



Digital literacy inequality and socioeconomic readiness toward sustainable development

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ABSTRACT

Background: Digital literacy has become a crucial foundation for achieving sustainable development in Indonesia, particularly in relation to education, economy, and technological inclusion. Despite rapid digital transformation, disparities in digital literacy across regions remain a challenge that can hinder progress toward the Sustainable Development Goals (SDGs) 2030. This study aims to examine the relationship between digital literacy and key socioeconomic factors, including education, economic capacity, and internet access, across Indonesia's Western, Central, and Eastern regions. **Methods:** Using a quantitative descriptive approach, this research analyzes secondary data from official government sources for the year 2022, including the Digital Literacy Index, average years of schooling, Gross Regional Domestic Product (GRDP) per capita, and percentage of households with internet access. **Findings:** The findings reveal that while the Western Region records the highest digital literacy index, followed by the Eastern and Central regions, the differences are relatively small. Education, GRDP per capita, and internet access show weak direct relationships with digital literacy, indicating that quality of education, digital exposure, and access to learning opportunities play more significant roles than duration of schooling or economic wealth. Internet access correlates with regional economic strength but does not necessarily guarantee higher literacy levels, as literacy involves critical and responsible use of technology. **Conclusion** The study concludes that improving digital literacy in Indonesia requires an integrated approach combining equitable infrastructure, quality education, and supportive policy. Strengthening national initiatives such as the National Digital Literacy Movement (GNLD) can accelerate progress toward SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure). **Novelty/Originality of this article:** This study provides a comprehensive analysis of the relationship between digital literacy and socioeconomic readiness at the regional level in Indonesia using national datasets. It offers new insights into how education, economy, and internet access interact in shaping digital competence, highlighting that improving literacy requires more than access but it requires quality, inclusion, and collaboration.

KEYWORDS: digital literacy; socioeconomic factors; Indonesia.

1. Introduction

The Sustainable Development Goals (SDGs) were introduced in 2015 by the United Nations as a global plan to end poverty, protect the environment, and promote peace and prosperity for all by 2030 (Sorooshian, 2024). The SDGs include 17 goals that address the world's most urgent social, economic, and environmental challenges. They highlight the importance of global cooperation, research, and innovation in building a more sustainable and inclusive future.

In Indonesia, the implementation of the Sustainable Development Goals (SDGs) still faces many challenges after several years of progress. Novita et al. (2024) explained that the

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main issues are related to communication, funding, and regional readiness to apply the SDG framework. The COVID-19 pandemic also made it more difficult to achieve the targets because it shifted the government's focus and resources toward health and economic recovery. These challenges show that strong collaboration, innovation, and digital readiness are needed to accelerate SDG achievement in Indonesia.

Digital literacy is important for achieving the 2030 Agenda for Sustainable Development Goals (SDGs) in Indonesia, especially SDG 4, SDG 9, and SDG 10. SDG 4 aims to ensure inclusive and fair quality education and promote lifelong learning for all. SDG 9 focuses on building strong and reliable infrastructure, supporting sustainable industrial growth, and encouraging innovation. Meanwhile, SDG 10 seeks to reduce inequality within and among countries.

Digital literacy plays an important role in reaching these goals, especially from the sides of access and inclusion. Shafira et al. (2024) stated that digital literacy helps people and communities take part in social, economic, and political life. When people have enough digital skills, they can use technology to get education, health services, and job opportunities. This also helps reduce inequality and supports fair participation for everyone. Digital literacy should therefore be seen not only as a personal ability but also as an important investment for inclusive and sustainable development.

Digital literacy is not only about technical skills but also about how individuals and communities use technology responsibly and effectively. It includes abilities such as communication, comprehension, critical thinking, evaluation, problem-solving, and the ethical use of digital information. With strong digital literacy, people can access digital services responsibly, take part in social and economic activities, and support inclusive and sustainable growth. Kamilah (2024) also explained that digital literacy acts as a key driver that helps people and communities access, understand, and use digital information effectively, which in turn supports wider access to education, decent jobs, and inclusive economic growth.

In Indonesia, digital transformation has grown rapidly in recent years. However, digital readiness remains uneven across regions. Technological infrastructure development is not always supported by equal human capacity and social readiness. This means that regions with lower education and economic levels often lag behind in adopting digital technologies. Similarly, Mulyaningsih et al. (2021) found that there is a digital divide within urban populations, especially among low-income groups. The diffusion of digital technology, particularly smartphones, is limited because poor people cannot afford the devices. This inequality affects people's ability to benefit from technology and participate equally in the digital economy.

The important factors that related to digital literacy are Education, economy, and internet access. Education has a strong connection with digital literacy because schools and universities are key environments where people learn to use technology in meaningful ways. Arissaputra et al. (2023) stated that digital literacy in education involves not only learning technical skills but also building critical thinking, responsible technology use, and digital citizenship. Economic conditions are also linked to digital literacy. Apsilyam & Ashrapova (2025) found that countries with higher levels of digital skills among their people often show better productivity, fewer inefficiencies, and stronger innovation. Developing digital literacy helps economies adapt to global market changes and respond to new challenges in the digital era. In addition, access to the internet is another key factor. Hussain & Phulpoto (2024) found that people who have easier access to the internet tend to show higher levels of digital literacy. This means that regions with higher internet access may have stronger digital literacy levels compared to those with limited connectivity.

Although digital transformation in Indonesia has developed rapidly, the level of digital literacy is still different across regions. Previous studies have discussed the digital divide from social and economic perspectives, but few have examined how education, economy, and internet access together relate to digital literacy in Indonesia. Understanding this relationship is important to identify which regions are more ready for digital transformation and sustainable development. Therefore, this study aims to analyze the

relationship between digital literacy and several socioeconomic factors, including education, economy, and internet access, using secondary data from Indonesian regions. The results are expected to give a clearer picture of digital readiness and support policies to reduce digital inequality. To understand these relationships, this study uses a quantitative approach based on secondary data. The data represent regional conditions in Indonesia and include indicators of education, economy, and internet access that are compared with Digital Literacy Index.

2. Methods

This study applies a quantitative descriptive research design, which aims to describe the relationship between digital literacy and socioeconomic readiness across different regions in Indonesia. The descriptive approach is used to identify general patterns and compare variables without testing causality (Insights Opinion, 2024). This design is appropriate for research using secondary data that focuses on understanding trends across large areas.

The study uses secondary data from official government publications, all referring to the year 2022 to maintain consistency. The Digital Literacy Index (DLI) was obtained from the Badan Pengembangan Sumber Daya Komunikasi dan Digital (2024), which reports literacy scores by region (Western, Central, and Eastern Indonesia). The education variable, represented by the Average Years of Schooling, was taken from *Statistik Pendidikan 2022* (Badan Pusat Statistik, 2022). The economic variable, Gross Regional Domestic Product (GRDP) per capita, was derived from the *BPS dataset Produk Domestik Regional Bruto per Kapita Atas Dasar Harga Berlaku Menurut Provinsi (Ribu Rupiah)*. Meanwhile, internet access, defined as the percentage of households with internet access, was obtained from *Statistik Telekomunikasi Indonesia 2022* (Badan Pusat Statistik, 2023).

Since the Digital Literacy Index was available only at the regional level. Other variables that were originally available by province were cleaned, organized, and averaged using Microsoft Excel to make the datasets consistent. The data cleaning process included checking for missing values, ensuring the same measurement units, and confirming that all values were reasonable. Then, provinces were grouped into three regions: Western Indonesia, Central Indonesia, and Eastern Indonesia. Western Indonesia includes Aceh, North Sumatra, West Sumatra, Riau, Riau Islands, Jambi, South Sumatra, Bangka Belitung Islands, Bengkulu, Lampung, Banten, DKI Jakarta, West Java, Central Java, Yogyakarta, East Java, North Kalimantan, West Kalimantan, Central Kalimantan, East Kalimantan, and South Kalimantan. Central Indonesia includes Bali, West Nusa Tenggara, East Nusa Tenggara, North Sulawesi, Gorontalo, West Sulawesi, Central Sulawesi, Southeast Sulawesi, and South Sulawesi. Eastern Indonesia includes Maluku, North Maluku, Papua, and West Papua. This classification follows the grouping used by the Badan Pengembangan Sumber Daya Komunikasi dan Digital (2024) in reporting the national digital literacy index. It reflects geographical and developmental differences across the country and is therefore suitable for analyzing regional disparities.

After the data were cleaned and grouped, regional averages were calculated for each variable. The data were analyzed using descriptive statistics to compare and explain differences in digital literacy, education, economy, and internet access among the three regions. The table created with Microsoft Excel was used to make the results easier to understand and to show patterns in regional digital readiness. To compare variables with different measurement units, all indicators were normalized to a 10–100 scale using the min–max normalization method. This approach allows a fair comparison between the Digital Literacy Index, education level, GRDP per capita, and internet access. The normalization was performed in Microsoft Excel, and the results were visualized in bar charts to show the relative differences among regions.

3. Results and Discussion

Results Table 1 presents the average values of the digital literacy index, average years of schooling, GRDP per capita, and internet access rate for the three main regions of Indonesia: Western, Central, and Eastern. These indicators represent the socioeconomic readiness of each region in supporting digital transformation. The result of this study shows that digital literacy levels in Indonesia remain uneven across regions, showing a persistent digital divide despite ongoing national efforts.

Table 1. Average digital literacy and socioeconomic indicators by region in Indonesia, 2022

Region	Digital Literacy Index	Avg. Years of Schooling (years)	GRDP per Capita (IDR)	Internet Access (%)
Western	3.56	9.34	91411428.57	68.89
Central	3.48	8.99	74179333.33	59.47
Eastern	3.55	9.36	39759500.00	47.50

The Western Region records the highest average index score of 3.56, while the Central Region has the lowest score of 3.48. Although the difference may appear small, it still reflects structural disparities in digital development and access to information and communication technology (ICT), highlighting that not all regions have benefited equally from Indonesia's digital transformation agenda. The uneven pattern of digital literacy can be associated with broader differences in ICT infrastructure and socioeconomic development across regions. ICT access and availability are essential components that shape the digital divide, which refers to the gap between individuals, households, and geographic areas in their opportunities to access and effectively use digital technologies. Within this framework, digital literacy represents a more advanced stage of digital inclusion, as it reflects not only people's ability to connect to the internet or own devices but also their capability to use digital tools critically, safely, and productively in daily life.

Previous research supports this finding. Ramadhanti & Astuti (2022) observed that ICT infrastructure in Indonesia remains highly concentrated in western regions, particularly on Java Island, where economic activity and educational facilities are more developed, giving the western region a significant advantage in both digital access and competence. Similarly, Nababan (2024) emphasized that regional gaps in digital literacy persist, with western Indonesia consistently outperforming central and eastern regions. However, the geographical pattern of digital inequality is not always straightforward; in some cases, eastern areas that face the greatest challenges in digital connectivity still manage to achieve moderate literacy levels through community-based initiatives, training programs, and government support. Overall, these findings suggest that digital literacy inequality in Indonesia cannot be explained by location alone but results from a complex interaction between infrastructure, education quality, local economic capacity, and community engagement in digital development (Ramadhanti & Astuti, 2022; Nababan, 2024). However, the difference between the three regions is relatively small, showing that regional efforts toward digital transformation have started to align at the national level. The Ministry of Communication and Information Technology has established the Digital Literacy Roadmap 2021–2024, which serves as a national reference to raise public awareness and improve digital competence. The roadmap adapts Law No. 11 of 2008 on Electronic Information and Transactions/*Undang-Undang Nomor 11 Tahun 2008 tentang Informasi dan Transaksi Elektronik*, as amended by Law No. 19 of 2016 on the Amendment to Law No. 11 of 2008 on Electronic Information and Transactions, to develop a structured framework for digital literacy education. This framework consists of four main pillars, including digital skills, which refer to an individual's ability to understand, operate, and use ICT devices and digital systems effectively. These skills include basic knowledge of the digital landscape, information searching, communication through digital platforms, and the use of digital transaction tools such as e-wallets and marketplaces (Isabella et al., 2023).

In addition to the national roadmap, Indonesia has also implemented the National Digital Literacy Movement/*Gerakan Nasional Literasi Digital* (GNLD), which has become one of the country's most comprehensive initiatives to strengthen public understanding and competence in the digital era. Since its official launch in 2017, this large-scale government program has reached more than 24 million participants across Indonesia, showing a strong commitment to improving the population's ability to use digital technology effectively and responsibly. The GNLD was created in response to the increasing demand for citizens to navigate the opportunities and challenges of digitalization, such as online learning, e-commerce, and cybersecurity. The program focuses on four main pillars (digital skills, digital safety, digital culture, and digital ethics) which together aim to equip individuals with the essential technical, cognitive, and ethical skills needed to participate meaningfully in today's digital society. Through workshops, online courses, webinars, and awareness campaigns, the GNLD provides people with practical knowledge to operate digital tools, manage online information, protect their personal data, and engage responsibly in digital communities. Despite these achievements, ensuring equal levels of digital literacy across all regions remains a major challenge. The movement has been particularly effective in urban and western parts of Indonesia, where digital infrastructure, education access, and training resources are more available. However, rural and remote regions continue to face obstacles such as limited internet access, inadequate digital facilities, and a shortage of qualified instructors, which hinder their ability to fully benefit from digital transformation efforts. Addressing these disparities requires continuous collaboration between the government, private sector, and educational institutions to expand infrastructure, provide inclusive training, and promote local innovation. As Banyu et al. (2024) emphasized, strengthening and expanding the GNLD plays a vital role in promoting equal digital opportunities, reducing social gaps, and supporting Indonesia's progress toward achieving inclusive and sustainable digital development. Recent findings also show that after the pandemic, digital literacy in Indonesia still faces challenges. Many programs have moved from emergency digital adaptation during COVID-19 to more stable and long-term digital transformation, but the progress is not the same in every region (Paramahita, 2024).

Furthermore, the National Digital Literacy Movement/*Gerakan Nasional Literasi Digital* (GNLD), plays an essential role in advancing Indonesia's progress toward the 2030 Sustainable Development Goals (SDGs), particularly in reducing inequality and promoting quality education. The program recognizes that improving digital literacy is not just teaching technical skills but also aims to empower individuals and communities to participate equally in the digital society. Through various initiatives such as online courses, webinars, digital bootcamps, and free digital learning materials, the GNLD provides inclusive access to digital education for people from all backgrounds, including students, teachers, professionals, and small business owners. These initiatives help participants develop essential abilities such as critical thinking, safe online behavior, effective communication, and responsible digital use. In addition to enhancing digital knowledge, the GNLD also contributes to economic empowerment by training communities to use digital platforms for online business, e-commerce, and digital marketing. This has supported small and medium enterprises (SMEs) in reaching wider markets, increasing productivity, and improving their income through online activities. Moreover, the GNLD strongly emphasizes digital ethics and online safety, helping users understand the importance of protecting their privacy, avoiding misinformation, and practicing responsible behavior in the digital world. Overall, the GNLD demonstrates the Indonesian government's commitment to building an inclusive and digitally skilled society. Its continuous expansion helps reduce the digital divide between regions, improve the quality of education, promote innovation, and enhance people's well-being. "All of these aspects show that digital literacy development is not only a technological priority but also a foundation for sustainable and equitable national growth (Banyu et al., 2024). Figure 1 shows a comparison between the digital literacy index and the average years of schooling across Indonesian regions.

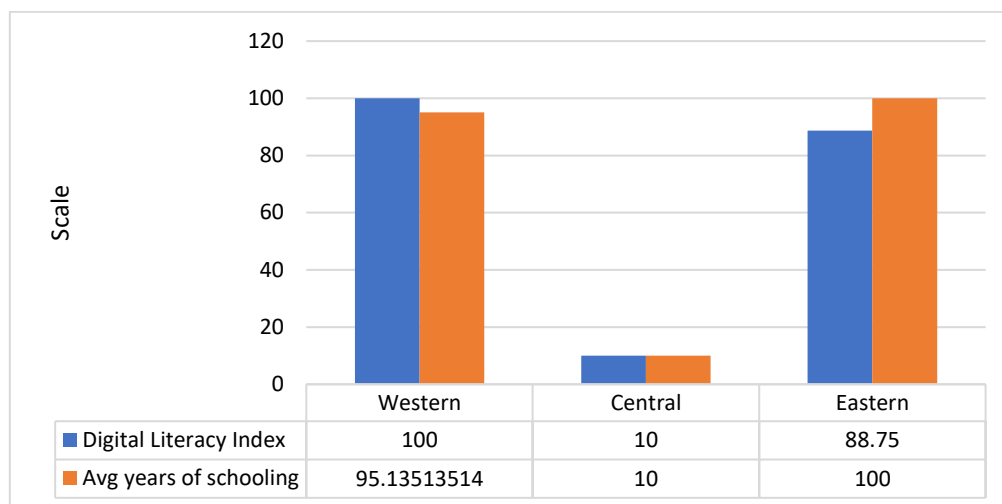


Fig. 1. Comparison between Digital Literacy Index and Average Years of Schooling by Region (Normalized 10–100)

The Western Region has the highest digital literacy score, while the Eastern Region shows a slightly higher average years of schooling. This pattern indicates that the duration of schooling does not directly determine digital literacy levels. All values were normalized to a 10–100 scale for comparison purposes. Interestingly, the average years of schooling in Indonesia show a slightly higher value in the Eastern Region (9.36 years) than in the Western Region (9.34 years). Although this difference is very small, it presents an interesting finding because the Western Region still records a higher digital literacy index. This result suggests that the length of formal education does not have a direct relationship with digital literacy levels. In other words, spending more years in school does not always lead to higher digital competence. One possible explanation is that formal education in several provinces continues to emphasize conventional teaching approaches that rely heavily on rote learning and memorization. Many schools still focus on textbook-based instruction rather than incorporating digital tools and interactive learning environments. As a result, students may graduate with limited practical experience in using technology for problem-solving, communication, or creative expression. Therefore, the quality and relevance of education, rather than its duration, appear to play a more important role in shaping digital literacy and readiness for the digital era.

This interpretation aligns with the view of Timotheou et al. (2023), who noted that despite continuous investment in digital technology for schools across different countries, the expected learning outcomes have not yet been achieved. The mere presence of digital devices or infrastructure does not automatically translate into improved learning performance or digital competence. In many cases, schools receive new computers, tablets, or internet connections, but teachers and students do not receive sufficient training on how to use them effectively in the learning process. Without adequate guidance, technology can even become underutilized or used in ways that do not enhance critical thinking or creativity. This situation illustrates that digital transformation in education requires more than just technological provision; it demands deep cultural and pedagogical change. Teachers must shift from traditional lecture-based instruction toward more interactive, student-centered approaches that encourage exploration, collaboration, and innovation through digital tools.

The COVID-19 pandemic has further highlighted these challenges. When schools were suddenly forced to switch to online learning, many were unprepared to deliver quality digital education. A lack of infrastructure, unstable internet connections, and insufficient digital skills among both teachers and students created major barriers. Some schools could not continue lessons effectively, and many students—especially in rural or economically disadvantaged areas—were left behind. This widened existing educational and digital gaps, revealing structural inequalities within the education system. Timotheou et al. (2023)

explained that these limitations demonstrate the complexity of digital transformation in education, which involves not only access to technology but also organizational, social, and cultural readiness. Building digital literacy in schools therefore requires a holistic approach that strengthens not only physical infrastructure but also human resources and institutional support systems.

Similarly, in Indonesia, integrating technology into basic education continues to face serious obstacles. According to Salma et al. (2025), despite the government's consistent efforts to promote digital transformation through various programs and initiatives, there are still large disparities in technology access and low digital literacy among teachers, particularly in rural and remote areas. Many teachers struggle to adapt to digital systems due to a lack of structured training, limited confidence in using technology, and inadequate technical support. Some schools have access to computers and internet networks but lack the knowledge or pedagogical frameworks to integrate these tools into their teaching practices. As a result, digital resources remain underused, and the potential benefits of educational technology are not fully realized. The challenges faced by teachers play a crucial role in shaping students' digital skills, since their level of digital competence directly influences how students engage with technology in the classroom. When teachers lack the skills or motivation to use digital tools, students also receive fewer opportunities to develop their own competencies. This reinforces the importance of continuous professional development for educators. Training programs that focus on practical applications of digital tools, curriculum integration, and digital pedagogy can help teachers become more confident and effective in guiding students toward digital literacy. Furthermore, collaboration between schools, local governments, and private institutions can support these efforts by providing the necessary resources, mentorship, and infrastructure. Overall, these findings emphasize that improving digital literacy through education in Indonesia requires a balanced strategy that addresses both technological and human factors. While access to technology remains important, it must be accompanied by strong pedagogical frameworks, relevant training, and continuous support for teachers and students. Educational transformation is a long-term process that demands not only investment in infrastructure but also a shift in mindset toward digital inclusion and lifelong learning. By focusing on the quality and relevance of digital education, Indonesia can build a more digitally competent generation capable of driving sustainable development and innovation across all regions (Timotheou et al., 2023; Salma et al., 2025). To better understand the relationship between regional economic conditions and digital literacy, this study compares the Digital Literacy Index with the Gross Regional Domestic Product (GRDP) per capita. Figure 2 illustrates the differences across Indonesian regions after normalization to a 10–100 scale.

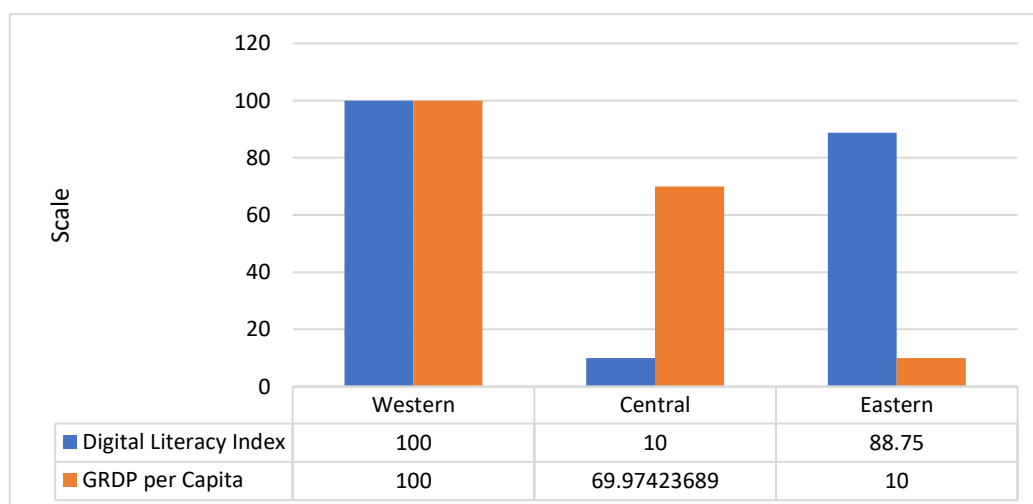


Fig. 2. Comparison between digital literacy index and GRDP per capita by region (normalized 10–100)

Figure 2 compares the Digital Literacy Index and the Gross Regional Domestic Product (GRDP) per capita across Indonesian regions. Regarding the economic indicator, the Gross Regional Domestic Product (GRDP) per capita shows a noticeable difference between regions in Indonesia. The Western Region, which records the highest GRDP per capita of IDR 91.4 million, only slightly surpasses the Eastern Region in digital literacy levels. This finding suggests that regional economic growth does not automatically lead to higher digital literacy. In other words, a region can be economically advanced yet still have limited digital competence among its population. This happens because economic wealth alone does not ensure that people have equal access to education, digital tools, or opportunities to learn new technologies. Digital literacy is not just about owning devices or having internet access, it reflects how individuals use technology to solve problems, learn, and communicate effectively. People who are digitally literate tend to be more productive because they can use technology to search for information, manage personal finances, and improve their business activities. For example, small business owners who understand digital marketing and e-commerce platforms can reach more customers and increase their income. Similarly, individuals who know how to use digital banking tools can save time, manage money more safely, and access financial services more easily. As Rini (2024) highlighted, both digital and financial literacy significantly influence how individuals make economic decisions and engage with online services. This shows that digital literacy plays an important role in shaping people's economic behavior and ability to participate in the modern economy.

Moreover, improving digital literacy can help promote social and economic inclusion, even in regions with lower income levels. When people have basic digital skills, they can access online learning materials, explore job opportunities, and connect with wider markets, which can reduce inequality. However, in wealthier regions, the benefits of economic growth do not always reach all groups of society equally. Some communities may still struggle to access quality education or digital tools, particularly in rural or marginalized areas. This means that while the infrastructure might exist, the actual capacity to use technology effectively remains uneven. Bridging this gap requires targeted policies that go beyond economic investment, focusing instead on human development, digital education, and skill-building initiatives. By empowering people with digital knowledge, even regions with smaller economies can participate more actively in digital innovation and entrepreneurship. Therefore, economic growth should go hand in hand with digital literacy programs to ensure that technological progress benefits everyone equally. Increasing people's ability to use digital tools effectively will not only support individual livelihoods but also strengthen local economies and national competitiveness in the long run (Rini, 2024). To examine the connection between internet availability and digital skills, this study compares the Digital Literacy Index and Internet Access (%) across regions. Figure 3 presents the normalized values (10–100) for each region.

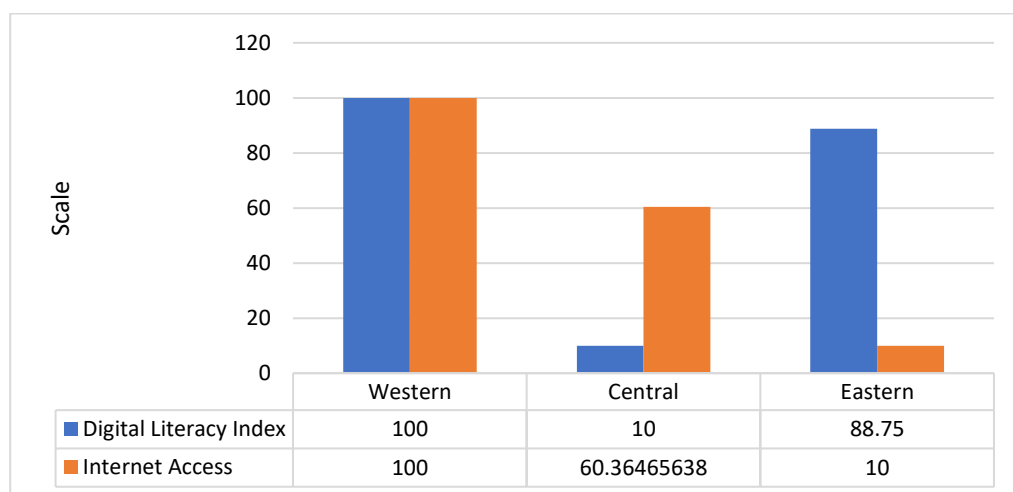


Fig. 3. Comparison between digital literacy index and internet access by region (normalized 10–100)

Figure 3 shows that the relationship between digital literacy and internet access is not consistent across regions. The Western Region has high values for both indicators, but the Central Region shows moderate internet access and very low digital literacy. In contrast, the Eastern Region has high digital literacy even though its internet access is low. This pattern suggests that internet access alone does not guarantee higher digital skills. Some regions may have good connectivity, but people may not use the internet for learning or skill development. In other regions, digital training programs, community learning activities, or stronger school involvement may help improve digital literacy even with limited internet access.

The analysis of internet access shows a more consistent and direct relationship with economic indicators such as GRDP per capita across Indonesian regions. The Western Region, which has the strongest economy, also records the highest proportion of internet users (68.89%). In contrast, the Eastern Region, which has the lowest GRDP per capita, shows the lowest internet access rate (47.50%). This difference reflects how economic capacity plays a major role in shaping technological infrastructure and the affordability of digital services. Regions with stronger economies are generally more capable of investing in broadband infrastructure, establishing reliable communication networks, and providing people with access to modern digital tools. In these regions, local governments and private companies are also more likely to collaborate in expanding digital infrastructure because of higher demand and greater financial stability. This finding supports the view that economic growth is an important enabler of internet development. A strong economy can provide the resources needed to expand access and improve service quality, which in turn contributes to further economic productivity and innovation (World Bank, 2022).

Internet access itself is one of the key elements supporting regional development in many ways. Access to internet-based technologies allows workers to complete their daily tasks more efficiently, communicate faster, and improve the overall quality of their work. In the business sector, having stable internet connections helps companies and entrepreneurs reach customers through online platforms, conduct digital marketing, and process financial transactions securely. For individuals, the internet creates opportunities to learn new skills through online courses, participate in remote work, and explore business or freelancing activities that were previously unavailable in traditional settings. At the same time, access to digital technologies also supports education, governance, and health services by providing easier communication and faster data exchange between institutions and the public. These benefits explain why internet access is often associated with higher productivity and income potential. Moreover, it enables people to participate more actively in the digital economy, where transactions are increasingly conducted online through e-commerce, digital banking, and mobile applications. For example, many small and medium enterprises in Indonesia now rely on social media or online marketplaces to sell products and expand their business reach, demonstrating how internet access contributes directly to economic inclusion (World Bank, 2022).

However, having a high level of internet access does not always translate into higher digital literacy. This distinction is very important to understand when analyzing the digital divide. Internet access reflects the availability and frequency of technology use, while digital literacy represents the ability to use technology critically, effectively, and ethically. In other words, someone may have a smartphone and a strong internet connection but still lack the necessary skills to search for accurate information, identify misinformation, or use online platforms responsibly. As Younus et al. (2024) explained, many people in developing countries, including Indonesia, may own digital devices or have access to the internet but still struggle to use them in ways that support learning, work, or participation in digital governance. This creates what is known as the digital literacy gap, a situation where access exists but competence is lacking. The gap limits people's ability to take advantage of online education, digital business opportunities, or government e-services. As a result, increasing internet penetration alone cannot guarantee that people will become digitally empowered or that they will benefit equally from digital transformation initiatives. In Indonesia, this

issue is particularly visible in rural and low-income communities where access to the internet has grown, but digital skills remain low due to limited training and awareness.

This situation illustrates that digital inequality should not only be viewed as a problem of access but rather as a multidimensional issue involving several interconnected factors. According to Hernandez & Faith (2023), these factors include the quality of internet connections, the types of devices used, the level of digital skills, motivation, and patterns of technology use. For instance, even if two people have internet access, their experiences can be completely different. A person using a high-speed computer with unlimited data can explore digital tools, learn coding, or join virtual courses, while another using a low-end phone with limited data may only access social media or entertainment content. These differences influence how much people can benefit from the internet and how they develop their digital competence. Moreover, motivational and psychological factors also matter — some individuals may avoid using technology because they feel it is too complex or unsafe. This shows that improving access alone is not enough. Policymakers must also pay attention to human behavior, learning culture, and the broader social context that affects how technology is used in everyday life (Hernandez & Faith, 2023).

The quality of internet infrastructure plays another crucial role in shaping digital literacy. Slow, unstable, or expensive internet can discourage people from using online platforms frequently. In remote parts of Indonesia, many communities still rely on poor connections that make it difficult to access e-learning platforms or digital government services. In such areas, people might technically have access, but the experience is so limited that it provides little practical benefit. This issue demonstrates that effective access is not the same as nominal access and what matters is not just whether people are connected, but how well they can use that connection to improve their quality of life. Therefore, when assessing digital inequality, it is essential to consider both infrastructure quality and user competence as interconnected dimensions of digital development.

According to Arnaud et al. (2025), several key elements can improve digital literacy and close the gap between access and competence. These include the availability of technological infrastructure, continuous training programs, and a supportive organizational culture that encourages people to adapt to digital change. In organizations or communities where technology is integrated into everyday activities and learning is encouraged, individuals tend to develop better digital skills. On the other hand, a lack of infrastructure, poor leadership support, or unclear government regulations can slow down progress. Without consistent guidance, even well-funded programs may fail to build lasting digital capacity. Therefore, government institutions and private organizations should design policies that not only expand access but also promote education, mentorship, and community-based training initiatives. Digital literacy must be seen as part of a long-term human capital investment rather than a short-term technology project (Arnaud et al., 2025).

This argument also aligns with the idea that digital transformation requires collaboration between multiple sectors (government, education, and private industries). The government can provide strategic policies, infrastructure, and funding support; educational institutions can integrate digital skills into curricula; and the private sector can contribute through innovation, training, and technology development. When these sectors work together, internet access can become a gateway to meaningful digital participation rather than just connectivity. Additionally, non-governmental organizations and local communities play a critical role in ensuring that people in rural areas or low-income groups are not left behind. Community-based digital learning centers, for example, can provide training for those who do not have access to formal education or professional courses.

Improving internet access, therefore, must always go hand in hand with developing people's digital skills. A balanced approach between infrastructure expansion and human capacity development will make sure that digital transformation supports inclusive social and economic progress. When citizens are digitally literate, they can use technology not just for entertainment but for learning, innovation, and civic participation. This also helps prevent risks such as misinformation, online fraud, or cyberbullying, because people understand how to use technology responsibly and safely. A digitally skilled population can

also help the government deliver public services more efficiently through e-governance systems and digital databases. As digital inclusion expands, economic and social inequalities can be reduced, creating a stronger foundation for sustainable development.

Overall, these findings emphasize that digital literacy inequality in Indonesia cannot be explained by economic, internet access or educational factors alone. Improving digital literacy requires an integrated approach that combines quality education, equal infrastructure distribution, and a strong digital culture. Rui & Attan (2024) found that socioeconomic factors have a small but meaningful effect on digital literacy. These factors provide resources that can either support or limit people's ability to take part in the digital world. Therefore, policies that aim to reduce socioeconomic inequality and improve access to digital learning are essential to ensure equal digital opportunities for everyone.

Policymakers should design more programs that promote inclusive digital access, improve digital education content, and encourage responsible use of technology across all regions. In line with Chen & Zainudin (2024), an effective digital literacy strategy should include clear goals, integration across educational levels, continuous professional development for educators, and strong infrastructure support. Furthermore, promoting digital citizenship and ethical digital behavior is essential to ensure that people do not only use technology effectively but also responsibly.

In line with Junaedi et al. (2024), despite ongoing efforts, barriers such as unequal access, limited educational integration, and resistance to change still hinder progress. Therefore, governments and educational institutions must strengthen digital literacy initiatives through multi-sector collaboration, focusing on equal access, curriculum integration, and continuous learning opportunities. Strengthening digital literacy not only supports economic growth but also promotes social inclusion and prepares individuals to become responsible digital citizens.

The results of this study also align with the broader objectives of the 2030 Sustainable Development Agenda, particularly SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure) and SDG 10 (Reduced Inequalities). Digital literacy plays a crucial role in advancing these objectives by improving access to education, fostering innovation, and enhancing participation in the digital economy. As noted by Shafira et al. (2024), strengthening digital literacy empowers individuals and communities to engage more fully in economic, social, and political life. It also ensures that technological progress promotes inclusive and sustainable development rather than widening existing inequalities. In line with Aqiilah et al. (2024), achieving sustainable development requires collaboration among the government, educational institutions, and society as a whole. Through collective efforts, Indonesia can make significant progress in implementing the 2030 Sustainable Development Goals and improving people's quality of life. Therefore, integrating digital literacy development into national and regional policies is essential to accelerate Indonesia's progress toward achieving inclusive and sustainable growth.

4. Conclusions

This study examined the relationship between digital literacy and socioeconomic factors in Indonesia, including education, GRDP per capita, and internet access. The results show that the Western Region has the highest digital literacy index, while the Central Region has the lowest. Although the differences are small, they indicate that digital readiness across regions is still uneven. The findings reveal that formal education, economic growth and internet access do not directly determine digital literacy levels. Regions with higher average years of schooling, higher GRDP per capita or higher internet access do not always have better digital literacy. This suggests that the quality of education, digital exposure, and access to learning resources play more important roles than duration of schooling, economic wealth or internet access.

Internet access shows a closer link to economic capacity but does not guarantee higher digital literacy. Access only reflects technology availability, while literacy represents people's ability to use it effectively and responsibly. Therefore, expanding internet access

must be accompanied by programs that strengthen digital competence and awareness. Overall, improving digital literacy in Indonesia requires an integrated approach involving education, infrastructure, and policy. Strengthening initiatives such as the National Digital Literacy Movement (GNLD) can support the achievement of SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure). Collaborative efforts between the government, educational institutions, and society are essential to ensure inclusive and sustainable digital development.

This study has some limitations. First, it only uses secondary data from 2022, so it may not show recent changes in Indonesia's digital literacy programs. Second, the analysis is done at the regional level (Western, Central, and Eastern Indonesia), which might hide differences between provinces or between cities and villages and may also cause some bias. Third, this study uses a descriptive method, so it can show patterns but not cause-and-effect relationships. Future research should use more recent and detailed data, for example from each province or district. Combining quantitative and qualitative methods can also give a deeper understanding of how education, economy, and internet access influence digital literacy. Future studies could also compare the 2022 data, which still reflects the COVID-19 period, when many activities became digital out of necessity and compare with post-pandemic data, when digital adoption has become more stable and integrated. This comparison can show how digital literacy develops from emergency adaptation toward long-term digital readiness. Researchers could also include interviews with teachers, communities, or policymakers to find better ways to improve digital inclusion and readiness in different areas.

Author Contribution

The author solely contributed to the conceptualization, data collection, analysis, visualization, and writing of this manuscript.

Author Contribution

The concept for this review was proposed by L.L.P. Data collection, analysis, interpretation and writing were prepared by L.L.P. All author has read and approved the final version of the manuscript.

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Ethical Review Board Statement

Ethical approval was not required for this study, as the analysis utilized exclusively secondary data obtained from publicly accessible databases and did not involve human subjects, personal information, or animal experiments.

Informed Consent Statement

Not available. This study did not include human participants, nor did it involve the collection, handling, or analysis of any personally identifiable information.

Data Availability Statement

Not available.

Conflicts of Interest

The author declares no conflict of interest.

Declaration of Generative AI Use

During the preparation of this work, the author(s) used ChatGPT to assist in improving grammar, clarity, and academic tone of the manuscript. After using this tool, the author(s) reviewed and edited the content as needed and took full responsibility for the content of the publication.

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