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Digital Literacy Research in Education : Trends and Insights

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Abstract: This study explores the latest trends and insights on digital literacy in education through bibliometric analysis. Using data from the Scopus database and VOSviewer software, the study analyzed 3,386 publications on digital literacy in educational contexts from 2015 to 2024. Qualitative content analysis methods were used to code and interpret text data. Findings show a significant growth in the number of publications, with the highest peak in 2023. The United States led the research contributions, followed by Spain, the United Kingdom, and Indonesia. The dominant field of study was social sciences, followed by computer science and engineering. Lead authors include Makhachashvili, R., with affiliations at Universidad Salamanca and Monash University. Significant trends identified include an increased focus on digital health, information accuracy, and online learning in response to the COVID-19 pandemic. The study emphasized the importance of digital literacy as a critical skill in a digital society, and identified gaps in the existing literature. This encourages further research to explore the impact of digital literacy on student learning outcomes and education policy. These findings can be a guide for developing a more relevant curriculum by integrating local cultural and technological elements, as well as improving the quality of education.

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Introduction

Digital transformation in education must be continuously promoted to ensure sustainable development. The rise in the application of technology to digitalization underscores the importance of effective and inclusive digital education. The growing dependency on digital technology requires thorough consideration of how people utilize technology, interact online, and possess the skills needed for tasks related to digitization (Schlebusch et al., 2024). Digital literacy includes not only the ability to use information and communication technology effectively and ethically but also the critical understanding and use of technology (Cherutti & Zucchetti, 2022; Puig et al., 2024; Schlebusch et al., 2024; Tutkyshbayeva & Zakirova, 2024; Uzun et al., 2023). It encompasses not only basic technological skills but also the ability to understand, evaluate, and produce digital content effectively (Budash, 2022). Digital literacy education plays a crucial role in helping individuals participate fully in an increasingly complex digital society (Biney, 2023; Chadwick et al., 2022). It not only improves technical efficiency but also supports the development of critical thinking, problem-solving, and collaboration skills in a technology-based environment (Anurogo et al., 2023). Moreover, digital literacy is vital for preparing individuals to face challenges and seize opportunities in the growing global digital economy (Biney, 2023; Haddade et al., 2024; Ibrahim & Aldawsari, 2023; Jashari et al., 2021, 2024).

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Demand for digital skills is rising rapidly, becoming the key to business sustainability, workers' livelihoods, and economic growth. Companies need a workforce that is not only technical, but also adaptive to technological change. (Dağ, 2023; Farsawang & Songkram, 2023; Rodriguez, 2023). Educational institutions play an important role in providing digital skills through innovative learning paths so that students not only master technical skills, but can also apply them widely. (Pangrazio & Sefton-Green, 2023). Effective digital education should include curricula that develop media literacy, cybersecurity, critical thinking, and collaborative skills (Ip, 2024; Kennedy et al., 2023). This includes the ability to use hardware and software well, discover, evaluate, use digital information critically and ethically, and communicate and collaborate effectively through a variety of digital platforms.

The school sector has used several tactics over the years to improve students' digital and learning skills and get them ready for a job that is increasingly reliant on technology. Several 21st-century educational frameworks and paradigms have been employed to romanticize the image of the present and future worker force. Often referred to as the 21st-century learning model or the learning framework 21, some of the well-known 21st-century educational frameworks and models are the Learning Framework of the Organisation for Economic Co-operation and Development (OECD), the Learning Model E3, the Partnership for 21st Century Skills (P21), and many more. Furthermore, the Substitution, Augmentation, Modification, and Redefinition (SAMR) framework and Technological Pedagogical Content Knowledge (TPACK) have been essential in assisting educators in effectively incorporating technology into the teaching and learning process (Yildirim & Özturk, 2023).

Recent research has highlighted that such frameworks and models have largely proved to be ineffective due to the high drop-out rates in existing higher education. Students Lacking the necessary digital skills and knowledge, individuals struggle to engage with technology-based learning. (Ayalon & Aharony, 2024; Getenet, Haeusler, et al., 2024). As a result, they could not continue their studies or quit school from the learning system. Research (Weninger, 2023) claimed that improving digital literacy can lower the high rates of online learning disruptions and better prepare graduates with digital education for the workforce.

However, the rapid evolution of digital technology has created a need for continuous updating and improvement in the digital literacy framework and practice Education (Khin & Ho, 2019; Mardiani et al., 2021; Purnomo et al., 2022; Wray et al., 2022). It requires a comprehensive understanding of the state of digital literacy research in education today, including trends, patterns, and insights that can be input into future research and education policies. Digital literacy covers more than just the use of technology, including research, analysis, and digital communication. (Weninger, 2023). In the world of education, digital literacy enables students and educators to search for information, analyze data, and communicate effectively using a variety of digital platforms. (Rusydiyah et al., 2020). It is important to improve the quality of learning and prepare students to face future challenges.

In the workplace, individuals with digital skills tend to perform better and more productively than those with less digital skills (Ilyas et al., 2024; Kaun & Forsman, 2024; Sogalrey et al., 2022; Qin et al., 2024). Organizations are also aware of the gap between existing and required digital competencies (Khoeini et al., 2024). To guarantee that their workforce possesses the necessary digital skills for a future driven by technology, many employers host workshops and training sessions. Russia and Kazakhstan are developing models for Industry 4.0; Germany has a national program for the digital economy, and Singapore is driving the smart nation program. The COVID-19 pandemic stresses the need to overcome the digital skills gap for survival. Efforts like internships and government

initiatives have not been successful. Therefore, a holistic and targeted approach is needed to address this problem.

This research offers a new contribution by presenting a bibliometric analysis that focuses on the latest trends and insights in digital literacy research in education, addressing gaps that have not been fully explored by previous studies. While H. Baber et al. (2022) and C. Wang & Si (2023) have conducted extensive bibliometric analyses of digital literacy, this study specifically examines shifts in research methodology and themes since the COVID-19 pandemic, as well as the impact of recent technologies such as artificial intelligence on the development of digital literacy in education. Additionally, this research distinguishes itself by evaluating significant differences in the implementation of digital literacy across various levels of education and analyzing inter-research collaborations and publications in leading journals. The global mapping provided by this study also offers new insights into contextual differences across different regions, which were previously under-observed. By focusing on these aspects, the research delivers a more comprehensive and contextual understanding of the latest developments in digital literacy in education. It aligns with the urgent need for reform in education policy in Indonesia, which should concentrate on integrating digital literacy into national curricula, enhancing technological infrastructure, and training educators. Through this approach, Indonesia can ensure that its education system remains relevant and effective in addressing the challenges of the ever-expanding digital world.

This research aims to explore and map out how digital literacy has evolved in a variety of academic and practical contexts. Focus on the quantitative component will provide insight into the volume of publication, research collaboration, and topic trends, while visual analysis will highlight patterns and relationships between the various themes and methodologies in digital Literacy studies (Hasnan Baber et al., 2022). The research is expected to reveal emerging trends that will affect future digital literacy research, as well as provide strategic guidance for researchers and practitioners to direct their studies to the most relevant and innovative areas.

Research Method

This study used a method of literature study with a quantitative approach. In this study, *VOSviewer software* is used for data analysis. *Vosviewer* is specially designed to build and visualize *bibliometric maps*. (Budianto, 2022). The research was carried out by filtering articles related to the field of digital literacy. Data collected through the Scopus database was collected in July 2024 and searched for the keyword "Digital Literacy", based on titles, keywords, and abstracts. This research obtained 7,329 publications with the keyword “digital literacy” publications and further, we analyzed the publications of digital literacy in education obtaining as much as 3,386 publications this data that we will use to analyze the trends in digital literature in education. (2.008), *Conference paper* 746, *Book Chapter* (344), *Riview* (154), *Book* (56), *Conference Riview* (34), *Note* (16), *Editoral* (10), *Letter* (6), *Erratum* (5), *Data paper* (3), *Short Survey* (3) dan *Retracted* (1). The focus of this research is on articles published in the last 10 years (2015-2024).

Collected articles saved in format *.RIS and analyzed using the VOSviewer application by visualizing and analyzing data with bibliometrics, which includes network mapping, density, and overlay visualization. This research using content analysis begins with the use of qualitative data in the form of text, which is made in accordance with the researchers' analysis. Then proceed with creating coding and interpretation of the results in the form of a description embossing.

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Results and Discussion

Based on the analysis of the data of this study, the following findings were obtained:

Publication growth

Can be seen in picture 1 below.

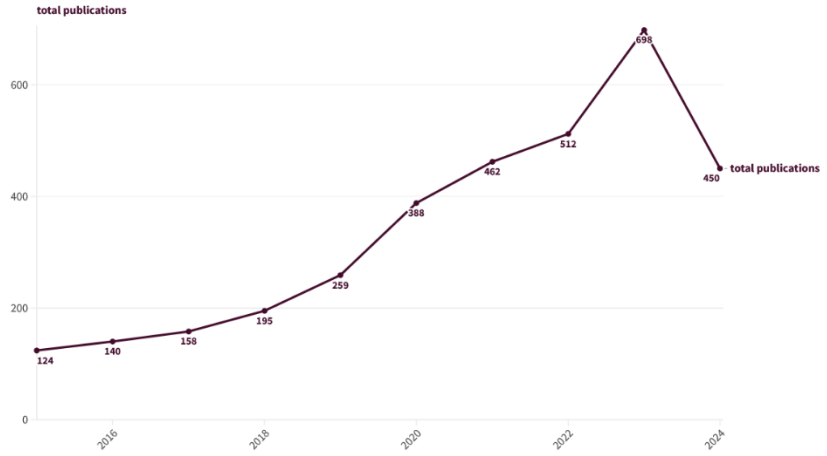

Figure 1. Pertumbuhan Publikasi digital literacy in education tahun 2015-2024

The above figure shows the growth of publications on "digital literacy" in education with the keywords "digitals" and "education" in the last 10 years. The amount of data is growing significantly every year, with a peak in 2023 of 698 publications. Note that since the last data collection took place in July 2024, the publication for the year 2024 is still ongoing, potentially changing this figure over time.

Document visualization by country or region

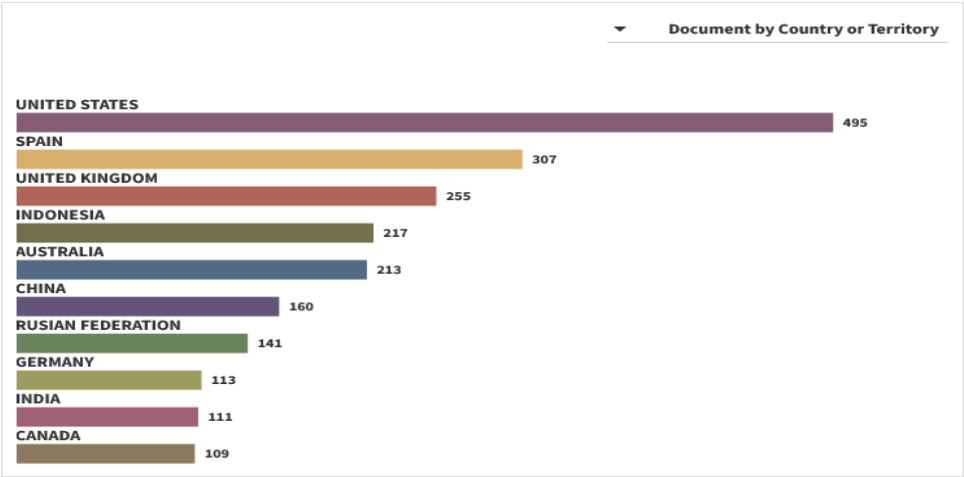

Figure 2. The distribution of leading countries in education from 2015 to 2024 is based on the keyword "digital literacy."

Various countries around the world have discussed the importance of digital literacy in education, emphasizing the need to continue encouraging its transformation for the next generation of national development. Figure 2 shows the distribution of the number of documents related to the keyword "digital literacy" in education in various countries or regions during the period 2015 to 2024. Based on our search through the Scopus website, we ranked 10 countries with keywords related to *"digital literacy"* in education. The results show that *the United States* ranks first with 495 or (14,6%), *Spain* (9%), *United Kingdom* (7,5%), *Indonesia* (6,40%), *Australia* (6,2%), *China* (4,72%), *Russian Federation* (4,1%), *Germany* (3,3%), *India* (3,2%) and the 10th position is occupied by *Canada* (3.2%) publications.

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Document Visualization by Subject Area

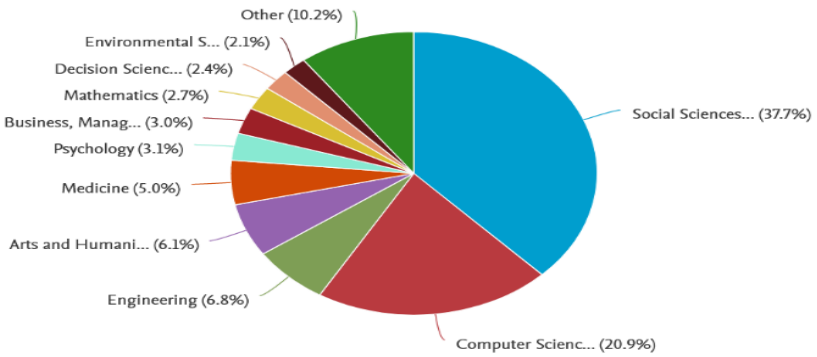

Figure 3. The percentage of subject areas in the field of education from 2015 to 2024 is based on the keyword "Digital Literacy".

This research also obtained documents based on the subject area from the Scopus database. We analyzed the search results and found the top 10 subject areas. First, *Social Sciences* (2239), *Computer Science* (1242), *Engineering* (404), *Art and Humanities* (360), *Medicine* (300), *Psychology* (184), *Business, Management, and Accounting* (178), *Mathematics* (159), *Decision Sciences* (141), *and Environmental Science* (126) *are subject areas.*

Document Visualization per Year by Source

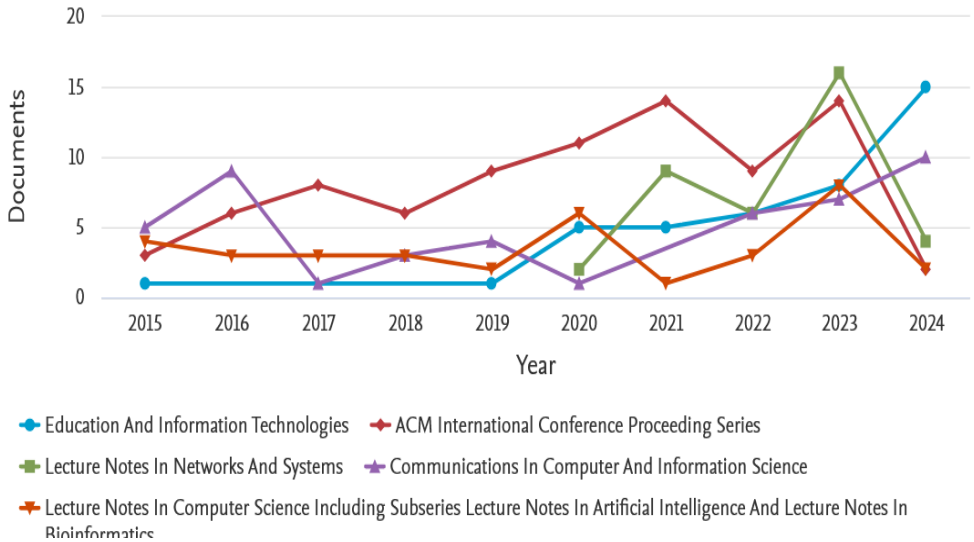

Figure 4. The visualization document is based on the keyword "digital literacy" in education from 2015 to 2024.

We also obtained documents based on Documents per Year by Source from our Scopus database. We analyzed search results and found five documents per year from top sources. *The ACM International Conference Proceeding Series* in the last 10 years reached (82) publication documents*; Communications in Computer and Information Science* (46) publications*; Education and Information Technologies* (41) publications*; Lecture Notes Networks and Systems (37)* publications; and *Lecture Notes in Computer Science, Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics (35)* publications.

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Document Visualization by Affiliation

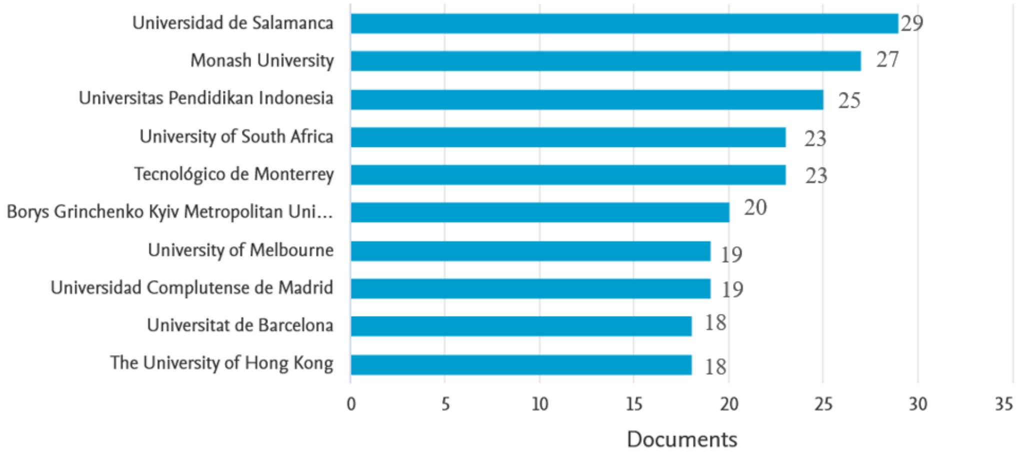

Figure 5. Visualization Document by Affiliation the document is based on the keyword "digital literacy" in education from 2015 to 2024.

We also obtained documents based on affiliation from the Scopus database. Figure 7 displays the top 10 affiliations. The top ranks are occupied by Universidad Salamanca and Monash University, and the 10th rank is occupied by the University of Hong Kong.

Digital Literacy Research Topics In Education

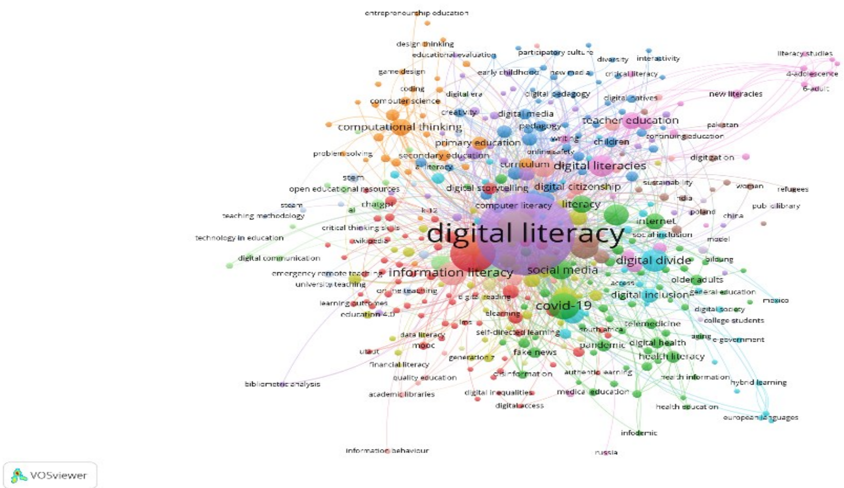

Figure 6. Author Keywords, Co-Occurrences, Network Visualization

In the network map of the second visualization, the relationships between various topics related to "digital literacy" are visible. Many topics, such as "emergency remote teaching," "*online teaching"* and "*self-directed learning*" indicate responses to the COVID-19 pandemic, which forced the adoption of distance learning and educational technology. Strong relationships between "*digital literacy*" and topics such as "*health literacy*" and "fake news" indicate attention to digital literacy in the context of health and accurate information. Other keywords, such as "*computational thinking*" and "*teacher education*" also indicate attention to broader digital skills development and the important role of educators in delivering digital literacy. This analysis demonstrates the growing recognition of digital literacy as a crucial skill in contemporary education, encompassing technology, health, and digital citizenship.

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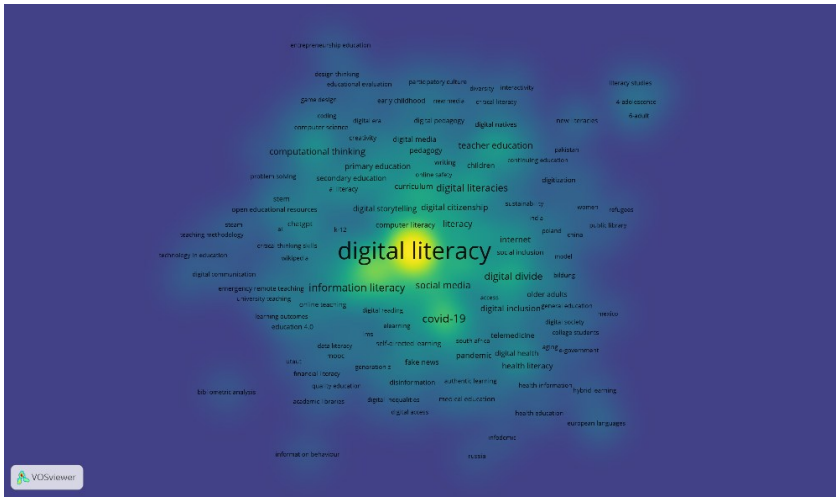

Figure 7. Author Keywords Co-Occurrences Density Visualization

The density map of Scopus data over the past 10 years, using the keyword "digital literacy" in education, reveals several key trends. The map shows that "*digital literacy*" is at the center of discussions, with keywords such as "*information literacy*" and "*social media*" frequently appearing together, indicating that information literacy and social media use are integral parts of digital literacy. The COVID-19 pandemic has also triggered a significant increase in discussions about digital literacy, especially related to distance learning and adjustments in education. The term "*digital divide*" appears frequently, indicating attention to digital perceptions and the importance of digital inclusion in education. Furthermore, discussions often include teacher education and computational thinking alongside digital literacy, signifying efforts to incorporate digital literacy into curricula and teaching methodologies. Other topics such as "*emergency distance learning*" and "*online teaching*" also indicate responses to the pandemic that forced the rapid adoption of educational technology. The map reflects how digital literacy has become increasingly important in the context of modern education, with aspects covering technology, health, and digital citizenship.

From the keywords related to digital literacy in education, it can be a new way for educational institutions to be able to make policies or support education by utilizing digital literacy. Because the application of digital literacy can be a transformation of education and educational development in the future (Achmad, Y. E., Rokhmat, A., Sogalrey, F. A. M., & Chairuddin, 2024; Getenet, Cantle, et al., 2024; Imjai et al., 2024; Kee et al., 2024; Puig et al., 2024; Rezai et al., 2024; Tutkyshbayeva & Zakirova, 2024; Umrotin et al., 2024). The goal of digital literacy in education is to equip students with the skills and knowledge necessary to function effectively and ethically in an increasingly connected and technology-driven world. Digital literacy aims to teach students basic technology skills, such as the use of digital devices and applications, as well as critical skills in evaluating and analyzing information found online (Černá et al., 2024; Jeanneau & Ollivier, 2023; Jeong, 2023; Rofidiyah & Widiaty, 2023). Another goal is to facilitate problem solving and creativity through the use of technology, as well as prepare students to adapt to technological changes and apply digital skills in professional contexts (Volpe et al., 2023). Digital literacy also aims to improve students' information and media skills so that they can become smart consumers of information and make informed decisions (Billingsley & Heyes, 2023).

This research has significant conceptual implications for enriching the literature on digital literacy in education by highlighting relevant trends and the latest developments. In practice, these research findings encourage the development of a more contextual and

relevant curriculum that integrates local cultural and technological elements. This research shows that digital literacy is a critical skill that students should have in today's digital age, so there is a need for greater emphasis in education policy. Indonesian future education policy should focus on strengthening digital literacy, paying attention to local and global needs, and preparing students to face challenges in an increasingly complex digital world.

Conclusion

The study's results reveal the growing importance of digital literacy in modern education, as it equips the next generation with the necessary skills for the digital era. Good digital literacy skills will improve the quality of human resources (HR) by ensuring they can adapt quickly to technological changes, access and evaluate information critically, and actively participate in the digital society. Digital literacy must be a top priority in education to ensure that future generations have the skills needed to succeed and contribute positively in this increasingly digital world. This study has defined the trend of digital literacy research in education as a fluctuating phenomenon, with periods of increase and decrease that can influence the direction and focus of future research. Future research can explore various topics related to digital literacy in education, including curriculum development, educational technology, and technology integration policies, thanks to the results of this study.

Recommendation

Recommendations for policymakers include integrating digital literacy into the national curriculum, providing training for teachers, and improving technology infrastructure in schools. For teachers and schools, it is necessary to adopt digital technology in teaching and continue to update learning methods. Further research is advised to explore the impact of digital literacy on learning outcomes and develop effective learning models in various educational contexts.

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