level is social

skills, and he can not only understand how a person works and functions at this level but also add to the social value that exists in society.

A survey conducted by the Indonesian Ministry of Information and Communication in 34 Indonesian states in November 2020 found that Internet users' digital literacy level is still low. The survey sample was extracted from August 18-31, 2020, by multi-stage sampling using the home visit procedure. The total number of respondents: was 1670. Tolerance  $\pm 2.45\%$ , 95% confidence level. Respondents are household members between 13 and 70 and have had internet access in the last three months. The efficacy and reliability check was conducted on August 11, 2020. Low digital literacy is reflected in many problems caused by the lack of digital literacy, including 1,064,000 immoral content, 233,000 gambling, and 10,700 content fraud (Kominfo, 2020).

### 3. Research Objectives & Methods

The format of this survey is descriptive. According to Suharsimi Arikunto (2013: 3), "descriptive research is research conducted on situations, conditions, etc., and the results are presented in the form of research reports." According to Sukmadinata (2011), qualitative descriptive research describes and describes existing phenomena, both natural and artificial, with more attention to the characteristics, quality, and interrelationships between activities. I am aiming for it. , Activities, features, changes, relationships, similarities, and differences between one phenomenon and another. A suitable type of study for this method is discourse or phenomenological analysis, which does not test the hypothesis. The data sources used were extracted from various written sources, including synergistic books, studies, articles, or websites related to the topics discussed. The data collected was analyzed in the cases covered in this study. The results of the analysis are displayed in the form of descriptive explanations. The procedures performed by this method of investigation include 1) selection and determination of the problem to be investigated, 2) searching for related investigations and conducting library observations by investigation, and 3) supporting that may help elucidate the current phenomenon. Data search, 4) editing and analysis. Various explanatory materials to help readers understand the results of this survey.

#### 3.1. Number of ICT specialists

In 2021, about 9 million people will work as ICT specialists in the European Union (EU). The most significant number (2 million) work in Germany, with more than one-fifth (22.5%) of the EU's ICT workforce finding jobs. France (1.2 million) has the second largest ICT workforce (13.9% of the EU total), followed by Italy (800,000; 9.5%).

#### 3.2. Relative share of ICT specialists in the total workforce

Across the whole of the EU, ICT specialists accounted for 4.5 % of the entire workforce in 2021 (see Figure 1).

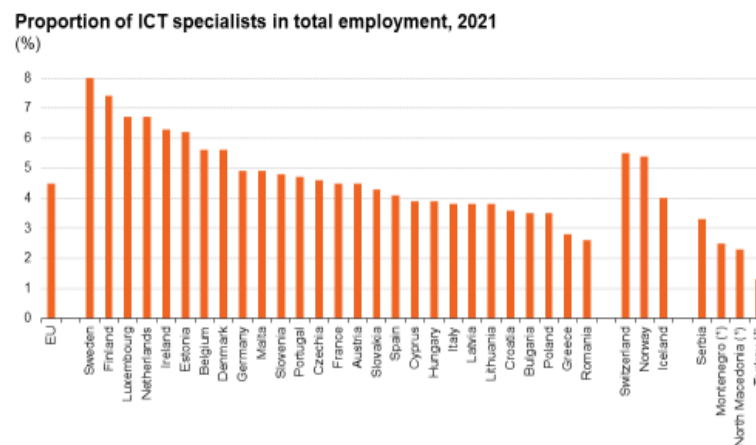


Figure 1. The proportion of ICT specialists in total employment, 2021 (%), Source: Eurostat (isoc\_sks\_itspt)

Sweden has the highest relative share of total employment as an ICT specialist, with 407 100 people employed as ICT specialists, 8.0% of Sweden's full employment, followed by Finland with about 188,000. ICT specialists account for 7.4%. For total employment. A relatively high percentage of people hired as ICT specialists in 2021 was also recorded in Luxembourg, the Netherlands, Ireland, Estonia, Belgium, and Denmark, all of which have at least 1 in 20 ICT specialists in total employment—reported that he was employed as. In contrast, on the other side of the scale, ICT specialists account for 2.6% of Romania's total employment and 2.8% of Greece's. Among the EFTA countries, Switzerland has a relatively large number of ICT specialists, followed by Norway, with a relative share of total employment above the EU average (5.5% and 5.4%, respectively). In Iceland, 4.0% of all workers are employed as ICT specialists. For candidate countries, each share of ICT specialists in total employment is below the EU average, based on data from Serbia in 2021 and other countries in 2020. In most European countries, most people working in ICT have a university degree. Also, recruitment portals in this area usually mention a degree from a first or second university as a prerequisite for an applicant. However, this fact is not only seen negatively, as the level of education achieved varies from country to country, and it is difficult to compare the quality of graduates of individual degrees internationally.

### 3.3. General developments in demand for ICT specialists

Over the past decade, the number of people employed as ICT specialists in the EU has generally withstood the effects of the global financial and economic crisis and many labor market downturns. As a result, the share of ICT specialists in total employment increased by 1.3 points from 3.2% in 2012 to 4.5% in 2021 (Figure 2).

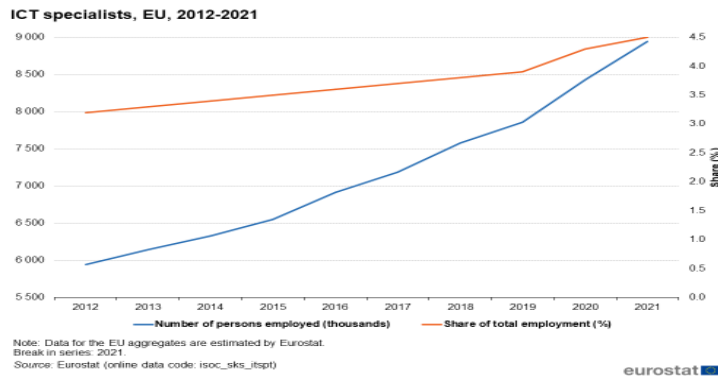


Figure 2. ICT specialists, EU,2012-2021 Source: Eurostat (isoc\_sks\_itspt)

The number of people employed as ICT specialists increased by more than 50.0% between 2012 and 2021, less than eight times the corresponding increase in total employment (6.3%) (see Figure 3). Over the last decade, ICT specialist employment has grown at a compound annual growth rate of 4.6%. After a monotonous increase between 2012 and 2019, the number of people hired as ICT specialists in 2019 and 2020 shows the highest increase at 7.3%. In the last year of the decade, progress was slightly slower, but it was still the second highest in the decade at 6.1%. This overall growth trend may reflect digital transformation affecting the economy (Figure 3).

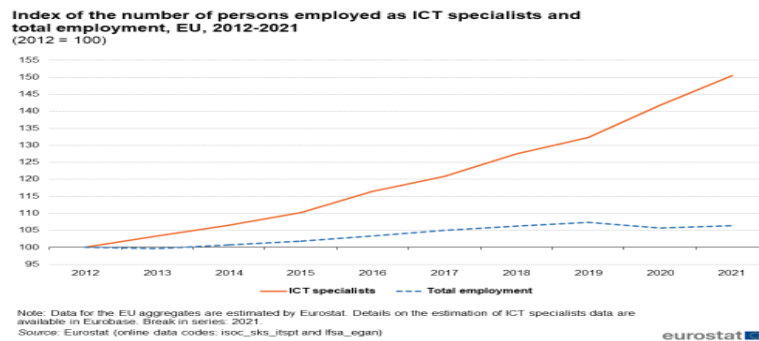


Figure 3. Index of the number of persons employed as ICT specialists and total employment, EU, 2012-2021(2012 = 100) Source: Eurostat (isoc\_sks\_itspt) and (lfsa\_egan)

Human capital in ICT is a driving force for digital and digital-enabled innovations and may be considered crucial for the competitiveness of modern-day economies. Although this labor market segment is quite small in absolute terms, ICT employment was relatively resistant to the cyclical nature of economic events during the most recent decade for which data are available. Indeed, as can be observed in Figure 3, annual rates of change for the number of persons employed as ICT specialists were consistently higher than those recorded for total employment across the EU economy. In the first two years of the decade, the rates of change for the number of persons employed as ICT specialists in the EU and for total employment showed slightly different patterns. Whilst the number of ICT specialists in hire grew with an annual average rate of 4.7 %, full employment grew by 0.7 % each year. Only in 2014 did total employment recover the values attained three years before. The global financial and economic crisis and its aftermath did not seem to affect the number of ICT specialists employed in the EU. The transition between 2019 and 2020 led to the highest annual progression of the index of the number of persons employed as ICT specialists ever observed during the decade, with a jump of 10.4 points of the index. The tendency continued in 2021: ICT specialists reinforced their progression in the total workforce at the rate of 6.1 % mainly above the 0.6 % increase in full employment.

### **3.4. Education at a Glance: OECD Indicators (OECD, 2019)**

OECD is the authoritative source for information on the state of education worldwide. It provides data on the structure, finances, and performance of education systems in OECD and partner countries. In 2017, about 16% of young adults in Indonesia had attained tertiary education, well below the G20 average of 38%. More young adults in Indonesia have earned a bachelor's degree than a short cycle tertiary qualification, but few have attained a master's degree. About 90% of young men in Indonesia are employed, regardless of their level of education, in contrast to young women, whose employment rate is 30 percentage points higher for those with a tertiary education compared to those with only upper secondary. Enrolment among younger children still lags most OECD countries. In 2017, only 3% of children under the age of two were enrolled in early childhood education and care in Indonesia, well below the OECD average of 21%.

Adults have greater educational attainment than in the past, but few have gone beyond a bachelor's degree. In 2017, about 16% of 25–64-year-olds in Indonesia had attained tertiary education, well below the OECD average of 44% and the G20 average of 38% (Figure 1). Bachelor's programs are the most popular form of tertiary education among young adults in Indonesia: 12% of 25–34-year-olds have earned a bachelor's degree, compared to 4% for short-cycle tertiary qualifications. Not many young adults will graduate with a master's or doctoral degree in Indonesia: only 1% have attained a master's degree and below 0.01% a doctorate (OECD averages: 14% and 0.8%). Young adults in Indonesia are reaching higher levels of education than before. About 26% of 25-64-year-olds have attained upper secondary or post-secondary non-tertiary education compared to 34% of 25-34-year-olds. The same pattern is found at the tertiary level: about 12% of 25–64-year-olds have attained tertiary education, but among the younger generation, the share has gone up to 16%, indicating a steep upward trend in attainment. Tertiary graduates enjoy similar labor-market outcomes to their peers in OECD countries (85%), with an employment rate of 85%. As in most OECD countries, higher educational attainment in Indonesia is associated with an increased likelihood of employment. However, unlike in most OECD countries, adults (25–64-year-olds) who have not completed upper secondary education have similar employment levels to those who attained upper secondary or post-secondary non-tertiary education (73% compared to 74%) and enjoy higher employment rates than the average across OECD countries (59%). In contrast, the average employment advantage for tertiary-educated adults in Indonesia is 11 percentage points over those with upper secondary education, compared to 9 percentage points on average across OECD countries. At the tertiary level, the broad fields of education, health and welfare, and information and communication technologies (ICT) are the most popular in Indonesia. Among those who graduated from tertiary education in 2017, 24% studied education (G20 average: 11%), 17% studied health and welfare (G20 average: 13%), and 9% studied ICT (G20 average: 4%). Women comprised about 78% of those looking for health and welfare and 35% of those looking for ICT, compared to 71% and 27% across G20 countries.

### **3.5. Vocational Upper-Secondary Education**

Indonesia's Technical and Vocational Education and Training (TVET) is unavailable both within the formal school system and in apprenticeships at the State Vocational and Skills Education Center (Balai Latihan Kerja, or BLK) or in any other vocational or training program. It will be officially done. .. In a formal system, vocational education



begins in high school and is provided by both secular vocational schools (SMK) and sectarian schools (MAK). The archipelago has more than 10,000 traditional vocational secondary schools, most of which are located on the populated islands of Java and Sumatra, about 70% of which are private. As mentioned above, more than 50% of Indonesian high school students are studying general education. Still, the government has significantly expanded VET and changed the enrollment rate, and by 2020 70% of students will have a severe problem. I am aiming to study VET preferentially to alleviate the pain. Shortage of skilled workers. In 2016, the government predicted that Indonesia would need 3.8 million new skilled workers each year until 2030 to fill the gap of 56 million skilled workers. (Figure 4)

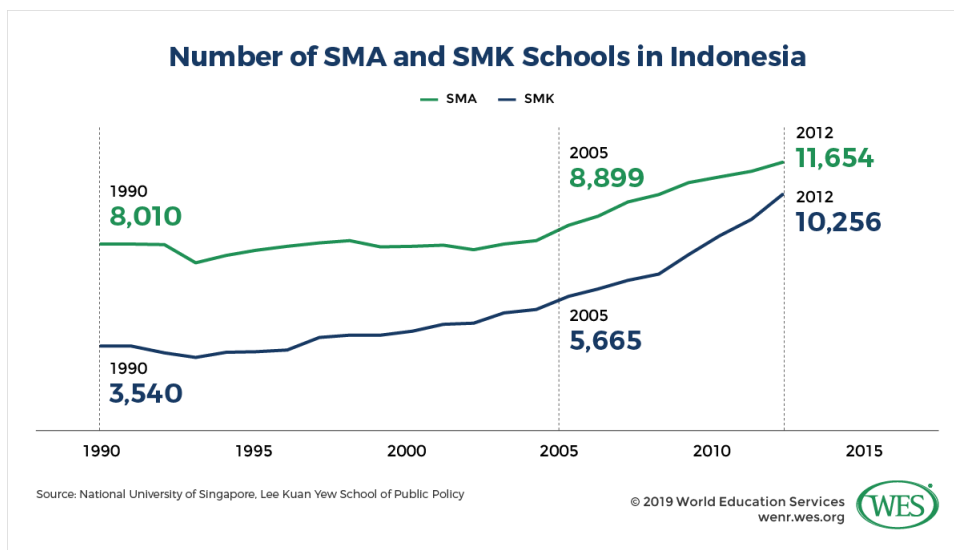


Figure 4. Number of SMA and SMK Schools in Indonesia, 1990-2015  
Source: National University of Singapore, Lee Kuan Yew School of Public Policy

The SMK program typically lasts from 9th grade for three years, but there is also a 4-year "SMK Plus" option. These cover secondary and post-secondary education and lead to awarding a one-year post-secondary diploma (D1) in addition to higher secondary education. Vocational high schools offer more than 140 different disciplines, including agribusiness: technology, Allied Health, Business and Management, Information and Communication Technology, and Engineering Technology. However, 60% of all students are enrolled in just ten popular majors, including accounting, computer engineering, marketing, automotive engineering, multimedia, or office management. Most vocational schools specialise in technology and industry (86%) and business and management (76%). The SMK program consists of a core general curriculum (including so-called normative subjects such as mathematics, Indonesian, English, science, social sciences, religious education and civilian) and vocational subjects. Some programs may include internships and other hands-on training components. After completing the program, students will take national exams in general and vocational subjects after completing the program. Graduates will receive a certificate of skill from Ijazah SMK and their specialty. Currently, students are planning to obtain formal vocational training qualifications in their research to enable graduates and dropouts to get higher quality qualifications in the labor market.

### 3.6. Measures of Digital competence

The questionnaire developed by He and Zhu (2017) was used to measure students' digital competence. Because this instrument included three dimensions (i.e., TS, CS, and EK), which measured the particular types of skills and knowledge required for using digital technologies (He & Zhu, 2017), the TS, CS, and EK dimensions had 11, 12, and 7 items; respectively Each item had to be scored on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). The instrument's reliability was Cronbach's  $\alpha = 0.85$ ; in addition, the reliability of the TS, CS, and EK dimensions was reported to be 0.81, 0.82, and 0.84, respectively (He et al. 2018). Also, in the present study, the instrument's reliability for the TS, CS, and EK dimensions was measured using Cronbach's alpha, and their reliability was estimated to be 0.91, 0.86, and 0.81, respectively. The acceptable value of Cronbach's alpha typically

ranges from 0.7 to 0.95; however, values above 0.6 have also been considered good (Taber, 2018). In the present study, the validity of this instrument was examined using confirmatory factor analysis.

#### **4. Results**

From a theoretical and policy perspective, this study rests on the assumption that sustainable competitiveness depends on and determines the strength of an innovation-based economy (Montalvo, 2006, Santos-Rodrigues et al. al., 2010). The theoretical framework considers: First, the concept of innovation, the determinants of innovation, and the types of innovation companies undertake. Next, a theory of human capital as a factor of innovation at the firm level is presented, and finally a newly developed theory underlying his IHC is presented. The focus group study was a large-scale study in which both quantitative and qualitative methods were employed and triangulated to understand various phenomena and barriers in the application of digital skills among university students. Researchers have chosen to use focus group methods to collect detailed information on specific topics of research. For example, we analyze students' perceptions of finding and retrieving information from digital content, and how they use their digital competencies for applied digital content access and learning use.

The survey highlights a continuing and growing concern among educators about the ability of young people to critically use digital content to meet their information needs. However, the impact of new digital technologies on redefining content and education, especially in the context of young people and students in Indonesia, is still under-explored. As such, both educators and students need to rethink their perceptions of what it means to be literate in a digital, technological world. The findings will further help educators and policy makers identify the best approaches needed to improve young people's digital literacy. This allows young people to effectively obtain and process information for academic purposes and later to help them with their employment and career purpose. This research will contribute significantly to the development of a digital literacy education framework to improve the digital literacy skills of Indonesian students.

##### **4.1. Digital informal learning**

The questionnaire designed by He and Li was used to measure students' DIL. Because they measured the students' informal learning behaviors in their daily life while using digital technology. This instrument included three dimensions (i.e., CL, SML, and MCL). The CL dimension contained four items, as did the SML and MCL dimensions. The reliability of the instrument was more significant than 0.70. In Belgium, the Cronbach's alphas for the CL, SML, and MCL dimensions were reported to be 0.79, 0.83, and 0.80, respectively. The alpha coefficient for this study's above three dimensions was 0.81, 0.82, and 0.83, respectively. The validity of this instrument was examined using confirmatory factor analysis (He and Li 2018).

##### **4.2. Procedures**

The main objective of this study was to examine the relationship between students' digital competence and their academic engagement with the mediating role of DIL. To this end, three main questionnaires were translated from English into Persian. Then, the translated questionnaires were approved by several translators and experts. Afterwards, the final versions of the questionnaires were sent to different groups in the sample. All sample students participated voluntarily in the study and received no incentive. Student participants were asked to answer and return the questionnaires within a week. Later, a reminder mail was sent to all participants to increase the response rate to the questionnaires. After the questionnaires were collected, the non-responding participants were checked to see whether they were equally distributed among different fields of the study and degree levels to avoid sampling bias. Finally, the data were analyzed using SEM to determine the relationship between the research variables. It should be noted that the data for this article is part of a more extensive data set—a part of it was used in this paper, and the other part was used in another form by Mehrvarz et al. (2021).

#### 4.3. Knowledge Base and Knowledge Transfer.

The knowledge base is storage, where knowledge is collected, processed, and prepared for transfer as learning material. Accumulated knowledge is about digital literacy with a broad scope of discussion covering three digital literacy dimensions. Knowledge as learning material is delivered in the form of one of these knowledge types, answering questions about what and the importance (why), best practice (how to do it), tips and tricks (maintenance), problem case examples and how to solve it (case solving). Goal-based knowledge is then delivered to learners through three types of transfer activities: Diffusion, dissemination, and implementation. Distribution for promoting awareness about digital literacy utilizes available knowledge accessed via every interface tool. Diffused knowledge answers what and why questions. (Figure 5)

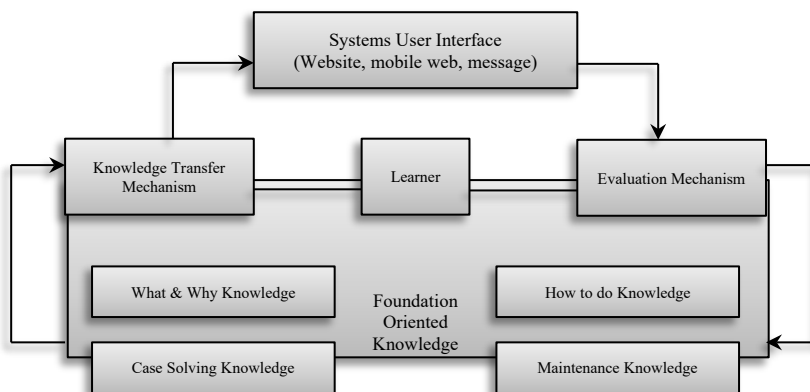


Figure 5. Knowledge transfer mechanism using Systems User Interface

It is processed and delivered to the general audience. Dissemination involves activities with particular learners. This activity needs learner profiling provided by the learner persona. They are learning material for this type that discusses how to do and maintain knowledge. Implementation is a transfer activity to create behavior change. Dissemination and implementation are held with the collaboration feature provided in the user interface. The knowledge delivered for the implementation activity discusses problem-solving cases. The main contributors to this type of knowledge are experts and practitioners. Collaboration with previous digital literacy education initiatives could enrich the knowledge base. This activity allows the learners to share their cases which are later moderated to be stored in the knowledge base.

#### 4.4. Evaluation and Learner Persona

Evaluation is conducted to assess learner comprehension of digital literacy. Comprehension is assessed for its understanding level and content level. Understanding consists of five levels that lead to attitude-behaviour consistency. These five are know-what, know-why, know-how, know-best practice, and know-how to solve problem cases. Content level refers to bloom's digital taxonomy. Learner persona/profile describes personal, or group characteristics determined by one or more of these categories: basic goal, age, role, social class, understanding level, and content level. This broad range of characteristics covers every party involved as digital media users (digital literacy learners) in Indonesia. Learner understanding aims for attitude-behavior consistency in utilizing digital technology in proper and effective ways and expertise in working-with-ICT competencies.

#### 4.5. User Interface

The user interface provides interactive media between the learner and the learning system. It utilizes digital media with specific functions and features to support knowledge transfer and evaluation. It is implemented using technology such as websites, mobile web, social media, and SMS broadcasts. The first function of the user interface is delivering learning material from the knowledge base. The knowledge diffusion process can be conducted using websites and mobile websites to deliver any type of knowledge. The knowledge dissemination process can be conducted using websites, mobile web, social media, and SMS broadcast to particular and engaged learners. The knowledge implementation process can be conducted using websites, mobile web, and social media to deliver knowledge about problem-solving cases and provide collaboration media for learners and the knowledge worker12 team to discuss. The Second function of the user interface is delivering tests and feedback between the learning

system and the learner. Test content is a summary of learning material taken from the knowledge base to evaluate the digital literacy understanding of the learner. Feedback is presented by learners as digital literacy comprehension state evaluation.

The link between strengthening digital literacy and improving the quality of human resources efforts to improve the quality of human resources can be done in various ways. Strengthening literacy is one way to improve the quality of Indonesian people in facing the competition in the digital era. Here are some of the benefits a person can get from mastering digital literacy:

1) Maximum Use and Utilization

Technical recognition and understanding of the technology enable users to make the most of it for their intended purpose. For example, understanding the functions of search engines will make it easier for someone to find the information needed,

2) Digital Resilience

Digital resilience is understanding when you might be at risk online, knowing what to do if something goes wrong, learning from experience, and being able to form self-defense against the negative effects of the internet. Digital resilience is born out of good literacy about how the internet works and how it impacts personal and social life.

3) Positive and Productive Personal

A good understanding of digital literacy will enable someone to map potential threats in the online world. This will make you focus more on potential and avoid negative impacts. The implication is an increase in one's productivity.

4) Part of Global Citizen

5) The internet has boundaries between countries in the world.

The difference between distance and time seems insignificant when everyone is connected to the internet. The consequence is the creation of digital norms and values that are mutually agreed upon throughout the world, such as the principles of universality, gender equality, tolerance and respect for human rights. The role of digital literacy will help accelerate Indonesia to become part of the world community.

## **5. Conclusion**

The focus of digital literacy activities in schools is to promote a culture of literacy. To achieve this goal, strengthen facilitation skills, increase the number and variety of quality reading sources, increase access to learning resources and learner coverage, increase public participation, and strengthen governance. In order for these factors to be closely related and to perform their functions optimally, cooperation among national educators, from the government to the smallest unit, the family, is very important. A well-functioning digital skills program creates a great national generation. Digital literacy education has an important role in protecting the generation of the country from the negative effects of the digital world. Therefore, attention is being paid not only to increasing human capital but also to developing digital skills for the population.

On the one hand, the education system needs to be modernized so that people with new skills can be trained. Public spending on education and R & D. The limitation of the research is that our research is based on quantitative indicators, but some authors argue that the quality of human capital needs to be comprehensively expressed by qualitative indicators as well. Another limitation is that this type of research cannot reliably determine the impact of human capital quality on economic indicators. Therefore, the attention is rightfully focused on increasing the level of human capital, but also the development of digital skills within the population. On one hand, education systems need to be updated and able to train people with new skills. Of course, there is no need to increase the number of people with a university degree and to increase the share of public expenditure earmarked for education or research and development. The crucial issue is which sectors are promising and soon there will be an increased demand for them in the labor market, as well as to which areas of research and development the increased expenditures should be oriented.

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