

Digital Transformation in Education in the Post-Pandemic Covid-19: Bibliometric Analysis (2020-2025)

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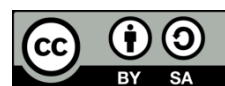
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ABSTRACT

This study explores the digital transformation in education accelerated by the COVID-19 pandemic using a bibliometric analysis of 1,300 Scopus-indexed publications from 2020–2025. Using the keywords “digital” AND “transformation” AND “education.” Analyzed using VOSviewer, Biblioshiny, and Microsoft Excel, and OpenRefine. The study identifies publication trends, prolific authors, institutions, and key research themes. The results show a surge in research on human-centered e-learning, innovation, and digital transformation. China tops the list with 83 articles, indicating high contributions, while the University of Oxford tops the list with the most contributions, with 28 articles. The Financial University, Under the Government of the Russian Federation, follows with 27 articles. The study emphasizes the importance of international collaboration and recommends further investigation into the socio-pedagogical implications of digital adoption in diverse educational contexts.

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1. INTRODUCTION

Digital transformation in education is a fundamental change in the way the teaching and learning process, academic administration, and interactions between educators and students are carried out by utilizing digital technology [1], [2], [3]. Rapid technological developments have encouraged educational institutions around the world to adapt by creating learning systems that are more flexible, efficient, and adaptive to the challenges of the digital era. [4], [5], [6]. This transformation is not only limited to the use of electronic devices but also involves a paradigm shift [7], learning models, and the role of education actors in welcoming the era of technological disruption [8].

Technological developments occur continuously without being realized. This progress cannot be avoided or even stopped [9]. In the current era, humans are required to carry out digital transformation, and this is the beginning of the creation of a new, more

effective, and efficient way to replace the long-standing process of doing something. This activity is carried out through the utilization or use of existing technology [10]. Digital transformation is a metamorphosis of a company or organization that involves several aspects, starting from human resources, processes, strategies, and structures through the adoption of technology to improve performance [9], [11], [12].

The COVID-19 pandemic marks a critical phase in the history of global education [13], [14]. As face-to-face learning was widely suspended, education systems experienced an abrupt shift to online learning models [15]. While many educational institutions struggled to adapt, this situation also opened up opportunities to accelerate the digitalization of education. In the post-pandemic era, many countries and institutions are starting to evaluate hybrid and blended learning models as long-term approaches rather than just stopgap solutions [16], [17]. To better understand how this digital transformation in education is evolving, a systematic and measurable analysis of the existing literature is needed. Bibliometrics is a quantitative method used to analyze scientific publication patterns, including publication frequency, collaborations between authors or institutions, citations, and topic trends in the literature [18], [19]. In the context of this study, a bibliometric approach is used to understand the dynamics of research on digital transformation in education as reflected in the Scopus database during the period 2020–2025. Bibliometric analysis is used to map the knowledge structure of a field, identify the most influential authors or journals, and track the evolution of keywords or popular topics [20], [21]. The data visualization of this study uses the VOSviewer and Bibliometrix tools [22], [23]. These tools can visualize emerging collaboration networks and theme trends with a clear view. This approach is especially relevant to analyze the highly dynamic and multidisciplinary Post-Covid 19 phenomenon.

Previous studies were more descriptive, discussing the impact of implementing digitalization in education [24]. The Role of Digitalization in Educational Progress [25], the positive and negative impacts of digitalization in education [26], [27], and the Urgency of Digitalization in Education [28]. Meanwhile, this study uses a bibliometric method to determine the trend of scientific publications in the study of digital transformation in the field of education. Therefore, this study is important to fill this gap by presenting a comprehensive analysis based on data from Scopus, one of the largest scientific databases in the world.

Based on this description, the purpose of this study is to analyze the trend and growth of scientific publications on digital transformation in education in 2020–2024 based on Scopus data, identify the most productive authors, institutions, and countries on this topic, map keywords and main themes that are currently developing. The formulation of the problem in this study is: 1. What is the trend of scientific publications related to digital transformation in education in the Scopus database in 2020–2024? 2. Who are the most productive authors and institutions on this topic? 3. What are the keywords and main themes that are currently developing in research related to digital transformation in education?

2. METHOD

This study uses a bibliometric analysis approach to analyze scientific publications, which allows researchers to conduct quantitative evaluations of the number of publications, research trends, and collaboration patterns between authors, institutions, and countries that contribute to this field. Bibliometric analysis aims to map the distribution of publications, identify dominant topics, and understand the relationship between elements in the literature that focuses on Digital Transformation in Post-COVID-19 Education. The bibliometric approach was chosen because it is able to provide a comprehensive quantitative picture of research trends, scientific collaborations, and publication distribution across geographic regions and academic institutions [29].

In this study, the Scopus database was used as the primary source for data collection, given its reputation as a leading scientific database that provides access to indexed scientific articles globally. Scopus was chosen because its articles have gone through a rigorous peer review process, making it a credible data source. The data collection stage in this study went through several systematic steps. The first step was to collect data at 09.00 on April 24, 2025, using a more specific title-abstract-keyword query ("Digital" AND "Transformation" AND "Education"). This search resulted in 6,300 document articles that were relevant to the topics of transformation, digital, and education. After the initial results were obtained, further data filtering was carried out to ensure that only articles that met the relevance criteria would be analyzed. Filtering was carried out with several filters, as follows: First, only selected journal articles were selected. Second, only articles that had been published were final. Third, ensure that the selected articles only use English. Fifth, the years are only from 2020-2025. This filtering process ensures that only articles of the highest quality and clear relevance to the research topic are used in the bibliometric analysis. Thus, the data analyzed in this study has high integrity and validity.

In the data visualization process, this study uses the Biblioshiny application as part of the Bibliometrix R package, VOSviewer, and also Microsoft Excel 2010 for additional data processing. Biblioshiny is used for descriptive statistical analysis and publication trend graphs. [30], while VOSviewer helps map keyword networks, author collaborations, and intertopic relationships in visual form [31]. Microsoft Excel is used to organize data, create tables, and calculate specific frequencies that cannot be generated directly from visualization applications [32]. To ensure the quality of the data used, the data cleaning process is also carried out using OpenRefine. OpenRefine is used to handle inconsistencies in data, such as duplication and writing errors, ensuring that the data used in the analysis is well-structured and free from errors that can affect the results of the analysis [33]. The combination of these tools allows for more comprehensive and structured data interpretation so that the research results have a strong analytical basis and can be scientifically accounted for.

This study applies strict inclusion criteria to ensure that only relevant and quality articles are used in bibliometric analysis. Articles included in the inclusion criteria must be final and complete and written in English to ensure consistency and readability in the analysis. In addition, the selected articles must discuss Digital Transformation in Education post-COVID-19 pandemic. The primary focus is on articles that discuss aspects of the role

and impact of digital transformation in education. On the other hand, the exclusion criteria stipulate that articles published in non-academic journals that have not gone through a peer-review process will be excluded because the quality of the article is not guaranteed and does not meet scientific research standards. Articles that have a final version or are published as early access will also be excluded. Articles that are not relevant to the topic of Digital Transformation in Education or articles that are incomplete or duplicate are also excluded from the analysis. This selection strategy aims to maintain the quality and validity of the research so that only the most relevant and verified articles are considered in this study.

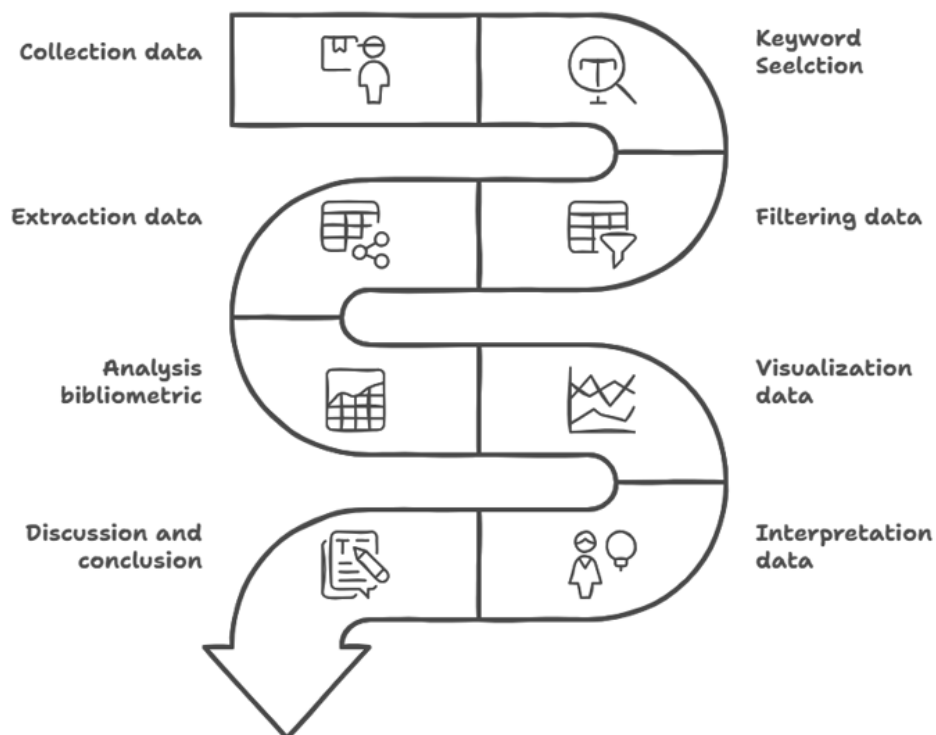


Figure 1. Research Flowchart

3. RESULTS

There are 6,300 documents in the form of articles, proceedings, and books from the search results at 09.00 on Thursday, April 24, 2025. After filtering based on the year of publication between 2020 and 2025 and only taking articles that use English and Indonesian with keywords that match the theme of digital education transformation, 1.300 articles were obtained, which will be analyzed and visualized by researchers

3.1. Development of the number of scientific publications on Digital Transformation of Education per year

Figure 2 illustrates the development of the number of scientific publications related to digital transformation in the period 2020 to 2025. From the graph, there is a consistent increasing trend in the number of scientific articles since 2020, which peaked in 2024. This can be attributed to the increasing urgency and attention to digital transformation in

education and global society, especially in response to the COVID-19 pandemic. The pandemic has accelerated the adoption of digital technology in education (e-learning, online learning, digital platforms), industry (Industry 4.0, digitization), and sustainable development (sustainability, human capital). So, it is not surprising that in those years, there was a spike in the number of scientific publications discussing these issues.

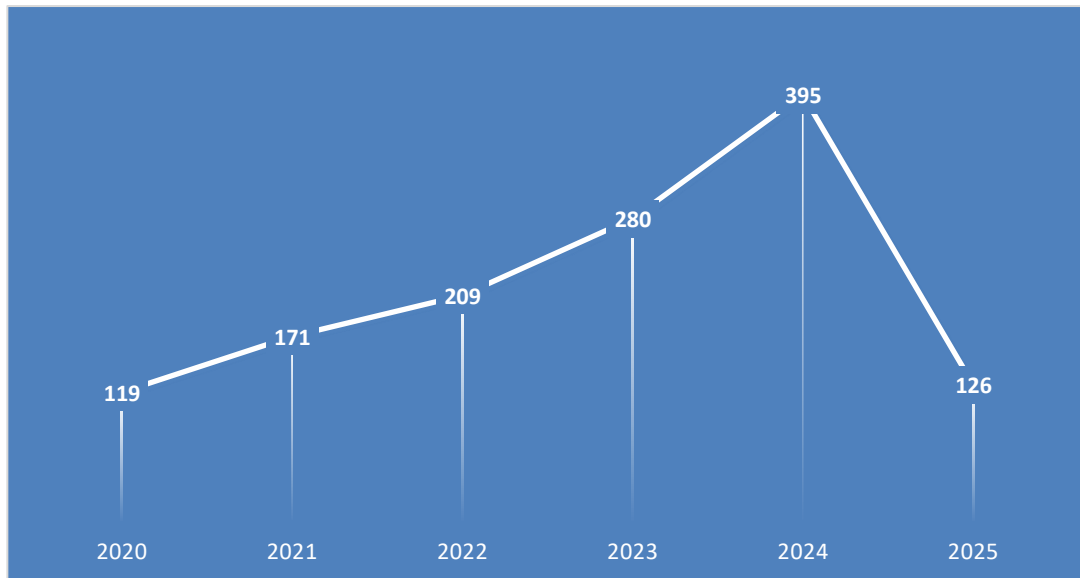


Figure 2. Development of Scientific Publications

Digital transformation in the world of education has become a central issue because of its crucial role in ensuring the continuity of the teaching and learning process amidst global disruption. In addition, the digitalization of education has also triggered new studies on the effectiveness of technology, accessibility of online learning, and the digital divide, which are increasingly becoming major concerns for the academic community.

However, the sharp drop in 2025 in this graph can be explained by two possibilities: first, the data for 2025 may not have been fully collected or available, given that this year is still ongoing. Second, there could also be a shift in research focus toward post-pandemic issues or new technological transitions that have not been widely discussed in the scientific literature. Digital transformation in education is a very active research topic and has seen a significant spike in recent years, especially as a result of the pandemic. Although 2025 shows a drop in the production graph, this trend is likely temporary and will continue to evolve as new challenges and innovations emerge in the global digital ecosystem.

3.2. Distribution of publications by country of corresponding author

Figure 3 explains the distribution of publications based on the country of the corresponding author, showing the dynamics of global research strength in the field of digital transformation. The dominance of China, which has the highest number of publications, and most of them are single-country publications (SCP), indicates that this country has a very strong domestic research ecosystem. This can be attributed to

aggressive national policies in supporting digitalization and domestic technology development, such as the “Made in China 2025” program that encourages innovation in the high-tech sector.

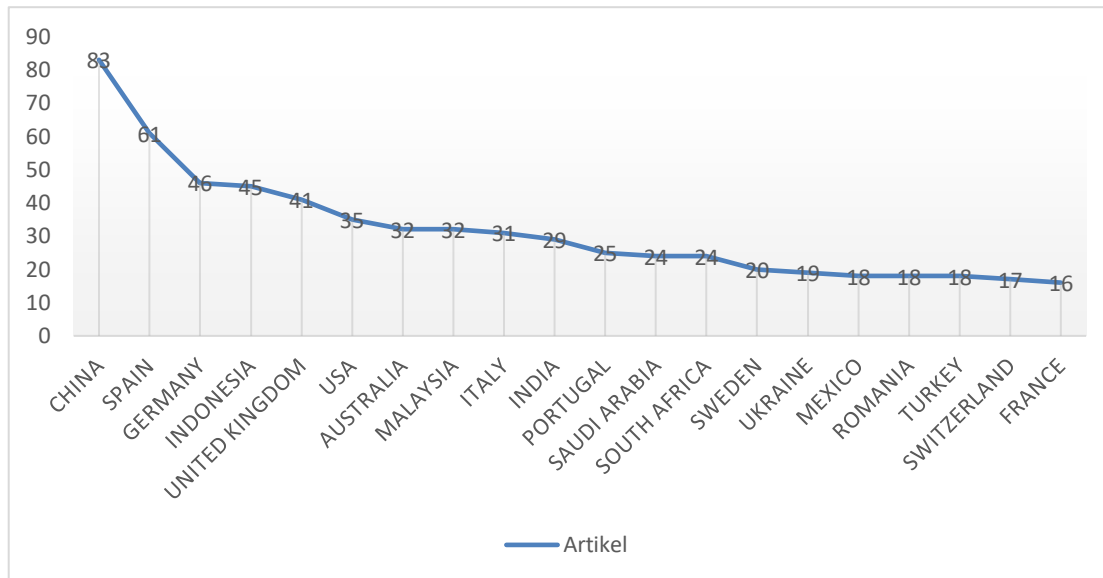


Figure 3. Distribution of publications by country of corresponding author

However, China's research strength is more inward-looking than that of countries such as Spain, Germany, and the UK, which show a larger proportion of international collaboration (MCP). This shows that although they may produce fewer documents than China, they are superior in global collaboration networks. In the modern knowledge ecosystem, cross-country collaboration is often correlated with increased research quality, technology transfer, and openness to more varied ideas and approaches.

It is interesting to note that Indonesia is in fourth place with a dominance of SCP. This shows that Indonesian researchers are actively producing literature in the field of digital transformation, but collaboration with foreign researchers is still limited. This could be an important signal for national research policy: there is an urgent need to encourage the internationalization of research, both through collaboration schemes, visiting scholar programs, and publications in highly reputable journals with foreign institutions. Without strengthening MCP, Indonesia's position on the global scientific map will remain limited to the local circuit.

Countries such as Malaysia, India, and South Africa also show a similar pattern to Indonesia's strong national production but still need to increase global engagement. Meanwhile, countries such as the United States and the United Kingdom, which historically have a well-established research tradition, continue to show a balance between local strengths and international networks. From a global science-policy perspective, this data strengthens the argument that international collaboration is not only about expanding access but also about encouraging quality, cross-border innovation, and research impact. Smart countries are those that are able to combine local strengths with global networks strategically.

3.3. The most cited scientific articles

Figure 4 shows the ten most cited scientific documents globally (Most Global Cited Documents) on the topic of digital transformation. From the graph, it can be seen that the article written by Dwivedi YK in 2023 and published in the *International Journal of Information Management* is ranked first with a total of 1968 global citations. The second position is also occupied by another article by Dwivedi YK from 2020 in the same journal, with 758 citations. Meanwhile, an article by Iivari N, also published in 2020 in the same journal, is ranked third with 616 citations. The dominance of the *International Journal of Information Management* journal in this list shows that the journal is the primary channel for publishing research related to digital transformation.

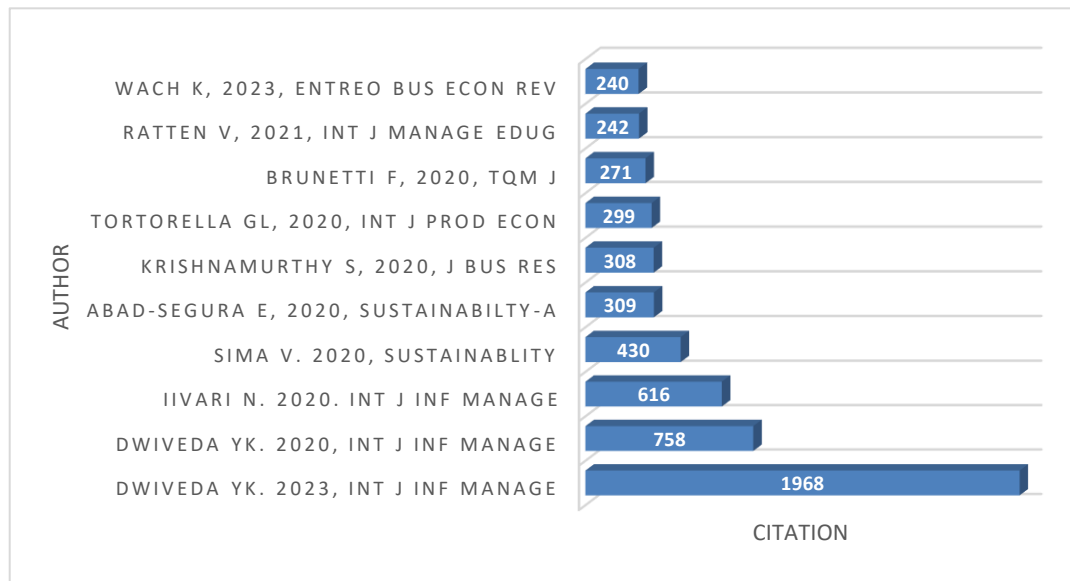


Figure 4. The ten most cited documents

Most of the articles included in this graph were published in the period 2020–2023, indicating that interest in the topic of digital transformation has increased sharply during and after the COVID-19 pandemic. This is in line with the fact that the pandemic has accelerated the adoption of digital technology in various aspects of life, including education, government, and the business sector. The interim conclusion of this graph shows that scientific publications in the field of digital transformation receive great attention from the global academic community, primarily if published in a highly reputable journal. This finding also emphasizes the importance and urgency of research on digital transformation in responding to the challenges of the times in the current era of technological disruption.

3.4. Most Relevant Affiliates

Figure 5 presents information on the “Most Relevant Affiliations” based on the number of articles produced by authors affiliated with these institutions. It can be seen that the University of Oxford is at the top with the largest contribution, with 28 articles. Following in second place is the Financial University Under the Government of the Russian Federation, with 27 articles. Beijing Normal University also shows quite high

productivity with 17 articles. Meanwhile, a group of institutions such as Linnaeus University, University of Johannesburg, University of Tasmania, Institute for the Future of Education, King Saud University, University of Patras, and University of Seville have a lower number of articles, ranging from 10 to 15 articles. Overall, the graph highlights the University of Oxford and Financial University as the main contributors to this collection of scientific publications, followed by Beijing Normal University. At the same time, the other institutions contribute less but are still part of the relevant publication landscape.

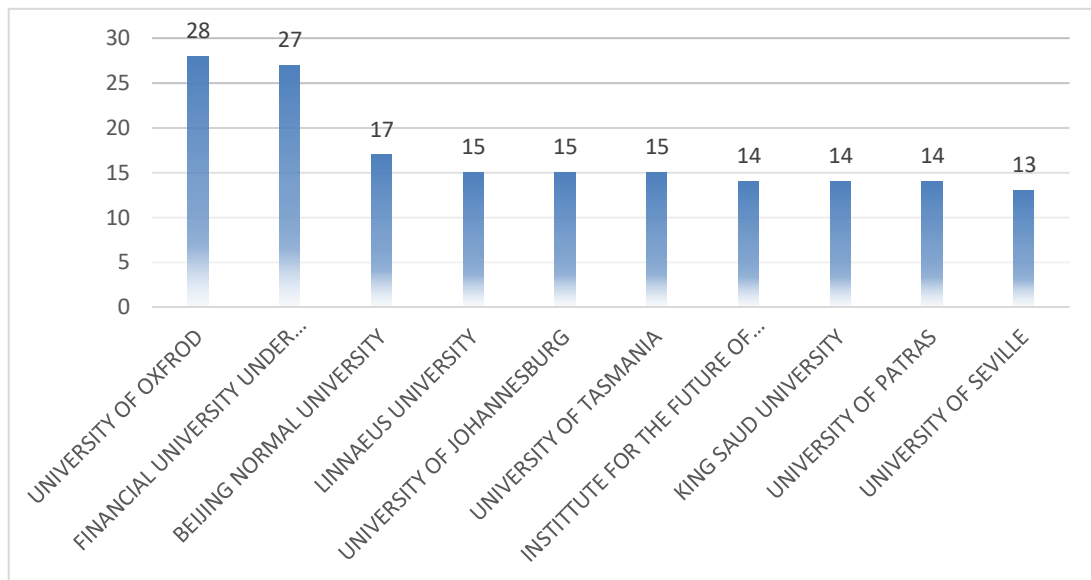


Figure 5. Most relevant affiliates

3.5. Frequently occurring keywords

Figure 6 below illustrates the relationship between keywords that frequently appear together in scientific publications on the theme of digital transformation in the context of education. In this visualization, the size of the circle indicates the frequency of occurrence of a keyword—the larger the circle, the more frequently the word is found in the document. Words such as “digital transformation,” “education,” and “e-learning” appear to be the most dominant words because they have the largest circles.

The red cluster depicts the theme of e-learning and digital learning, with keywords such as students, teachers, online learning, and educational innovation. The green cluster indicates a focus on digital transformation and education through keywords such as digitization, human capital, and education. The blue cluster highlights the link between the COVID-19 pandemic and the acceleration of the digitalization of education, with words such as COVID-19, motivation, and teacher. The yellow cluster shows the relationship between digital transformation, industry 4.0, and sustainable development through terms such as sustainable development, economic growth, and competencies. The purple or orange cluster shows the linkage of digital transformation to engineering and technology education, particularly in higher and vocational education, through words such as engineering education, digital platforms, and higher education institutions.

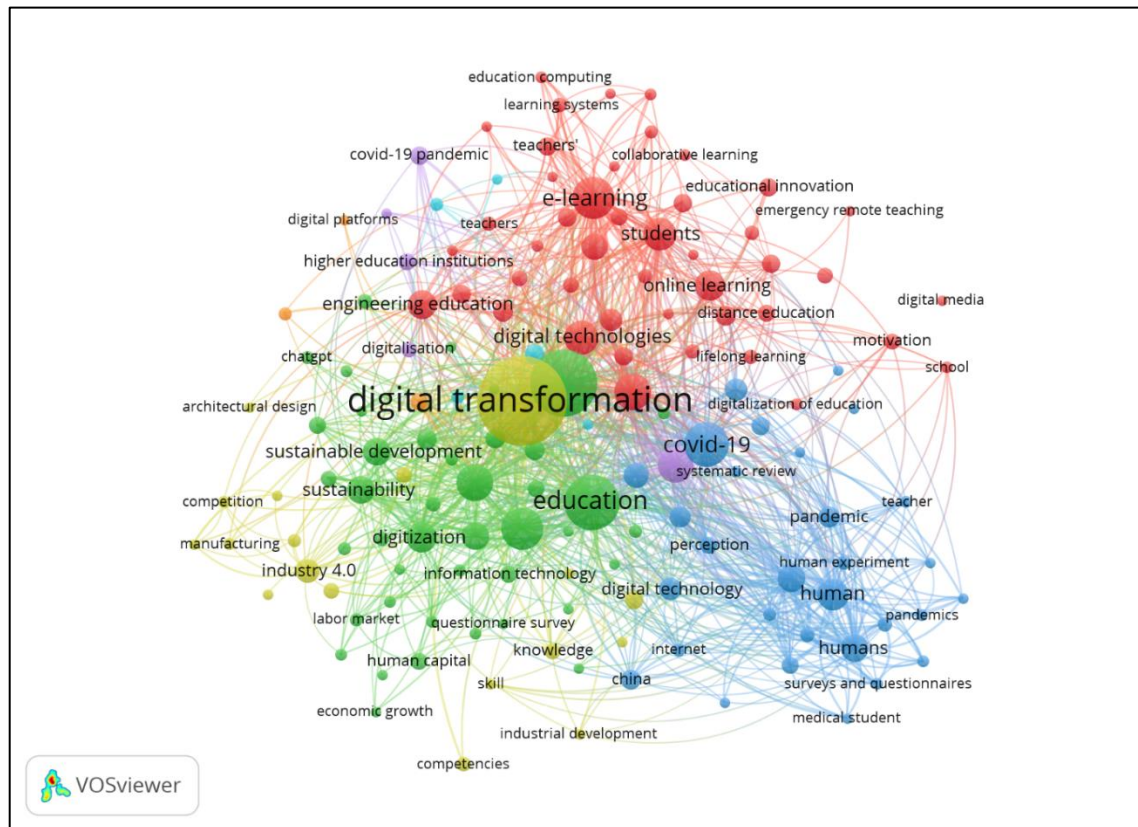


Figure 6. Network Visualization

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Overall, this visualization reveals that the topic of digital transformation in education is multidisciplinary and closely connected with several important sub-themes. These include learning technologies, the impact of COVID-19 on education systems,

industry readiness through digitalization, and innovation in higher education and human resource development.

4. DISCUSSION

This study shows a significant upward trend in scientific publications related to the digital transformation of education between 2020 and 2025. This surge was mainly driven by the impact of the COVID-19 pandemic, which forced the global education system to adapt rapidly to digitalization. Research topics that initially focused on crisis responses, such as distance learning and the digitalization of learning technology, have gradually shifted towards more innovative and adaptive learning models, including the development of e-learning, hybrid learning, and the use of artificial intelligence-based learning platforms. Bibliometric analysis shows that countries such as Indonesia, Malaysia, and India dominate the national production of scientific articles, although international collaboration networks are still relatively limited and need to be strengthened.

The digital transformation discussed in this finding not only includes the use of technology as a tool but also as a representation of a paradigm and cultural shift in education. Platforms such as Learning Management Systems (LMS), video conferencing, and adaptive learning systems have become part of the main infrastructure in the implementation of post-pandemic education. Thus, digital transformation cannot be seen merely as a response to the crisis but as a strategic momentum to fundamentally reform the teaching and learning process and the management of educational institutions as a whole. As stated by Nasihuddin [1] and Sriyanta [2], this transformation demands a shift from the digitalization of tools to the renewal of pedagogical paradigms and learning models that are more responsive to the needs of the 21st century.

In the context of time evolution, the digital transformation of education has undergone a fundamental change from the pre-pandemic phase, marked by the limited and optional use of technology, to the pandemic phase, where digitalization has become a necessity to maintain the continuity of education. In the pre-pandemic phase, the adoption of learning technology was generally additional and had not been integrated into the national education strategy. This is consistent with the Technology Acceptance Model framework [34], which emphasizes that the perception of the usefulness and ease of technology is not yet strong enough to encourage widespread adoption.

However, the situation changed drastically during the pandemic, when educational institutions around the world had to make an emergency transition to online learning. This phase shows a form of digitalization that is functional but still lacks pedagogical planning. The use of Zoom, Google Classroom, and similar platforms has increased sharply as a means of organizing online classes. In this condition, the Crisis-Induced Innovation Theory [35] is relevant to explain how a crisis can encourage massive adoption of technology in a short time while creating space for the birth of innovation. On the other hand, the need for inclusive learning introduces the Universal Design for Learning (UDL) framework as a more inclusive and responsive online learning design strategy for learner diversity.

Entering the post-pandemic phase, digital transformation is moving towards a more strategic and systemic direction. Educational technology no longer only plays a role as a tool but as the leading platform in curriculum development, learning evaluation, and improving teacher and student competencies. Learning models such as flipped classrooms, microlearning, and adaptive learning are part of ongoing innovations that enrich the learning experience. At the same time, global institutions such as UNESCO and the World Bank are encouraging long-term digital education policies through various reports and strategies that emphasize strengthening digital literacy, reducing the gap in access to technology, and increasing the capacity of educators. This is where the Technological Pedagogical Content Knowledge (TPACK) framework [36] becomes key in ensuring that technology integration does not sacrifice the quality of pedagogy and the substance of teaching materials.

The bibliometric analysis in this study also shows a significant shift in academic focus. Shows that the research theme has shifted from a focus on technology as a tool to institutional and cultural transformation. The dominance of specific authors and institutions indicates the existence of centers of excellence in digital education research but also suggests the need for expanding global collaboration so that the transfer of knowledge and innovation is more evenly distributed. Damayanti et al. [37] emphasize that the success of digital transformation in education is not enough just by presenting technology but must involve all aspects of the education ecosystem: curriculum, leadership, learning culture, and community participation.

Thus, this study confirms the importance of a comprehensive and multidimensional digital transformation approach. In line with the findings of Panjaitan & Lupiana [12] and Prastiwi [11], successful educational transformation lies not only in the adoption of technology but also in the reform of organizational culture and learning systems. The bibliometric approach used in this study makes an important contribution by presenting the latest trends until 2025 while also showing how the direction of global research is moving from a focus on tools to a comprehensive transformation. These findings have broad strategic impacts, especially in encouraging educational institutions to design holistic and sustainable digital strategies, expand access to learning, improve the quality of education, and prepare students to face the challenges of the digital era. In addition, this study emphasizes the importance of strengthening international collaboration and research networks to ensure that digital transformation in education is not only inclusive but also sustainable and equitable globally.

5. CONCLUSION

This study reveals a significant increase in scientific publications on digital transformation in education in the 2020–2025 period. This surge was triggered by the COVID-19 pandemic, which accelerated the adoption of digital technologies in the education sector, from online learning to efficient and transparent education management. Digital transformation does not only include the use of technological devices such as Learning Management Systems and adaptive learning platforms but also changes in paradigms, learning models, and the culture of educational institutions as a whole. Key

findings reveal that digital transformation is multidisciplinary in dimension, with various aspects that are also influenced, such as learning technology, innovation, sustainability, and demographic and geographic factors. In addition, research has also begun to integrate artificial intelligence technologies such as ChatGPT to enrich the learning and teaching experience. However, digital transformation also presents challenges that require special attention related to the quality of human-technology interactions and the strength of human resources in managing the digital education ecosystem. Based on these results, it is recommended that further research focus on evaluating the effectiveness and socio-pedagogical impact of digital transformation, as well as the adaptation of sustainable strategies in the educational environment. Educational practices need to emphasize human resource capacity building, strengthening technological infrastructure, and increasing inter-institutional collaboration to accelerate inclusive and responsive digital transformation to ever-changing technological developments. This approach is essential to creating an adaptive, efficient, and sustainable education system in the digital era. This study has several limitations. First, the bibliometric approach used is quantitative, so it does not describe in depth the context of the content or practical impact of the publications analyzed. Second, the use of a single database, namely Scopus, limits the scope of literature that may be relevant but not indexed in it, especially from local or non-indexed sources. Further research is recommended to combine bibliometric analysis with qualitative approaches such as case studies or content analysis and expand data sources to other platforms such as Web of Science or Google Scholar. This is important to provide a more holistic understanding of the implementation of digital transformation in education, including its social and pedagogical impacts.

REFERENCES

- [1] M. Nasihuddin, "Peran Kecerdasan Buatan terhadap Transformasi Pendidikan di era Digital," *Salimiya J. Stud. Ilmu Keagamaan Islam*, vol. 5, no. 4, pp. 410–418, 2024.
- [2] A. Sriyanta, "Kemajuan Digital Dalam Pembelajaran Mengubah Paradigma Pendidikan," *J. Tahsinia*, vol. 4, no. 2, pp. 312–325, 2023.
- [3] N. M. F. D. Svari and K. D. Arlinayanti, "Perubahan paradigma pendidikan melalui pemanfaatan teknologi di era global," *Metta J. Ilmu Multidisiplin*, vol. 4, no. 3, pp. 50–63, 2024.
- [4] H. Harini, A. G. Prananosa, and A. A. Terminanto, "Inovasi teknologi dalam meningkatkan efisiensi manajemen pendidikan dan pengabdian masyarakat di era digital," *Community Dev. J. J. Pengabd. Masy.*, vol. 4, no. 6, pp. 12891–12897, 2023.
- [5] D. H. Sihotang, "Urgensi Manajemen Pendidikan dalam Menghadapi Era Digitalisasi," *JHIP-Jurnal Ilm. Ilmu Pendidik.*, vol. 8, no. 3, pp. 2536–2541, 2025.
- [6] A. Ismunandar, "Strategi Peningkatan Kemampuan Sumber Daya Manusia di Era Digital: Tantangan dan Adaptasi pada Lembaga Pendidikan," *Bisma Bus. Manag. J.*, vol. 3, no. 1, pp. 27–36, 2025.
- [7] J. Cannavaro, M. Asbari, and R. Nurmayanti, "Transformasi Pendidikan: Memperkuat Kecerdasan Sosial dan Emosional Anak di Era Disrupsi," *J. Inf. Syst. Manag.*, vol. 3, no. 3, pp. 1–6, 2024.
- [8] A. Suryanto, "Transformasi Administrasi Publik Menjawab Tantangan era Disrupsi: Gagasan Pembaharuan dan Praktik Kepemimpinan Prof. Dr. Adi Suryanto, S. Sos., M. Si., CHRM." Lembaga Administrasi Negara, 2023.
- [9] V. Andita and D. Rafaela, "Akselerasi Transformasi Digital Untuk Pendidikan Berkualitas," *J. Inf. Syst. Manag.*, vol. 3, no. 2, pp. 90–93, 2024.
- [10] H. Haqqi and H. Wijayati, *Revolusi industri 4.0 di tengah society 5.0: sebuah integrasi ruang, terobosan teknologi, dan transformasi kehidupan di era disruptif*. Anak Hebat Indonesia, 2019.
- [11] M. W. Prastiwi, I. Mustafiah, A. A. Jalaludin, G. D. Prawesti, and B. D. Lukitoaji, "Reformasi Pendidikan Indonesia sebagai Upaya Penerapan Transformasi Digital Pendidikan di Era Globalisasi," *BASICA Acad. J. Pendidik. Anak Sekol. Dasar*, vol. 1, no. 1, 2025.

- [12] W. J. Panjaitan and F. Lupiana, "Penerapan Tranformasi Digital dan Hambatannya Pada Industri Kuliner di Indonesia," *J. Ris. Manaj. Dan Ekon.*, vol. 1, no. 2, pp. 278–301, 2023.
- [13] Y. Hanafi, M. A. Ikhsan, M. Saefi, T. N. Diyana, and M. L. Arifianto, "Pendidikan Agama Islam di masa pandemi Covid-19: tantangan dan respon." Delta Pijar Khatulistiwa, 2021.
- [14] L. Nurtika, *Strategi Meningkatkan Minat Baca Pada Masa Pandemi*. Lutfi Gilang, 2021.
- [15] V. J. García-Morales, A. Garrido-Moreno, and R. Martín-Rojas, "The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario," *Front. Psychol.*, vol. 12, p. 616059, 2021.
- [16] S. K. Azhari, "Pendidikan Karakter menuju pembangunan berkelanjutan," *Pendidik. Karakter*, p. 25, 2023.
- [17] B. Mojumder, M. J. Uddin, and K. Dey, "Perspectives, preparedness and challenges of the abrupt transition of emergency online learning to traditional methods in higher education of Bangladesh in the post-pandemic era," *Discov. Educ.*, vol. 4, no. 1, p. 33, 2025.
- [18] I. Muhammad, F. Marchy, H. K. Rusyid, and D. Dasari, "Analisis bibliometrik: Penelitian augmented reality dalam pendidikan matematika," *JIPM (Jurnal Ilm. Pendidik. Mat.*, vol. 11, no. 1, pp. 141–155, 2022.
- [19] D. E. Sari, "Analisis Bibliometrik Pustakaloka: Jurnal Kajian Informasi dan Perpustakaan Periode 2017-2021," *Libraria*, vol. 11, no. 1, pp. 29–68, 2023.
- [20] M. H. Mubarak and B. Robandi, "Tren dan Perkembangan dalam Pembelajaran Motorik Anak Prasekolah: Analisis Bibliometrik," *J. Dunia Pendidik.*, vol. 5, no. 1, pp. 263–277, 2024.
- [21] S. Kurnia, "Science, Technology, Engineering, Art And Mathematics (STEAM) di Pendidikan Sains: Analisis Bibliometrik dan Pemetaan Literatur Penelitian Menggunakan Perangkat Lunak Vosviewer." UIN Raden Intan Lampung, 2021.
- [22] H. Arruda, E. R. Silva, M. Lessa, D. Proença Jr, and R. Bartholo, "VOSviewer and bibliometrix," *J. Med. Libr. Assoc. JMLA*, vol. 110, no. 3, p. 392, 2022.
- [23] A. Kemeç and A. T. Altınay, "Sustainable energy research trend: A bibliometric analysis using VOSviewer, RStudio bibliometrix, and CiteSpace software tools," *sustainability*, vol. 15, no. 4, p. 3618, 2023.
- [24] Y. Demmanggasa, M. Sabilaturrizqi, K. Kasnawati, B. Mardikawati, A. Ramli, and N. Y. Arifin, "Digitalisasi pendidikan: akselerasi literasi digital pelajar melalui eksplorasi teknologi pendidikan," *Community Dev. J. J. Pengabd. Masy.*, vol. 4, no. 5, pp. 11158–11167, 2023.
- [25] W. Sutarsih and T. Haryati, "Peran Digitalisasi Sekolah Terhadap Mutu Pendidikan," *Learn. J. Inov. Penelit. Pendidik. Dan Pembelajaran*, vol. 4, no. 2, pp. 288–295, 2024.
- [26] A. I. Susanti, "Dampak Positif dan Negatif Digitalisasi Pendidikan," 2024.
- [27] M. Mailin, M. Y. H. Nasution, A. Ardiansyah, and A. N. A. Nst, "Dampak Digitalisasi Pendidikan terhadap Komunikasi Interpersonal Siswa Madrasah Aliyah Negeri Karo," *J. Guru Kita*, vol. 6, no. 1, pp. 126–133, 2021.
- [28] C. N. Isma, R. Rahmi, and H. Jamin, "Urgensi digitalisasi pendidikan sekolah," *AT-TA'DIB J. Ilm. Prodi Pendidik. Agama Islam*, pp. 129–141, 2022.
- [29] Y. Ananda, E. Rizal, and A. S. Rohman, "Analisis Bibliometrik Artikel Jurnal Bidang Informartion Quality Pada Database Scopus Menggunakan Vosviewer," *J. Pustaka Budaya*, vol. 12, no. 1, pp. 89–109, 2025.
- [30] A. Singh, N. Kapoor, A. Kumar, R. Sharma, and M. Kumar, "'Ecotourism' and 'Sustainability': A Bibliometrics Analysis using Biblioshiny and VOS viewer," *J. Environ. Manag. Tour.*, vol. 16, no. 1, pp. 49–67, 2025.
- [31] A. Rejeb, K. Rejeb, S. Simske, and E. Süle, "Industry 5.0 research: an approach using co-word analysis and BERTopic modeling," *Discov. Sustain.*, vol. 6, no. 1, pp. 1–24, 2025.
- [32] A. Morrin and D. Diamond, *Spreadsheet Applications in Chemistry Using Microsoft Excel: Data Processing and Visualization*. John Wiley & Sons, 2022.
- [33] B. Clark, C. Smith, and E. Walker, "From Necessary Maintenance to Intentional Management: A Workflow for Remediating and Enhancing Institutional Repository Metadata," *Tech. Serv. Q.*, vol. 41, no. 1, pp. 45–63, 2024.
- [34] F. D. Davis, "Technology acceptance model: TAM," *Al-Suqri, MN, Al-Aufi, AS Inf. Seek. Behav. Technol. Adopt.*, vol. 205, no. 219, p. 5, 1989.
- [35] L. Lien and B. Timmermans, "Crisis-induced innovation and crisis-induced innovators," *Ind. Innov.*, vol. 31, no. 2, pp. 183–217, 2024.
- [36] J. H. L. Koh, C. S. Chai, and M.-H. Lee, "Technological pedagogical content knowledge (TPACK) for pedagogical improvement: Editorial for special issue on TPACK," *The Asia-Pacific Education Researcher*, vol. 24. Springer, pp. 459–462, 2015.
- [37] S. Damayanti, W. D. Setiawan, S. E. Pangestu, S. A. Pribadi, and H. Argadinata, "Transformasi

kepemimpinan digital sekolah dasar dalam menuju efisiensi dan transparansi di era digital,” *Proc. Ser. Educ. Stud.*, pp. 1–9, 2024.
