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LINKING DIGITAL LITERACY TO WORKFORCE DEVELOPMENT AND MACROECONOMIC GROWTH

Nurul Fadilah Aswar*

Universitas Negeri Makassar

E-mail: nurul.fadilah.aswar@unm.ac.id

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Abstract

This study examines the linkage between digital literacy, workforce development, and macroeconomic growth in the context of an increasingly digitalized economy. Moving beyond descriptive approaches, it investigates how digital competencies function as a critical mechanism shaping labor productivity, innovation capacity, and economic performance. Using cross-sectoral data and workforce survey evidence, the study analyzes the extent to which digital skills contribute to workforce adaptability and organizational efficiency. The findings reveal that higher levels of digital literacy significantly enhance workforce development by improving skill alignment, fostering innovation, and increasing competitiveness across industries. At the macro level, these improvements translate into measurable contributions to economic growth through productivity gains and structural transformation. Furthermore, the study underscores the importance of multi-stakeholder collaboration among educational institutions, industry, and government in designing integrated digital literacy programs. Such coordinated efforts are essential to ensure sustainable skill development and long-term economic resilience. This research contributes to the literature by providing an integrated perspective that explicitly links digital literacy to both workforce development and macroeconomic outcomes, offering practical implications for policymakers and stakeholders in shaping inclusive and sustainable growth strategies.

Keywords: *Digital literacy; Workforce development; Macroeconomic growth; Labor productivity; Innovation capacity; Economic transformation, Human capital; Skill development*

1. INTRODUCTION

In recent decades, the development of information and communication technology (ICT) has dramatically changed the global economic landscape, this is due to the increasing automation and use of technology in various sectors of activity. One of the main competencies in the midst of technological transformation that determines the ability to participate in the global economy is digital literacy. Digital literacy involves not only the basic ability to use technological devices, but also includes a deep understanding of how these technologies can be used to drive economic efficiency, innovation, and social inclusivity (Helsper, 2021). In the context of the global economy, digital literacy plays a strategic role in increasing productivity, expanding markets, and optimizing supply chains through technology integration (Miller & Atkinson, 2020).

The digitalization of the economy has brought fundamental changes to the way people interact and transact, where digital technology has created an increasingly connected business environment. This development can be seen from cross-border transactions that occur in seconds, and decision-making relies on real-time data (Westerman et al., 2014). This is because digital literacy plays a strategic role in increasing productivity, expanding markets, and optimizing supply chains through technology integration (Miller & Atkinson, 2020). Countries with high levels of digital literacy show faster economic growth because they are able to adopt technology to increase productivity, efficiency, and international competitiveness (Castells, 2010; Van Dijk, 2020; Chen et al., 2021). For example, research by Ahmed et al. (2021) shows that the application of digital technology in developing countries increases the contribution of the MSME sector to Gross Domestic Product (GDP) by up to 20%. The research is also supported by the results of a meeting from the Organisation for Economic Co-operation and Development (PTM OECD) in Paris in 2020 which stated that digital literacy increases the contribution of the information technology sector to the economic growth of developed countries by up to 25%. This is due to its ability to drive innovation and facilitate participation in the global digital economy.

Apart from improving the country's macroeconomic sector, it is known that digital literacy encourages economic inclusivity by opening opportunities for vulnerable groups to participate in the digital economy. Research by Yoon et al. (2022) states that digital literacy contributes to reducing economic equality through wider access to jobs and educational resources. By improving digital skills among vulnerable communities, such as women and rural communities, digital literacy can reduce economic and social disparities (Heeks, 2020). For example, a digital literacy program in India documented by Khan et al. (2021) has succeeded in increasing the income of rural communities by 30% through technology-based entrepreneurship training. This is in line with a UNESCO report (2021) which emphasizes that digital literacy strengthens individuals' ability to make optimal use of the digital economy, especially among women and rural communities.

Digital literacy itself includes the basic ability of individuals to use information and communication technologies, but also includes skills in navigating critical information, interacting in a digital environment, and utilizing technology as a tool for economic and social development (Czerniewicz & Brown, 2020; Helsper, 2021). These skills will not only affect an individual's ability to participate in the job market, but also make a significant contribution to overall economic growth. As stated by Hase et al. (2020), digital literacy not only improves job skills, but also encourages participation in the knowledge-based economy, which is becoming increasingly relevant in the global context. In the midst of rapid digital transformation, it is important for people to understand and utilize digital tools and platforms to increase productivity and innovation. Because individuals with high digital literacy are better able to adapt to technological changes and dynamic market demands (Müller & Jansen, 2020). This is because digital literacy contributes to better access to information and resources, which in turn drives economic growth and creates new jobs (Bennett et al., 2021). Therefore, it can be understood that in the context of the modern economy, digital literacy not only affects the ability of individuals to participate in the job market, but also has a broader impact on macroeconomic trends and workforce development. So every country must prepare a competitive and adaptive workforce to rapid market changes.

While digital literacy has a significant positive impact, global challenges remain. This is because not all countries have equal access to digital literacy. In developing countries, lack of

technological infrastructure, internet access gaps, lack of training, education levels, social vulnerability and low digital inequality are the main obstacles (World Bank, 2020; Donovan et al., 2020). Research from Salamzadeh et al. (2021) shows that strengthening digital literacy in the Southeast Asian region still faces systemic obstacles, including unsupportive regulations and a lack of cross-sector collaboration. The research was also reinforced by Gillwald et al. (2021) where they showed that in sub-Saharan Africa, the lack of digital literacy has an impact on limited access to technology-based job opportunities, thereby slowing down economic growth. From this phenomenon, it can be seen that countries that fail to improve digital literacy among their citizens are at risk of falling behind in global competition (Choudhury & Kaur, 2019). Therefore, challenges related to digital literacy must also be overcome, including unequal access and training in various community groups. Choudhury and Kaur (2019) stated that without proper attention to the development of digital literacy, social and economic gaps can widen.

To face these challenges, collaboration between the government, the private sector, and the public is needed to create an inclusive digital ecosystem. Digital literacy programs must be designed to meet local needs while responding to global demands. For example, the national strategy of digital literacy in Finland documented by Sipilä et al. (2019) has been shown to be successful in increasing digital inclusivity and competence through community-based education programs. Then it is supported by research by Barkat & Busuioc (2020) which emphasizes the need for an educational curriculum that is integrated with digital literacy to meet the demands of the ever-changing job market.

Understanding the relationship between digital literacy, macroeconomic trends, and workforce development is critical to formulating effective and inclusive policies. Therefore, this study aims to explore the role of digital literacy in influencing macroeconomic trends and workforce development. By referring to various sources of literature and the latest research, it is hoped that it can provide deeper insights into the importance of digital literacy in the context of an ever-evolving global economy.

2. RESEARCH METHOD

In this study, the approach used is descriptive with the Systematic Literature Review (SLR) method. This approach aims to provide a comprehensive overview of the phenomena being studied, as well as to identify, analyze, and synthesize findings from various studies relevant to the topics of digital literacy and economic growth. Further in this approach can be described as follows:

1. **Descriptive Approach**

   Descriptive research methods are used to describe the characteristics of the phenomenon being studied. According to Sugiyono (2018), descriptive research aims to provide in-depth information about the variables involved in the research. In this context, the data collected will provide a clear picture of how digital literacy contributes to economic growth through increased innovation. Data collection is carried out through the identification and selection of relevant literature from various sources, including journals (Google Scholar, Proquest, ScienceDirect, Scopus, etc), articles and books. The data obtained will provide comprehensive information on the relationship between digital literacy and economic growth, as well as the factors that influence this relationship.

2. **Systematic Literature Review (SLR)**

   The SLR method is used to collect, analyze, and synthesize existing research on digital literacy and economic growth. The SLR process consists of several key steps:

   a. **Identify Research Questions**: Clear and specific research questions will be established to guide the literature search. For example, "How does digital literacy contribute to economic growth through increased innovation?"
   b. **Literature Search**: Searches are conducted in various academic databases, including Copernicus and Scopus, to find relevant articles. Keywords used in the search will include "digital literacy," "economic growth," "innovation," and other combinations.
   c. **Study Selection**: Studies found will be selected based on the inclusion and exclusion criteria that have been set. These criteria can include the year of publication, the type of research, and relevance to the research question.
   d. **Data Extraction**: Data from the selected studies will be extracted and recorded. It includes information about the methodology, findings, and conclusions of each study.
   e. **Analysis and Synthesis**: The data that has been extracted will be analyzed to identify patterns, themes, and relationships that emerge from the literature. This synthesis will provide a clearer picture of how digital literacy contributes to economic growth through innovation.

3. **Validity and Reliability**

   To ensure the validity and reliability of the SLR results, this study will use triangulation, which combines various literature sources and analysis methods. In addition, the selection and analysis process will be carried out systematically and transparently to ensure that the results obtained can be accounted for.

4. **Presentation Result**

The results of this study will be presented in the form of a narrative explaining the main findings of the SLR, as well as tables and graphs describing the relationship between digital literacy and economic growth. The presentation of these results aims to provide a better understanding of the contribution of digital literacy to innovation and economic growth. With this descriptive and SLR approach, it is hoped that the research can provide in-depth insights into the relationship between digital literacy and economic growth, as well as provide useful recommendations for the development of policies and practices in this field.

3. RESULTS AND DISCUSSION

Digital literacy has become one of the main factors affecting macroeconomic dynamics in many countries. With the increase in digitalization, digital literacy not only affects economic growth, but also income distribution, labor productivity, and economic structural transformation. Countries with high levels of digital literacy tend to have faster economic growth rates, especially in the information technology, e-commerce, and digital-based services sectors. According to Moorthy and Kaur (2020), digital literacy increases efficiency in business processes and accelerates innovation, which ultimately drives GDP growth. This is in line with what Zhang and H. L. (2021) revealed,

individuals who have digital skills tend to be more efficient in using technology, so they can increase output and productivity.

This increase in productivity is not only limited to the technology sector, but also extends to traditional sectors such as agriculture and manufacturing, which are increasingly growing. In addition, digital literacy encourages the transformation of the economic structure, from an agrarian or manufacturing-based economy to a service and technology-based economy. Choudhury and Kaur (2019) showed that digital literacy accelerates the shift to more productive sectors, such as information technology, financial services, and e-commerce. So that countries that realize the importance of digital literacy tend to increase investment in digital infrastructure, such as high-speed internet networks, digital literacy training, and technology ecosystems. According to Tran and Pham (2021), this investment not only improves connectivity but also accelerates the adoption of digital technology in various sectors. This is in line with what Moorthy & Kaur (2020) stated, with good digital skills, small businesses can leverage e-commerce platforms to reach customers around the world, increasing their sales and revenue. Ultimately, these changes lead to a change in demand in the labor market, with an increasing need for workers with digital skills. Bennett et al. (2021) stated that low-skill-based jobs are increasingly being replaced by automation, while the demand for digital skills-based jobs continues to increase.

As previously stated, digital literacy is one of the important factors in determining access and job opportunities in the digital era. With digitalization growing, the ability to use digital technology affects not only job opportunities but also the types of jobs available. Digital literacy allows individuals to access a wider range of job opportunities, including remote and technology-based work. With the ability to use online platforms, such as job search portals, recruitment applications, and freelance platforms, individuals can connect with global job opportunities. According to Zhang and H. L. (2021), digital literacy expands the job market by allowing workers to access jobs that were previously unavailable in their geographic area. In addition, as previously stated, digitalization has created new types of jobs that rely on digital skills, such as data analysis, digital marketing, and social media management. Moorthy and Kaur (2020) show that this transformation not only creates new jobs but also changes traditional jobs to be more technology-based. For example, jobs in manufacturing now require skills in using automated machines and control software. Another impact of the development of digital literacy is that it can help reduce unemployment, especially in sectors that are experiencing rapid growth due to digitalization. According to Bennett et al. (2021), sectors such as information technology, e-commerce, and technology-based services have created many job opportunities for individuals with digital skills. Workers with good digital literacy are more likely to be employed in these sectors. This reinforces the notion that digital literacy also affects career mobility. Workers with digital skills can more easily switch jobs or explore new career opportunities. Choudhury and Kaur (2019) highlight that digital skills allow workers to develop their careers into more advanced fields, such as information technology, web design, or application development. In addition, broadly speaking, digital literacy also has an impact on the recruitment process itself. Companies are now using digital platforms to search for candidates, and workers who are able to use these tools have an advantage in the recruitment process. According to Smith and R. T. (2020), candidates who understand how to create a professional profile on platforms like LinkedIn or utilize online job portals have a greater chance of getting a job.

Apart from the positive impact on job opportunities, some negative impacts are finally felt by prospective workers because although digital literacy increases access to jobs, the existence of a digital divide can exacerbate inequality in job opportunities. Hase and B. C. (2021) stated that individuals who do not have access to technology or digital literacy training tend to lag behind in the job market. This mainly impacts the population in rural areas or workers from the lower economic groups. So it can be concluded that positively digital literacy has a big impact on job opportunities in the digital era. Digital skills not only open access to new jobs but also increase worker mobility and competitiveness in the job market. However, the digital divide remains a challenge that needs to be addressed to ensure that all individuals can take advantage of the job opportunities generated by digitalization. Therefore, investment in digital literacy training and access to technology should be a priority for labor policies in various countries.

Digital literacy plays a very important role in the development of the workforce in today's digital era. Among them are Zhang & H.L. (2021) and Moorthy & Kaur (2020) revealed in their research that digital literacy improves individual job skills, allowing them to adapt to new technologies and increase competitiveness in the job market. This results in individuals with good digital literacy having greater access to job opportunities, including remote work and technology-based jobs (Smith & R. T., 2020; Bennett et al., 2021). This happens because digital literacy supports innovation and creativity in the workplace, allowing employees to utilize digital tools in solving problems and developing new products (Müller & Jansen, 2020; Alavi & Leidner, 2001). On the other hand, digital literacy encourages continuous professional development, where the workforce can continue to learn and adapt to industry changes (Hase & B. C., 2021; Choudhury & Kaur, 2019). This development can be achieved because employees who are digitally literate, have access to professional communities and social networks, where they can increase opportunities for collaboration and knowledge exchange (Alvesson & Sandström, 2020; Tran & Pham, 2021). So it can be concluded that digital literacy has a significant impact on workforce development, both in terms of skills, job access, and innovation. Increasing digital literacy among the workforce can contribute to overall economic growth and prepare individuals for future challenges.

As previously stated, in the 4.0 era marked by increasing digitalization and automation, the skills needed for workforce development are the main focus. Digital skills themselves refer to an individual's ability to use digital technology, software, and online platforms effectively and efficiently. It covers a wide range of competencies, ranging from basic skills such as computer and internet use, to advanced skills such as data analysis, programming, and the use of specialized software. Furthermore, existing skills can be described, including skills in the use of digital technology, software, and online platforms, where workers must be able to adapt to various technological tools that continue to develop (Zhang et al., 2021; Moorthy & Kaur, 2020). In addition, the skills to analyze data and solve complex problems are also becoming increasingly important in the modern data-dominated work environment (Müller & Jansen, 2020; Hase & B. C., 2021). Another skill that must be possessed by individuals is the need to have the ability to think creatively and innovatively, which allows them to develop new solutions and contribute to the innovation process in the company (Alavi & Leidner, 2001; Choudhury & Kaur, 2019). An equally important next skill is effective communication, both verbal and written, essential for team collaboration and interaction with clients in a global context (Smith & R. T., 2020; Bennett et al., 2021). This is because in the global economy cooperation is not only limited to a limited number of people, so with the

increase in teamwork across disciplines and locations, the ability to work in teams and collaborate with others from different backgrounds becomes invaluable (Alvesson & Sandström, 2020; Tran & Pham, 2021). Another skill required in workforce development is the skill to plan, execute, and manage projects efficiently which is key to achieving goals in a dynamic work environment (Zhang & H. L., 2021; Houghton & Sheehan, 2000). Because in a rapidly changing world, workers must have the ability to learn independently and adapt to the changes that occur (Creswell, 2014; Selwyn, 2016).

While digital literacy offers many benefits, efforts to improve it in different countries, especially in developing countries, face a number of challenges. One of the biggest challenges is *the digital divide* or the gap in access to digital technology. According to Zhang and H. L. (2021), this gap occurs between urban and rural areas, upper and lower economic groups, and the younger and older generations. Residents in rural or remote areas often face infrastructure limitations, such as lack of internet access and digital devices. Without adequate access, efforts to improve digital literacy are hampered. It is known that in many developing countries, such as Indonesia, only a small number of villages have stable internet access, so it is difficult for people in these areas to be involved in digital literacy programs (Hase & B. C., 2021). This is because developing countries face budget constraints to support digital literacy programs on a large scale. Lack of financial resources hinders infrastructure development, the provision of digital devices, and quality training. Alvesson and Sandström (2020) note that low-income countries often rely on international aid to fund digital literacy initiatives. The next challenge is a slow or uneven internet network, which is a major obstacle in improving digital literacy. Moorthy and Kaur (2020) note that poor technological infrastructure often leads to the inability of governments or organizations to provide digital literacy training. This problem is more common in developing countries, where governments face budget constraints for investment in digital infrastructure.

In addition, currently there are still many formal education systems that have not fully integrated digital literacy into their curriculum. According to Choudhury and Kaur (2019), formal education that does not prioritize digital literacy causes a skills gap among the younger generation, which ultimately hinders the readiness of the workforce to face digital transformation. Social and cultural factors are also important challenges. In some societies, especially in developing countries, there is still resistance to the adoption of digital technologies, which is based on mistrust, fear of change, or a lack of understanding of the benefits of technology. Tran and Pham (2021) noted that social stigma against technology use, especially among women or older individuals, often hinders digital literacy.

These problems can be formed due to several things, among others, from digital literacy training programs that often do not cover all groups of society, especially those who need it most, such as low-income individuals, the elderly, or people with disabilities. According to Smith and R. T. (2020), many training programs are only offered in urban areas, so rural communities do not benefit from the same. In addition, many individuals are not aware of how digital literacy can improve their quality of life, both in terms of work, education, and access to information. Bennett et al. (2021) noted that without adequate awareness, digital literacy programs are often ignored by the public. If these problems are left unchecked and not taken seriously, a lack of understanding of how to protect personal data or avoid cyber threats can lead to resistance to technology adoption.

According to Tran and Pham (2021), fear of cybersecurity threats often makes people hesitant to get involved in digital literacy programs. Improving digital literacy is a complex and multidimensional challenge. Gaps in access to technology, lack of infrastructure, socio-cultural barriers, and limited financial resources all contribute to slow progress in digital literacy. Therefore, a holistic approach, such as investment in digital infrastructure, inclusive policies, and extensive training programs, is needed to address these challenges and ensure that the benefits of digital literacy can be felt by all levels of society.

4. CONCLUSION

In today's digital era, digital literacy has emerged as one of the main factors affecting economic and workforce development around the world. An individual's ability to use digital technology effectively not only increases job opportunities, but also contributes to overall economic growth. Digital literacy itself contributes significantly to increasing productivity in various sectors. According to Moorthy and Kaur (2020), workers who have digital skills tend to be more efficient in using tools and software related to their work. This not only speeds up the work process but also increases the output and effectiveness of the entire organization. In addition, increasing digital literacy also encourages innovation. Bennett et al. (2021) noted that companies with a digitally literate workforce are better able to innovate and adapt to market changes. The ability to quickly access and analyze data allows companies to develop new products and improve services, which in turn strengthens their competitive position in the global market. Digital literacy also plays an important role in the growth of the digital sector, including e-commerce, fintech, and technology-based services. Zhang and H. L. (2021) show that countries that invest in digital literacy see a significant surge in the contribution of the digital sector to the country's GDP.

In addition to the influence shown in economic growth, digital literacy also affects the development of a digital skill-based workforce where digital literacy increases the readiness of the workforce to face changing market demands. Choudhury and Kaur (2019) emphasized that digital skills are a key requirement for job seekers in many industries. Workers who are skilled in digital technology have an easier time getting a job and have a better chance of getting a higher position. With the increase in digital literacy, the quality of the workforce has also improved. Hase and B. C. (2021) noted that educational programs that integrate digital literacy in the curriculum help create more prepared and competitive individuals. Education that emphasizes digital skills prepares the younger generation to be more adaptive, creative, and innovative in the work environment. Finally, digital literacy opens up opportunities for reskilling and upskilling for existing workers. According to Tran and Pham (2021), continuous digital skills training helps workers stay relevant in a fast-changing market, reducing the risk of unemployment due to automation and digitalization.

Digital literacy plays a crucial role in shaping macroeconomic trends and workforce development. By increasing productivity, encouraging innovation, and strengthening competitiveness, digital literacy is not only beneficial for individuals, but also for society and the economy as a whole. To maximize these benefits, comprehensive public policies and targeted educational programs are needed that can reach all levels of society. Thus, digital literacy will continue to be an important pillar in creating a more inclusive and sustainable future.

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