Inovasi Kurikulum - p-ISSN 1829-6750 & e-ISSN 2798-1363
Volume 23 No 1 (2026) 13-26

Inovasi Kurikulum

https://ejournal-hipkin.or.id/index.php/jik

Mapping the landscape of techno-pedagogical research

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ABSTRACT

The rapid development of global technology has significantly changed various aspects of education, transforming traditional pedagogical practices to accommodate new methodologies. Despite the crucial role of technopedagogy in improving education systems, including curriculum development, teacher knowledge, and learning outcomes, significant gaps remain in understanding its evolving impact on educational transformation. This study examines research trends in technopedagogy over the past decade to identify emerging topics in this field. Using a bibliometric research design, data were collected from the Scopus database, utilizing keywords such as “technopedagogy,” “technology pedagogy,” “teaching,” and “learning.” The collection process followed the SALSA (Search, Assessment, Synthesis, and Analysis) framework, resulting in a comprehensive dataset of 1,744 documents. Bibliometric analysis conducted in R revealed a consistent increase in publication volume and citation rates each year, with a significant spike in 2018. The results further indicate that the United Kingdom and the United States are leading countries in technopedagogy research. Key thematic trends identified include hybrid learning, educational challenges, the impact of COVID-19, and online teaching practices. This research emphasizes the importance of continued exploration of these trends to understand the implications of technopedagogy in educational contexts fully.

ARTICLE INFO

Article History:
Received: 26 Aug 2025
Revised: 5 Dec 2025
Accepted: 20 Dec 2025
Publish online: 12 Jan 2026

Keywords:
bibliometric; pedagogy; research trends; technology; techno-pedagogy.

Open access
Inovasi Kurikulum is a peer-reviewed open-access journal.

ABSTRAK

Pesatnya perkembangan teknologi global telah mengubah berbagai aspek pendidikan secara signifikan, mentransformasi praktik pedagogi tradisional untuk mengakomodasi metodologi baru. Meskipun teknopedagogi berperan krusial dalam meningkatkan sistem pendidikan, termasuk pengembangan kurikulum, pengetahuan guru, dan hasil belajar, masih terdapat kesenjangan yang signifikan dalam memahami dampaknya yang terus berkembang terhadap transformasi pendidikan. Studi ini mengeksplorasi tren penelitian di bidang teknopedagogi selama dekade terakhir, dengan tujuan mengidentifikasi topik-topik yang muncul dalam bidang ini. Menggunakan desain penelitian bibliometrik, data dikumpulkan dari basis data Scopus, menggunakan kata kunci seperti "teknopedagogi", "pedagogi teknologi", "pengajaran", dan "pembelajaran". Proses pengumpulan data mengikuti kerangka kerja SALSA (Pencarian, Penilaian, Sintesis, dan Analisis), menghasilkan kumpulan data komprehensif yang terdiri dari 1.744 dokumen. Analisis bibliometrik yang dilakukan menggunakan Perangkat Lunak R menunjukkan peningkatan yang konsisten dalam volume publikasi dan tingkat sitasi setiap tahun, dengan lonjakan signifikan terjadi pada tahun 2018. Hasil ini lebih lanjut menunjukkan bahwa Inggris dan Amerika Serikat merupakan negara-negara terdepan dalam penelitian teknopedagogi. Tren tematik utama yang diidentifikasi meliputi pembelajaran hibrida, tantangan pendidikan, dampak COVID-19, dan praktik pengajaran daring. Penelitian ini menekankan pentingnya eksplorasi berkelanjutan terhadap tren-tren ini untuk memahami sepenuhnya implikasi teknopedagogi dalam konteks pendidikan.

Kata Kunci: *bibliometrik; pedagogi; teknologi; teknopedagogi; tren penelitian*

How to cite (APA 7)
Setiawardani, W., Susilana, R., Rusman, R., & Emilzoli, M. (2026). Mapping the landscape of techno-pedagogical research. *Inovasi Kurikulum, 23*(1), 13-26.

Peer review
This article has been peer-reviewed through the journal’s standard double-blind peer review, where both the reviewers and authors are anonymised during review.

https://doi.org/10.64014/jik.v23i1.219

INTRODUCTION

The rapid technological development has transformed various aspects of people's lives, including education. The acceleration of technological development affects the education sector (Huang, 2025). Technology helps change the education system for the better (Setia et al., 2023; Susanti et al., 2025). Technology's role in reshaping education extends across the learning process, curriculum, and education system (Li & Xing, 2025; Samuelsson, 2025). Technology in the learning process is based on techno-pedagogy. Techno-pedagogy is a hybrid learning method that uses ICT resources in classroom instruction (Dutta & Singh, 2025; Karanfiloğlu & Bulut, 2025; Sijali & Poudel, 2025). The use of ICT in learning demonstrates that technology is a tool in the learning process. Using this technology can facilitate discussion, the exchange of work, and the use of learning media (Apriani & Kunci, 2023; Fadhilah et al., 2021; Lubis et al., 2023). Many use technology as a learning tool (Kim & Kim, 2022; Tuma, 2021). This indicates that techno-pedagogy is a pedagogical approach that uses technology as a learning resource and medium.

Technology enhances the enjoyment of learning for students and teachers (Ghory & Ghafory, 2021; Raja & Nagasubramani, 2018; Shu & Gu, 2023). Teachers are satisfied with the use of technology in the learning process because it provides convenience. The convenience afforded to teachers by technology lies in the ease of preparing learning materials, providing learning media, and using them in the assessment process (Sofi-Karim et al., 2022; Prabawati et al., 2021). In addition to teachers, students are satisfied with the use of technology in the learning process. Students value technology because it enables independent, active learning (Alkhabra et al., 2023; Labonté & Smith, 2022). The role of technology in the learning process is not limited to that. However, emerging technologies enable the development of new approaches to teaching (Monib et al., 2024; Yaseen et al., 2025). This role affirms that technology is not limited to a single source or learning medium but can also serve as a basis for creating new learning materials. There are several potential advantages to utilizing technology in learning to enrich the educational experience (Akintayo et al., 2024; Kalyani, 2024).

However, these benefits come with challenges that educators must address. Sustainability and transferability are two of the main challenges of technology-supported pedagogical innovation (Ahmed & Opoku, 2021; Zhang & Yu, 2022; Zhang et al., 2023). Moreover, teacher literacy is a challenge in implementing technology-based learning (Teane, 2024). Addressing these issues is crucial for the successful implementation of techno-pedagogy. Technology supports learning and the development of critical thinking, analysis, and evaluation skills (Gürsan et al., 2023; Hursen, 2020). The results indicate that technology contributes to improved learning outcomes. In addition, the use of technology in learning can provide continuity of knowledge, as students develop the competencies they will need in their future professional work (Zheng, 2024). The competencies help students to see their prospects. The explanation above shows that techno-pedagogy has a significant role in education. These roles affect the education system, curriculum, teachers' knowledge, learning effectiveness, and outcomes (Biswas & Sankar, 2024; Gurukkal, 2021; Lyonga et al., 2021; Shahibi et al., 2017; Tosuntaş et al., 2021). It is undeniable that techno-pedagogy plays a vital role, yet we lack a clear understanding of its trajectory in recent years.

In addition, there is a need to deepen research on hot topics in techno-pedagogy. Before discussing this trend, it is important to note the paucity of research focused on the application and development of techno-pedagogy. A preliminary review reveals a gap in research on the application and challenges of techno-pedagogy (Alabi et al., 2025; Hassan et al., 2021; Silva-Díaz et al., 2023). Based on these studies, many aspects and challenges of implementing technology in education remain under-researched. This demonstrates the significant scope for further research in this area. This research aims to explore the evolving landscape of techno-pedagogy by first examining research trends over the past decade (2014-2024). This involves analyzing the types of studies conducted, the methodologies employed, and the key

https://doi.org/10.64014/jik.v23i1.219

findings regarding the integration of technology into educational practices. The second question seeks to identify emerging and trending topics likely to shape techno-pedagogy research, taking into account current educational challenges and technological advancements. Based on these questions, the research aims to identify gaps in the existing literature and propose avenues for further exploration to enhance the effectiveness of educational technology. By systematically analyzing the existing literature on techno-pedagogy, this study aims to provide insights into current research trends and their implications for future educational practices. Overall, examining these trends will illuminate the trajectories of techno-pedagogy research, underscoring the need for ongoing investigation in this dynamic field. Understanding the techno-pedagogical landscape will not only aid educators in integrating technology into their teaching but also in developing effective pedagogical strategies. However, it will also inform policymakers and researchers about the future directions of educational technology.

LITERATURE REVIEW

Techno-pedagogy Concept

Techno-pedagogy combines two important domains in education: technology and pedagogy. Terminologically, the term "techno-pedagogy" refers to the use of technology to support and enhance teaching practices and learning processes (Rosenberg & Koehler, 2015). This approach harmonizes technological tools and teaching strategies to create more meaningful, relevant, and effective learning experiences for students in higher education settings (Alam & Mohanty, 2023; Kuznetsova et al., 2024). With the rapid development of digital technology, the application of techno-pedagogy is crucial to ensure students master not only academic material but also the skills necessary to adapt to the challenges of a constantly changing workplace (Gurukkal, 2021). The key characteristics of techno-pedagogy include three central elements: technology, pedagogy, and content (Sijali & Poudel, 2025). The integration of these three elements enables the implementation of teaching strategies tailored to students' characteristics and needs, as well as to the content being studied. In practice, this approach may include various digital learning tools and platforms, such as Learning Management Systems (LMS), educational applications, and interactive online resources (Koh & Kan, 2021; Munna et al., 2024). Thus, techno-pedagogy supports active and collaborative learning, in which students play a more active role in the learning process rather than simply receiving information (Gosain & Rajendran, 2022).

Trends in Techno-Pedagogical Research

Over the past five years, techno-pedagogical research has experienced significant transformations, with a noticeable shift towards the integration of digital technologies in educational settings. Recent studies highlight the importance of adopting blended learning approaches, in which traditional teaching methods are complemented by online resources, thereby fostering greater student engagement and accessibility (Al-Hattami, 2025; Bazina et al., 2024). The COVID-19 pandemic has accelerated this trend, prompting educators to explore innovative pedagogical strategies that leverage technology to meet the needs of diverse learners (Muhammad, 2023; Rahimi & Oh, 2024). Furthermore, research indicates a growing emphasis on developing educators' digital competencies, as teacher training programs increasingly incorporate techno-pedagogical frameworks to enhance instructional practices (Hussain et al., 2025; Safyari & Rezaei, 2024). Moreover, studies are beginning to address equity issues related to technology access, advocating for inclusive practices that ensure all students benefit from technological advancements in education (Siddiqi, 2024). This evolving landscape underscores the critical need for ongoing research and adaptation in techno-pedagogy to harness technology's potential to enhance learning outcomes effectively.

https://doi.org/10.64014/jik.v23i1.219

METHODS

Research Design

Bibliometric research explores and provides information on publications related to specific topics (Donthu et al., 2021). For example, this study aims to identify publications on "techno-pedagogy" from the last decade. In this regard, the researcher considers the bibliometric research design appropriate for this study, as it can support the investigation of the research questions.

Data Collection

Data are collected through documentation. The data source comes from the Scopus database. The data search was conducted using the keywords "techno-pedagogy, technology pedagogy, pedagogy, teaching, learning" in the "Article title, Abstract, Keyword" fields for 2014-2024. Subject areas excluded are "*medicine, Neuroscience, Nursing, Health professions, Dentistry, Immunology & Microbiology, Pharmacology, Toxicology & Pharmaceutics, Veterinary and undefine*". Filter again related to "*Source type = Journal and Conference Proceeding)*". Document type "*article and conference paper*" and language "*English*". The Enter query string in the Scopus database "*title-abs-key(techno-pedagogy or technology pedagogy and pedagogy or teaching) and (limit-to (oa,"all")) and (exclude (subjarea,"medi") or exclude (subjarea,"heal") or exclude (subjarea,"nurs") or exclude (subjarea,"phar") or exclude (subjarea,"dent") or exclude (subjarea,"neur") or exclude (subjarea,"immu") or exclude (subjarea,"vete")) and (limit-to (pubyear,2024) or limit-to (pubyear,2023) or limit-to (pubyear,2022) or limit-to (pubyear,2021) or limit-to (pubyear,2020) or limit-to (pubyear,2019) or limit-to (pubyear,2018) or limit-to (pubyear,2017) or limit-to (pubyear,2016) or limit-to (pubyear ,2015) or limit-to (pubyear,2014)) and (limit-to (srctype,"j") or limit-to (srctype,"p")) and (limit-to (doctype,"ar") or limit-to (doctype,"cp")) and (limit-to (language,"english")))).*"

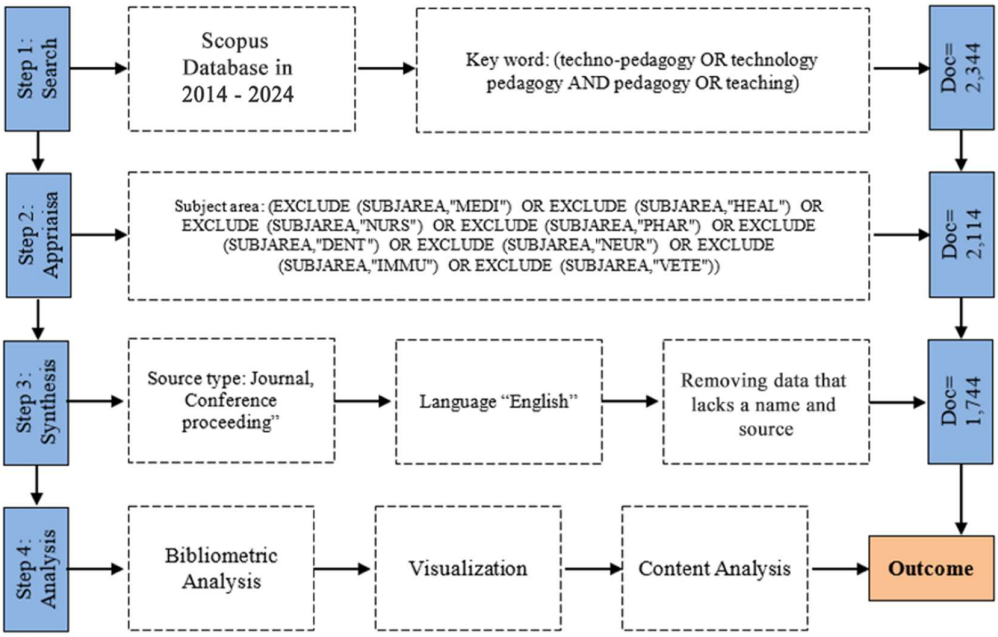

Figure 1. SALSA Framework
Source: Research 2025

The SALSA framework guided this data collection to achieve the research objectives and reduce bias in data analysis (Gaio et al., 2025; Tekin & Aktog, 2025). This framework aims to improve data selection. The steps using the SALSA framework are shown in **Figure 1**.

https://doi.org/10.64014/jik.v23i1.219

Data Analysis

Data analysis in this study used bibliometric analysis. Bibliometric analysis is a method for exploring and analyzing large volumes of scientific data on publications (Donthu et al., 2021). Research analysis with the R package Biblimeterix (Derviş, 2019). The R analytics process in this research employed bibliometric analysis using the R package Bibliometrix to explore a comprehensive dataset of 1,744 documents and identify publication trends, key thematic topics, and collaborative patterns in techno-pedagogy research over the past decade. Analysis results in R can provide information on article production, resources, authors, topic trends, and collaboration.

RESULTS AND DISCUSSION

Publication Trend

Based on the data collected, this study identified 1,744 documents in the Scopus database related to techno-pedagogy. The data come from 684 sources (Journals and Conference Proceedings). Therefore, the growth in research related to techno-pedagogy is approximately 13.75%. Some information related to the data description is presented in **Table 1**.

Table 1. Main Information

Description	Results
Main information about the data	
Timespan	2014:2024
Sources (Journals and Conference Proceedings)	684
Documents	1744
Annual Growth Rate %	13.75
Document Average Age	3.36
Average citations per doc	9.651
References	74753
Document contents	
Keywords Plus (ID)	2969
Author's Keywords (DE)	4734
Authors	
Authors	4631
Authors of single-authored docs	382
Authors collaboration	
Single-authored docs	398
Co-Authors per Doc	2.9
International co-authorships %	17.2
Document types	
article	1533
conference paper	211

Sources: Research 2025

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The growth of techno-pedagogy publications is sufficient. It can also be observed that the number of techno-pedagogy publications increases annually.

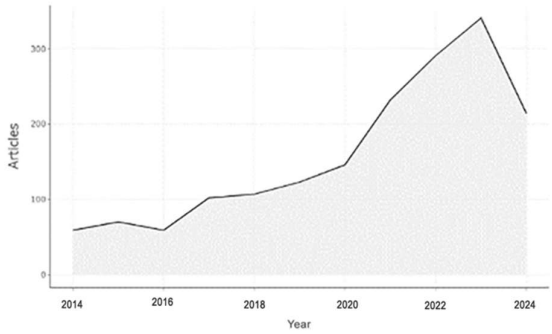

Figure 2. Annual Scientific Production
Sources: Research 2025

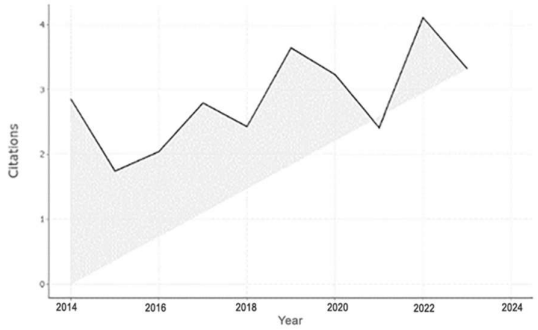

Figure 3. Average Citation Per Year
Sources: Research 2025

From 2014 to 2024, publications on techno-pedagogy increased significantly **(Figure 2**). In 2018, growth was pronounced, but in 2024 it declined relative to 2023. This growth is also consistent with the number of annual citations (**Figure 3**). Growth in 2021 declined relative to several previous years. However, the number of citations increased again. This publication trend indicates that issues related to techno-pedagogy remain a focus of ongoing review. Furthermore, the number of publications and citations on this issue continues to increase annually.

Author's Contributions

The trend analysis of techno-pedagogy publications indicates that the discussion remains compelling and continues to grow, particularly since the COVID-19 pandemic. Many authors have contributed to the development of this science. The following presents data on authors who have contributed to the development and discussion of techno-pedagogy over the years.

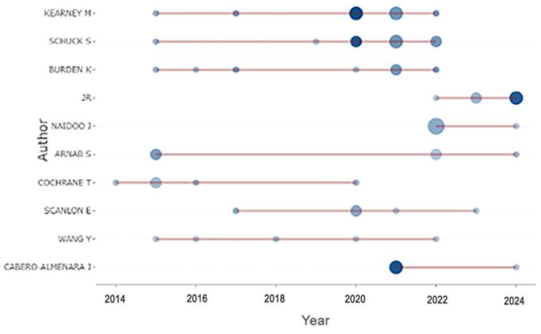

Figure 4. Authors' Production over Time
Sources: Research 2025

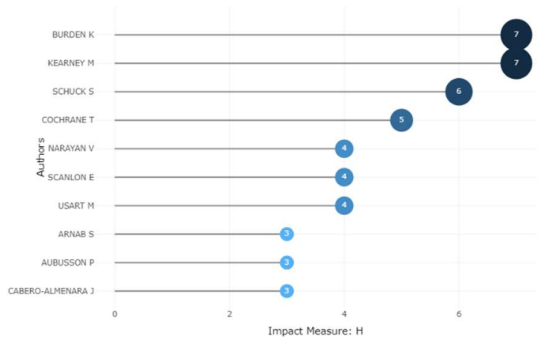

Figure 5. Author's Impact
Sources: Research 2025

Figures 4 and **Figure 5** show authors who have developed and discussed techno-pedagogy. **Figure 4** illustrates the number of writing results from year to year for each author. The figure shows that the three most consistent writers wrote from 2015 to 2022. Interestingly, the fourth and fifth authors began developing and discussing their work from 2022 to 2024, whereas Arnab began writing in 2015 and is ranked sixth. This is highly relevant to the current COVID-19 pandemic, which relies more on technology in the learning process. In contrast, the first-, second, and third-most authors stopped in 2022. **Figure 5**

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shows the writing impact of each author as indicated by the number of citations. The first-most author does not get more citations than the third-most author. This shows that Burden K's writing offers greater benefits for developing and discussing techno-pedagogy. They are followed by Kearney M, who showed no significant difference.

Resources

The results of techno-pedagogical writing are published in several relevant sources. Here are the most published results in the relevant sources.

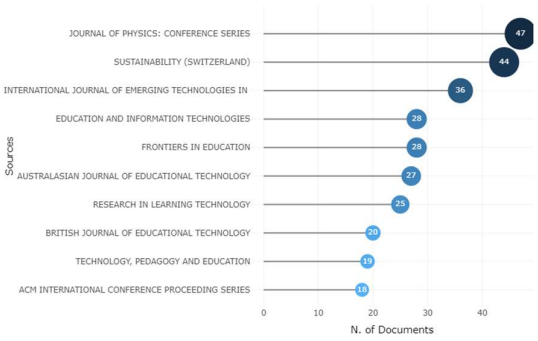

Figure 6. Most Relevant Sources

Sources: Research 2025

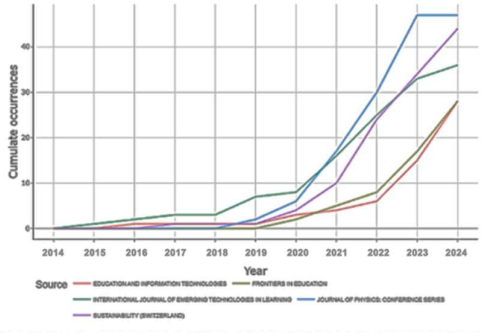

Figure 7. Source Dynamics

Sources: Research 2025

The results of this study indicate several sources that influence research on techno-pedagogy. **Figure 6** presents the number of studies on Techno-pedagogy by source. Eight sources have more than 20 publications on techno-pedagogy. The top 3 sources by number of publications are the Journal of Physics: Conference Series, Sustainability (Switzerland), and the International Journal of Emerging Technologies in Learning. The Journal of Physics: Conference Series contains 47 research articles related to techno-pedagogy.

Figure 7 shows the year-to-year trend in techno-pedagogical publications by source. It can be seen from 2014 to 2024. There has been an increase in publications on techno-pedagogy. The International Journal of Emerging Technologies in Learning has accumulated the most citations and continues to increase annually. However, in 2020, the Journal of Physics Conference Series experienced a relatively significant increase that surpassed the cumulative impact of the International Journal of Emerging Technologies in Learning through 2024. Likewise, Sustainability (Switzerland), which increased significantly from 2020, surpassing the International Journal of Emerging Technologies in Learning, ranks second. The number of publications in a source is not necessarily proportional to the number of citations. The list of the most cited sources is presented in **Figure 9**.

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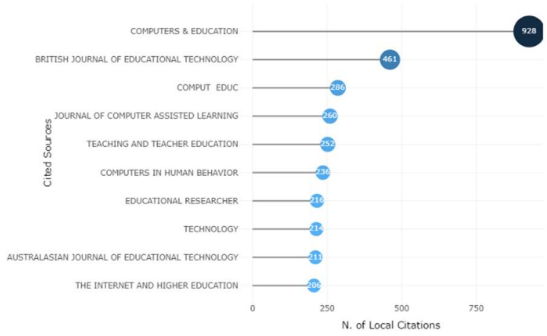

Figure 8. Source Local Impact
Sources: Research 2025

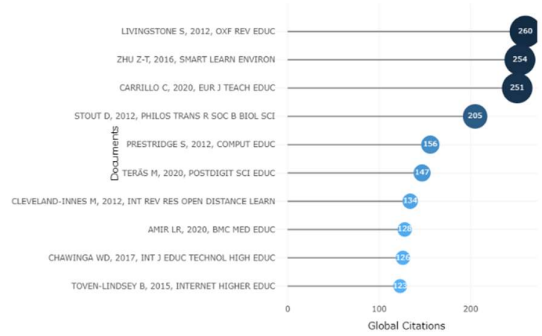

Figure 9. Most Global Cited Documents
Sources: Research 2025

Figure 8 shows that Computer and Education is the most-cited journal in techno pedagogy. The number of citations is 928, nearly double that of the second-largest source, the British Journal of Education Technology, which has 461 citations. Likewise, Comput Educ has 286 citations, substantially lower than those of the British Journal of Education Technology. The fourth position is the Journal of Computer Assisted Education, with 260 citations, whose number of citations is not significantly different from those of the sources below.

Figure 9 presents the authors with the highest number of citations related to techno-pedagogy. The first to third positions have many relatively close citations. The first position is an article by Livingstone in 2015 entitled “Critical Reflections on The Benefits of ICT in Education”, which was published in the Oxford Review of Education with a total of 260 citations. The second position is an article by Zhu ZT in 2019 with the title “A Research Framework of Smart Education published in Smart Learning Environments” with a total of 254 citations. The third position is an article by Carrillo C in 2020 with the title “COVID-19 and Teacher Education: A Literature Review of Online Teaching and Learning Practices” which has 251 citations.

Global Contributions and Collaborations

After reviewing authors and publications, development trends, and discussions related to techno-pedagogy, it is also possible to examine this matter in countries that contribute to and collaborate on it. Countries contributing to and collaborating on techno-pedagogy are depicted in **Figure 10** and **Figure 11**.

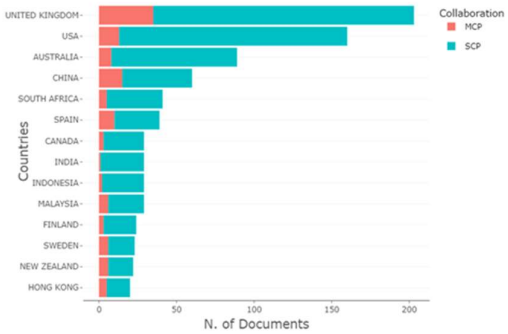

Figure 10. Corresponding Author's Country
Sources: Research 2025

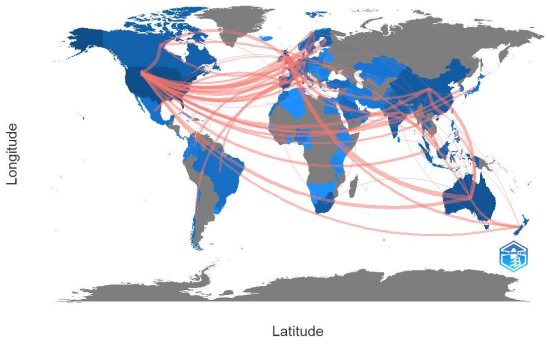

Figure 11. Collaboration World Map
Sources: Research 2025

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Figure 10 shows the countries that have made the most contributions to the development and discussion of techno-pedagogy. The first position is the United Kingdom, with 200 articles, of which about 25 concern collaborations between countries; the remainder concern collaborations with the United Kingdom. The USA follows it in second position, and Australia in third. This result is particularly noteworthy because Indonesia participates in the development and discussion of techno-pedagogy. Indonesia ranks ninth among 14 countries in the development and discussion of techno-pedagogy. Collaboration between countries is more clearly depicted in **Figure 11**. The red line indicates the linkages among countries to collaborate in the development and discussion of techno-pedagogy.

Research Topic Analysis

Techno-pedagogy has an extensive discussion. This is evident in the analysis results, which present the specific keywords and topics most widely discussed in the article. This is presented in **Figure 12** and **Figure 13**.

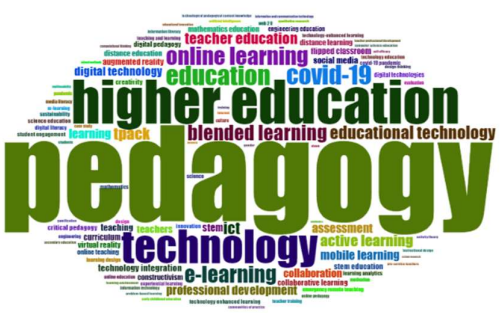

Figure 12. Keywords Related to Techno-pedagogy
Sources: Research 2025

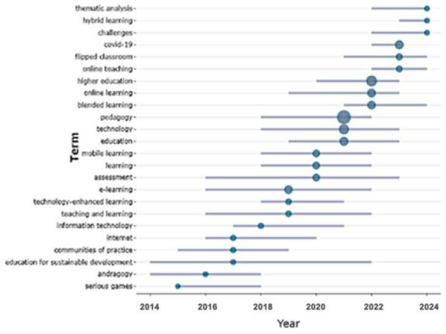

Figure 13. Trend Topics
Sources: Research 2025

Figure 12 shows the most frequently published keywords related to techno-pedagogy, namely pedagogy, higher education, technology, and related terms. The most discussed topic in Figure 13 is Thematic Analysis, from 2019 to 2024. Next, the E-learning topic covers 2019 to 2024, and the Challenges topic also covers 2019 to 2024. This is relevant to the COVID-19 pandemic, which began in 2019.

Discussion

In the digital era, the role of techno-pedagogy is expanding, affecting all aspects of people's lives, including education. The entire academic community must be able to adapt to this condition (Asad et al., 2021; Baltà-Salvador et al., 2021; Safyari & Rezaei, 2024). Further learning is required to enhance technological skills and cognitive abilities (Kurbakova et al., 2021; Yan et al., 2023). Therefore, the learning process was designed to be more varied to enhance engagement and improve learning outcomes (AlNajdi, 2022; Darmayanti, 2022; Feiyue, 2022). This is consistent with research findings that techno-pedagogical development and discussion have increased over the past decade, particularly from 2014 to 2024. The study results indicate global collaboration to develop and discuss these topics, which the United Kingdom, the USA, and Australia currently dominate. Many topics have been discussed and researched over the past three years: thematic analysis, hybrid learning, challenges, COVID-19, flipped classrooms, and online teaching.

The most common keywords are pedagogy, higher education, and technology. These topics are closely related, particularly during the COVID-19 pandemic, which affected the world. Given technological advances in information extraction and pandemic-related limitations, many researchers have chosen

https://doi.org/10.64014/jik.v23i1.219

thematic analysis as their method of study. Thematic analysis is a research method for analyzing data by identifying themes in collected data (Braun & Clarke, 2019; Castleberry & Nolen, 2018). Some research in education employs thematic analysis, which redefines dropout and retention strategies in open online education (Greenland & Moore, 2022). Other research also employs thematic analysis to examine leadership behavior and change management in higher education to enhance sustainability (Aldulaimi & Abdeldayem, 2020; Veres et al., 2025). Other thematic analysis methods are also used to examine the scope of inclusive practice among class teachers, as well as in many other studies (Finkelstein et al., 2021). In addition to thematic analysis, hybrid learning is the other most discussed topic. Higher education is already implementing hybrid learning to invest in technology-enhanced learning spaces.

In addition to higher education, primary and secondary education have also adopted hybrid learning models (Kuswati, 2021). Hybrid learning combines face-to-face and online instruction. This online learning is currently closely linked to the COVID-19 pandemic. The entire academic community uses this method to continue learning amidst a pandemic. This is evidenced by the numerous studies that address this issue. For example, research was conducted at universities during the pandemic; however, online learning presents challenges in its implementation (Mahmood, 2021). These challenges, namely the lack of direct interaction with students and sudden changes in settings, affect students' learning processes (Sepulveda-Escobar & Morrison, 2020). The most discussed topic in the development and discussion of techno-pedagogy is the flipped classroom. This technique is widely used, especially during the pandemic. Flipped classrooms were among those suggested by the Ministry of Education and Culture at that time. Many studies discuss and implement this technique in learning, such as research by Turan & Akdag-Cimen, who applied it to English language learning (Turan & Akdag-Cimen, 2020).

CONCLUSION

This study shows that research trends in techno-pedagogy are advancing, as evidenced by continued annual growth in publications. Although research on the implementation and challenges of techno-pedagogy remains limited, the data indicate a significant number of researchers are exploring this topic. Furthermore, numerous international journals and conferences regularly publish research relevant to techno-pedagogy. Over the past three years, several emerging topics have been frequently discussed in this research, including thematic analysis, hybrid learning, educational challenges, the impact of COVID-19, and online teaching practices. These topics not only illustrate current developments but also provide direction for future techno-pedagogy research, underscoring the need for further research to understand and address the challenges of its implementation.

AUTHOR'S NOTE

The author declares that there is no conflict of interest regarding the publication of this article. Furthermore, the author confirms that this article is free of plagiarism and is an original work developed entirely by the author. All sources used in this article have been appropriately cited and are accepted in accordance with applicable academic standards.

REFERENCES

Ahmed, V., & Opoku, A. (2021). Technology supported learning and pedagogy in times of crisis: The case of COVID-19 pandemic. *Education and Information Technologies, 27*(1), 365-405.

https://doi.org/10.64014/jik.v23i1.219

Akintayo, O. T., Eden, C. A., Ayeni, O. O., & Onyebuchi, N. C. (2024). Evaluating the impact of educational technology on learning outcomes in the higher education sector: A systematic review. *International Journal of Management and Entrepreneurship Research, 6*(5), 1395-1422.

Alabi, O. A., Adeoye, M. A., Abiola, A. A., & Raji, M. O. (2025). Science education in the digital era: Socioeconomic barriers, ICT integration and emerging gaps in teaching and learning. *Eduvis: Jurnal Manajemen Pendidikan Islam, 10*(2), 71-88.

Alam, A., & Mohanty, A. (2023). Educational technology: Exploring the convergence of technology and pedagogy through mobility, interactivity, AI, and learning tools. *Cogent Engineering, 10*(2), 1-37.

Aldulaimi, S. H., & Abdeldayem, M. M. (2020). A thematic analysis of leadership behaviours and change management in higher education to boost sustainability. *International Journal of Higher Education and Sustainability, 3*(1), 34-51.

Al-Hattami, H. M. (2025). Understanding how digital accounting education fosters innovation: The moderating roles of technological self-efficacy and digital literacy. *The International Journal of Management Education, 23*(2), 1-11.

Alkhabra, Y. A., Ibrahem, U. M., & Alkhabra, S. A. (2023). Augmented reality technology in enhancing learning retention and critical thinking according to STEAM program. *Humanities and Social Sciences Communications, 10*(1), 1-10.

AlNajdi, S. M. (2022). The effectiveness of using Augmented Reality (AR) to enhance student performance: Using Quick Response (QR) codes in student textbooks in the Saudi education system. *Educational Technology Research and Development, 70*(3), 1105-1124.

Apriani, H. (2023). Utilization of "Learning House" as a technology-based media for technology-based Indonesian learning*. Edunesia: Jurnal Ilmiah Pendidikan, 4*(2), 695-710.

Asad, M. M., Aftab, K., Sherwani, F., Churi, P., Moreno-Guerrero, A. J., & Pourshahian, B. (2021). Techno-pedagogical skills for 21st century digital classrooms: An extensive literature review. *Education Research International, 2021*(1), 1-12.

Baltà-Salvador, R., Olmedo-Torre, N., Peña, M., & Renta-Davids, A. I. (2021). Academic and emotional effects of online learning during the COVID-19 pandemic on engineering students. *Education and Information Technologies, 26*(6), 7407-7434.

Bazina, M., Bimenyimana, S., & Idahemuka, M. (2024). Mathematics teachers' perceptions on the use of technological tools in teaching and learning practices in selected Rwandan secondary schools. *African Journal of Empirical Research, 5*(3), 813-821.

Biswas, S., & Sankar, C. S. (2024). Secondary school teachers' intuition Towards Transformative Techno Pedagogy (TTP) in capital complex of Arunachal Pradesh. *International Journal of Scientific Research in Modern Science and Technology, 3*(11), 25-42.

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health, 11*(4), 589-597.

Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? *Currents in Pharmacy Teaching and Learning, 10*(6), 807-815.

Darmayanti, R. (2022). Digital comic learning media based on character values on students' critical thinking in solving mathematical problems in terms of learning styles. *Al-Jabar: Jurnal Pendidikan Matematika, 13*(1), 49-66.

Derviş, H. (2019). Bibliometric analysis using bibliometrix an R Package. *Journal of Scientometric Research, 8*(3), 156-160.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*(1), 285-296.

https://doi.org/10.64014/jik.v23i1.219

Dutta, S., & Singh, A. (2025). Digital pedagogy in educational landscape: Teaching-learning setting a novel prospect. *Journal of East-West Thought (JET), 15*(1), 427-439.

Fadhilah, F. D., Harahap, F. H., Sofia, N. Z., Prayoga, S., & Ihsan, M. T. (2021). The utilization of information technology as learning media. *Jurnal Riset dan Inovasi Pembelajaran, 1*(2), 164-173.

Feiyue, Z. (2022). Edutainment methods in the learning process: Quickly, fun and satisfying. *International Journal of Environment, Engineering and Education, 4*(1), 19-26.

Finkelstein, S., Sharma, U., & Furlonger, B. (2021). The inclusive practices of classroom teachers: A scoping review and thematic analysis. *International Journal of Inclusive Education, 25*(6), 735-762.

Gaio, A. P. C., de Lima, A. P. M., Meiriño, M. J., Pérez, D. V., Meza, L. A., & Binsztok, J. (2025). Models, guidelines and frameworks for sustainable management: A bibliometric analysis from the perspective of interdisciplinarity. *Business Strategy and the Environment, 34*(6), 6735-6753.

Ghory, S., & Ghafory, H. (2021). The impact of modern technology in the teaching and learning process. *International Journal of Innovative Research and Scientific Studies, 4*(3), 168-173.

Gosain, K., & Rajendran, M. (2022). Evaluation of a conceptualised learning design for the development of techno-pedagogic competencies among pre-service teachers. *Journal of Information and Knowledge Management, 21*(2), 1-12.

Greenland, S. J., & Moore, C. (2022). Large qualitative sample and thematic analysis to redefine student dropout and retention strategy in open online education. *British Journal of Educational Technology, 53*(3), 647-667.

Gürsan, S., Broutın, M. S. T., & İpek, J. (2023). Technology supported teaching implementations designed to improve critical thinking skills. *Journal of Educational Technology and Online Learning, 6*(3), 554-577.

Gurukkal, R. (2021). Techno-pedagogy needs mavericks. *Higher Education for the Future, 8*(1), 7-19.

Hassan, R. H., Hassan, M. T., Naseer, S., Khan, Z., & Jeon, M. (2021). ICT enabled TVET education: A Systematic Literature Review. *IEEE Access, 9*(1), 81624-81650.

Huang, R. (2025). Accelerating the digital transformation of education to promote high-quality school development. *People's Education, 15*(1), 28-32.

Hursen, C. (2021). The effect of problem-based learning method supported by web 2.0 tools on academic achievement and critical thinking skills in teacher education. *Technology, Knowledge and Learning, 26*(3), 515-533.

Hussain, T., Jamil, I., & Nasreen, A. (2025). Comparative analysis of techno-pedagogical competencies among undergraduate and pre-service education students: Assessing readiness for 21st-century teaching and learning. *International Journal of Social Sciences Bulletin, 3*(3), 551-559.

Kalyani, Dr. L. K. (2024). The role of technology in education: Enhancing learning outcomes and 21st century skills. *International Journal of Scientific Research in Modern Science and Technology, 3*(4), 5-10.

Karanfiloğlu, M., & Bulut, M. A. (2025). Techno-pedagogical communication, ed-tech and media professionals: Crossroads for enhancing instructional quality. *Interactive Learning Environments, 33*(7), 4193-4217.

Kim, N. J., & Kim, M. K. (2022). Teacher's perceptions of using an artificial intelligence-based educational tool for scientific writing. *Frontiers in Education, 7*(1), 1-13.

Koh, J. H. L., & Kan, R. Y. P. (2021). Students' use of learning management systems and desired e-learning experiences: are they ready for next generation digital learning environments?. *Higher Education Research and Development, 40*(5), 995-1010.

Kurbakova, S. N., Volkova, Z. N., & Kurbakov, A. V. (2021). Developing students' cognitive abilities in e-learning environment. *ACM International Conference Proceeding Series, 1(*1), 124-130.

https://doi.org/10.64014/jik.v23i1.219

Kuswati, E. (2021). Development of an e_learning management model based on hybrid learning. *Proceedings of the 6th International Conference on Science, Education and Technology (ISET 2020), 574*(1), 125-132.

Kuznetsova, H., Danylchenko, I., Zenchenko, T., Rostykus, N., & Lushchynska, O. (2024). Incorporating innovative technologies into higher education teaching: Mastery and implementation perspectives for educators. *Multidisciplinary Reviews, 7*(1), 1-8.

Labonté, C., & Smith, V. R. (2022). Learning through technology in middle school classrooms: Students' perceptions of their self-directed and collaborative learning with and without technology. *Education and Information Technologies, 27*(5), 6317-6332.

Li, D., & Xing, W. (2025). A comparative study on sustainable development of online education platforms at home and abroad since the twenty-first century based on big data analysis. *Education and Information Technologies, 30*(11), 1-22.

Lubis, L. H., Febriani, B., Yana, R. F., Azhar, A., & Darajat, M. (2023). The use of learning media and its effect on improving the quality of student learning outcomes. *International Journal of Education, Social Studies, and Management (IJESSM), 3*(2), 7-14.

Lyonga, N. A. N., Moluayonge, G. E., & Nkeng, A. J. (2021). A study of techno-pedagogical skills and teachers' performance in HTTTC Kumba, Cameroon. *European Journal of Education and Pedagogy, 2*(1), 46-50.

Mahmood, S. (2021). Instructional strategies for online teaching in COVID-19 pandemic. *Human Behavior and Emerging Technologies, 3*(1), 199-203.

Monib, W. K., Qazi, A., & Mahmud, M. M. (2025). Exploring learners' experiences and perceptions of ChatGPT as a learning tool in higher education. *Education and Information Technologies, 30*(1), 917-939.

Muhammad, G. (2023). Trends and innovations in the prospects of distance learning. *Journal of Education and Finance Review, 2*(1), 41-53.

Munna, M., Hossain, Md. R., & Saylo, K. R. (2024). Digital education revolution: Evaluating LMS-based learning and traditional approaches. *Journal of Innovative Technology Convergence, 6*(2), 21-40.

Prabawati, A., AM, S. A., & AM, S. A. (2021). The students' perception of the online media used by teacher in learning English. *English Language Teaching Methodology, 1*(3), 169-181.

Rahimi, R. A., & Oh, G. S. (2024). Rethinking the role of educators in the 21st century: Navigating globalization, technology, and pandemics. *Journal of Marketing Analytics, 12*(2), 182-197.

Raja, R., & Nagasubramani, P. C. (2018). "Recent trend of teaching methods in education" organised by Sri Sai Bharath College of Education Dindigul-624710. *India Journal of Applied and Advanced Research, 2018*(3), 33-35.

Rosenberg, J. M., & Koehler, M. J. (2015). Context and Technological Pedagogical Content Knowledge (TPACK): A systematic review. *Journal of Research on Technology in Education, 47*(3), 186-210.

Safyari, S., & Rezaei, E. (2024). Identifying the criteria for techno-pedagogical competencies of faculty members in blended learning implementation: A review. *Interdisciplinary Journal of Virtual Learning in Medical Sciences, 15*(1), 18-32.

Samuelsson, R. (2025). From technological distribution to educational innovation: How context, curriculum, and local practice frame educational technology use in early childhood education. *Education and Information Technologies, 30*(12), 1-26.

Sepulveda-Escobar, P., & Morrison, A. (2020). Online teaching placement during the COVID-19 pandemic in Chile: challenges and opportunities. *European Journal of Teacher Education, 43*(4), 587-607.

https://doi.org/10.64014/jik.v23i1.219

Setia, M. N. I., Irawati, L. D. D., & Putri, Y. A. (2023). Relevance of educational technology competence as human resources in the apprentice industry. *Curricula: Journal of Curriculum Development, 2*(1), 1-12.

Shahibi, M. S., Rusli, K. N. K. K., Shahibi, M. S., & Rusli, K. N. K. K. (2017). The influence of Internet usage on student's academic performance. *International Journal of Academic Research in Business and Social Sciences, 7*(8), 873-887.

Shu, X., & Gu, X. (2023). An empirical study of a smart education model enabled by the edu-metaverse to enhance better learning outcomes for students. *Systems, 11*(2), 1-20.

Siddiqi, M. M. (2024). Future of digital education: Inclusive, immersive, equitable. *MediaSpace: DME Media Journal of Communication, 5*(1), 8-24.

Sijali, K. K., & Poudel, T. (2025). The role of techno-pedagogical approach in educational practices: A systematic literature review. *International Journal of Research in Education and Science, 11*(3), 588-602.

Silva-Díaz, F., Marfil-Carmona, R., Narváez, R., Silva Fuentes, A., & Carrillo-Rosúa, J. (2023). Introducing virtual reality and emerging technologies in a teacher training STEM course. *Education Sciences, 13*(10), 1-15.

Sofi-Karim, M., Bali, A. O., & Rached, K. (2023). Online education via media platforms and applications as an innovative teaching method. *Education and Information Technologies, 28*(1), 507-523.

Susanti, W., Widi, R., Nasution, T., Johan, J., & Verawardina, U. (2025). The role of artificial intelegensia technology in improving the quality of education. *Journal of Applied Business and Technology, 6*(1), 11-15.

Teane, F. M. (2024). Technological literacy and its influence on teachers' adoption of a blended learning approach. *Reading and Writing (South Africa), 15*(1), 1-10.

Tekin, B. H., & Aktog, M. A. (2025). A conceptual framework for biophilic architectural design in cold climates: A meta-synthesis analysis. *Buildings, 15*(21), 1-24.

Tosuntaş, Ş. B., Cubukcu, Z., & Beauchamp, G. (2021). Teacher performance in terms of technopedagogical content knowledge competencies. *Kastamonu Education Journal, 29*(1), 63-83.

Tuma, F. (2021). The use of educational technology for interactive teaching in lectures. *Annals of Medicine and Surgery, 62*(1), 231-235.

Turan, Z., & Akdag-Cimen, B. (2020). Flipped classroom in English language teaching: A systematic review. *Computer Assisted Language Learning, 33*(5), 590-606.

Veres, C., Tănase, M., Bacos, I. B., & Kardos, M. (2025). Sustainable universities: A bibliometric and thematic analysis in higher education. *Sustainability, 17*(5), 1-19.

Yan, D., & Li, G. (2023). A heterogeneity study on the effect of digital education technology on the sustainability of cognitive ability for middle school students. *Sustainability, 15*(3), 1-20.

Yaseen, H., Mohammad, A. S., Ashal, N., Abusaimeh, H., Ali, A., & Sharabati, A. A. A. (2025). The impact of adaptive learning technologies, personalized feedback, and interactive AI tools on student engagement: The moderating role of digital literacy. *Sustainability, 17*(3), 1-27.

Zhang, J., & Yu, S. (2022). Assessing the innovation of mobile pedagogy from the teacher's perspective. *Sustainability, 14*(23), 1-15.

Zhang, X., Chen, S., & Wang, X. (2023). How can technology leverage university teaching and learning innovation? A longitudinal case study of diffusion of technology innovation from the knowledge creation perspective. *Education and Information Technologies, 28*(12), 15543-15569.

Zheng, X. (2024). Research on the key educational competencies for continuing education in vocational and technical colleges. *International Journal of Educational Teaching and Research, 1*(2), 1-6.

https://doi.org/10.64014/jik.v23i1.219