

TPACK Research Trends in Indonesia: Contributions to Enhancing the Equivalency Education History Teacher Community

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Abstract

Background: Technological Pedagogical Content Knowledge (TPACK) is a vital framework for integrating technology into education. In Indonesia, TPACK research has grown significantly, yet most studies focus on science and mathematics, leaving gaps in social studies, particularly history education. Additionally, its potential in supporting the equivalency education system, which serves non-formal learners, remains underexplored.

Urgency Research: The limited application of TPACK in history education in Indonesia highlights the urgency of improving the quality of history learning in the digital era. Without enhancing teachers' digital competencies, the gap in integrating technology, pedagogy, and content may widen, hindering the effectiveness of teaching and students' understanding of historical concepts. Therefore, strategic efforts are needed to enhance digital literacy and TPACK competencies among history teachers to ensure more relevant and meaningful learning experiences.

Research Objectives: This study aims to analyze TPACK research trends in Indonesia (2019–2023), examine its contribution to the equivalency education history teacher community, and provide recommendations for integrating TPACK into history education.

Research Method: Using bibliometric analysis, this study analyzed 1,208 documents from the Scopus database with the keyword "TPACK." The analysis focused on publication trends, dominant themes, and geographical contributions, particularly in history education and equivalency education.

Research Findings: Indonesian researchers dominated TPACK research during the study period. Most studies focused on pre-service teacher training and learning media development, primarily in science and mathematics. Limited attention was given to social studies, especially history, highlighting an opportunity to expand TPACK research into history education and the equivalency education system.

Research Conclusion: This study emphasizes the need to integrate TPACK into history education to enhance the competencies of equivalency education history teachers. By leveraging TPACK, educators can create innovative, technology-enhanced learning experiences tailored to non-formal learners. Professional development programs are also essential to equip teachers with TPACK skills.

Research Novelty/ Contribution: This study provides a comprehensive bibliometric analysis of TPACK trends in Indonesia, identifies gaps in social studies research, and offers practical recommendations for applying TPACK in history education and non-formal learning contexts. It paves the way for future research and practical applications in underserved educational areas.

Keywords: history learning; history teacher; TPACK research trends; teacher community.

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INTRODUCTION

The use of technology in education has had an enormous impact and challenges (Akintayo et al., 2024). Digital tools and resources have revolutionized educational practices, enabling more interactive, engaging, and personalized learning experiences (Drushlyak et al., 2023). However, this integration is not without its obstacles. Educators often face various obstacles, including a lack of technological infrastructure, inadequate training, and resistance to change (Colognesi et al., 2020). This challenge is exacerbated by the need for educators to develop new pedagogical skills to integrate technology into their teaching practices effectively.

The integration of technology in education has fundamentally transformed pedagogical approaches, fostering more interactive and personalized learning environments. Digital tools such as learning management systems, interactive simulations, and online resources have enabled educators to tailor their teaching strategies to meet diverse student needs, thereby enhancing engagement and motivation in the learning process (Ghory & Ghafory, 2021). Moreover, the incorporation of technology has been shown to facilitate self-directed learning, allowing students to access information and resources independently, which is particularly beneficial in higher education settings (Njadat et al., 2021). The shift towards technology-enhanced education not only supports the development of critical thinking and problem-solving skills but also prepares students for a workforce increasingly reliant on digital competencies (Gadzali, 2023; Sari et al., 2024).

However, the successful implementation of educational technology is fraught with challenges that educators must navigate. A significant barrier is the lack of adequate technological infrastructure in many educational institutions, which can hinder the effective use of digital tools (Joseph et al., 2021). Additionally, educators often face resistance to change, stemming from a lack of familiarity with new technologies and insufficient training opportunities (Rahayu et al., 2023). This resistance can be exacerbated by technostress, where the pressure to adapt to rapidly evolving technologies leads to anxiety and disengagement among educators. To overcome these challenges, it is essential for educational institutions to invest in comprehensive training programs that equip teachers with the necessary skills to integrate technology into their teaching practices effectively (Lin & Zhang, 2024; Izzati et al., 2024). Furthermore, fostering a culture of innovation and adaptability within educational settings can help mitigate resistance and promote a more seamless integration of technology into the curriculum.

In response to these challenges, the Technological Pedagogical Content Knowledge (TPACK) framework has emerged as an important model for understanding and implementing technology integration in education (Mishra & Warr, 2021). TPACK highlights the intersection between technology, pedagogy, and content knowledge, emphasizing the need for teachers to master all three areas in order to effectively integrate technology into their teaching (Chen et al., 2023; Warr et al., 2020). Over the past decade, research on TPACK has gained significant momentum around the world, reflecting its importance in the context of modern education. Many studies have explored various aspects of TPACK, including its theoretical foundations, practical applications, and impact on teaching and learning outcomes (Apriandi et al., 2023; Ekawati & Prastyo, 2022; Malik et al., 2023; Setyo et al., 2023; Tzavara & Komis, 2023).

Although there is more research on TPACK, its application in history education, especially in Indonesia, is still limited (Ciriza-Mendivil et al., 2022). Many history teachers in Indonesia still struggle to integrate TPACK into their teaching practices. This is shown by the results of our study which found that 56% of history teachers in Surakarta still have difficulty in integrating digital technology in history learning (Wardhana, 2021). Factors contributing to this problem include limited access to technology, lack of professional development opportunities, and lack of understanding of effectively combining technological tools with pedagogical and content knowledge (Moseikina et al., 2022). This gap in implementation highlights the need for targeted efforts to improve the digital literacy of history teachers and support them in developing their TPACK competencies. The limited application of TPACK in history education in Indonesia highlights the urgency of improving the quality of history learning in the digital era. Without enhancing teachers' digital competencies, the gap in integrating technology, pedagogy, and content may widen, hindering the effectiveness of teaching and students' understanding of historical concepts. Therefore, strategic efforts are needed to enhance digital literacy and TPACK competencies among history teachers to ensure more relevant and meaningful learning experiences.

The main objective of this study is to explore TPACK research trends globally and analyze their relevance and application in the context of history education in Indonesia (Sitanggang, 2024). By conducting a bibliometric analysis, this study aims to identify key themes, patterns, and gaps in the existing literature on TPACK (Lim, 2021). Understanding this trend is very important to develop strategies to improve the digital competence of history teachers in Indonesia. In addition, the study also seeks to answer broader questions about how TPACK can contribute to the development of a strong and dynamic community of history teachers who

are adept at integrating technology into their pedagogical practices (Lou & Zou 2022).

The study's contribution goes beyond academia; it has practical implications for the professional development of history teachers in Indonesia. By providing insight into global trends in TPACK research and its application in history education, the study aims to inform policy and practice. In particular, the study seeks to support the design and implementation of professional development programs that equip history teachers with the skills and knowledge necessary to effectively integrate technology into their classrooms. Ultimately, this research aims to build a community of innovative and digitally literate history teachers who can utilize technology to improve student engagement and learning outcomes. Overall, this research on TPACK not only addresses the existing challenges faced by history teachers in Indonesia but also contributes to the broader discourse on the integration of technology in education. By bridging the gap between global research trends and local educational practices, this study aims to have a meaningful impact on the professional development of history teachers and the quality of history education in Indonesia.

METHOD

This study is qualitative with a bibliometric analysis approach (Donthu et al., 2021; Marvi & Foroudi, 2023). This study focuses on literature with sources of journal articles and proceedings related to TPACK in the Scopus database in 2019-2023. The researcher searched by entering the word "TPACK" in the title, keywords, and abstract from 2019 to 2023. The data retrieval step can be observed in Figure 1.

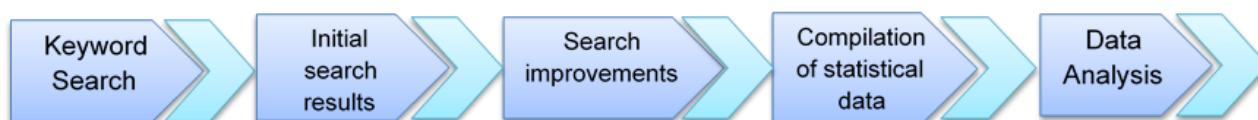


Figure 1. Five steps in conducting bibliometric analysis
Source: (Marvi & Foroudi, 2023)

The data of articles related to TPACK in the Scopus database as of July 2024 is 2287 documents. Then, after the data was limited from 2019 to 2024, 1208 documents were filtered (see Figure 2). The data was then stored as (.ris) and (.csv). Furthermore, this data was processed in different program applications through bibliometric and network analysis through VoSViewer and Microsoft Excel. VoSViewer was chosen because this application can be used to find out research trends (Ding & Yang, 2020). The analysis through VosViewer and Microsoft Excel was conducted to analyze research trends that included publication output characteristics, document sources, language sources, country and institution distribution, output distribution in subject categories, top authors, top citations, and publication trends from 2019 to 2024 (Nazarovets, 2023). The keyword of the research trend was obtained from VoSViewer, which uses the Visualization of Similarities (VoS) algorithm as an alternative to multidimensional scaling (Hernandez-Leon, 2022).

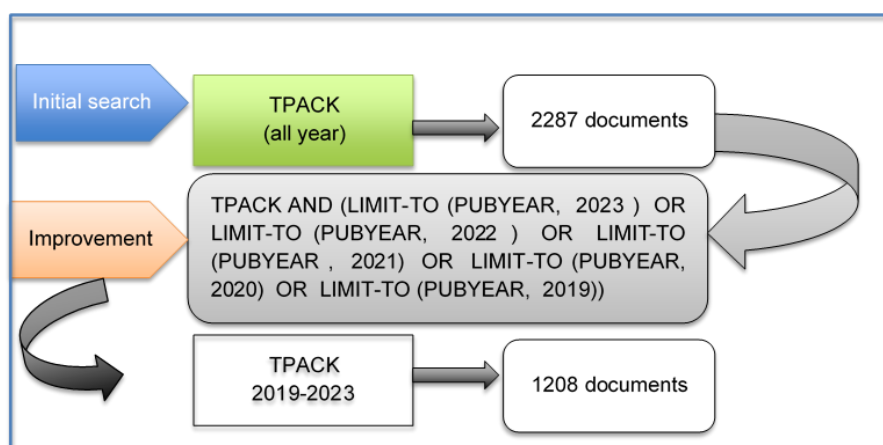


Figure 2. Data search illustration

RESULTS and DISCUSSION

In recent years, research on Technological Pedagogical Content Knowledge (TPACK) has experienced significant growth, particularly in the context of technology integration in education. TPACK, as a conceptual framework, has become the foundation for developing teachers' competencies in effectively integrating technology, pedagogy, and content knowledge (Mishra & Koehler, 2006). These studies have not only contributed to the development of educational theory but have also provided practical implications for improving the quality of learning in the digital era.

To comprehensively understand the development of TPACK research, it is essential to analyze several key aspects, such as publication output, document sources, languages used, geographical and institutional distribution, contributions of leading researchers, research trends, and the specific role of Indonesian researchers. This analysis will provide a clearer picture of how TPACK research has evolved, who the main actors in this field are, and how contributions from various countries, including Indonesia, have advanced our understanding of TPACK. In this paper, these six points will be discussed in depth to provide a holistic insight into the trends and dynamics of TPACK research.

Publication Output, Document Source and Language Source

There are 1208 documents related to Technological Pedagogical Content Knowledge (TPACK) in the Scopus database, consisting of journals, conference papers, chapter books, books, and editorials (Sierra, 2023). Publications devoted to TPACK throughout 2019-2023 are shown in Figure 3 and Figure 4. The number of TPACK documents throughout the year has always experienced a significant increase (Suprpto, 2021). The results show that in 2019, the number of publications was 204, and in 2020, it had decreased to 188 publications, which was possible due to the COVID-19 pandemic that made research activities less than optimal. However, the TPACK research trend continued to increase significantly until, in 2023, it reached 330 publications.

The term TPACK was originally introduced by Shulman in 1987 under the name Content Knowledge (CK) in his book Shulman (1987). This knowledge includes concepts, theories, ideas, organisational frameworks, evidence and proofs, as well as established practices and approaches to developing such understanding (Schmid, 2021). Shulman (1987) states that the emphasis on subject matter knowledge and teacher pedagogy is treated as exclusive.

Shulman believes that teacher education programmes should combine the two areas of knowledge (Bayrhuber, 2024). To overcome this dichotomy, he introduced the notion of pedagogical content knowledge, which includes pedagogical knowledge and content knowledge, among other categories (Chan, K. 2022). Early descriptions of teacher knowledge included curriculum knowledge and knowledge of the educational context (Shulham, 1986). Later, in 2009, it was developed by Mishra and Koehler under the name TPACK. Technological Pedagogical Content Knowledge (TPACK) attempts to identify the knowledge teachers need to integrate technology into their teaching while addressing the complex and diverse nature of teacher knowledge (Luo & Zou, 2024). The term Technological, Pedagogical, Content Knowledge (TPACK) is a framework for designing new learning by combining three main aspects, namely technology, pedagogy, and content knowledge. Therefore, publications on TPACK will increase dramatically in 2024-2028 (Luo & Berson, 2022).

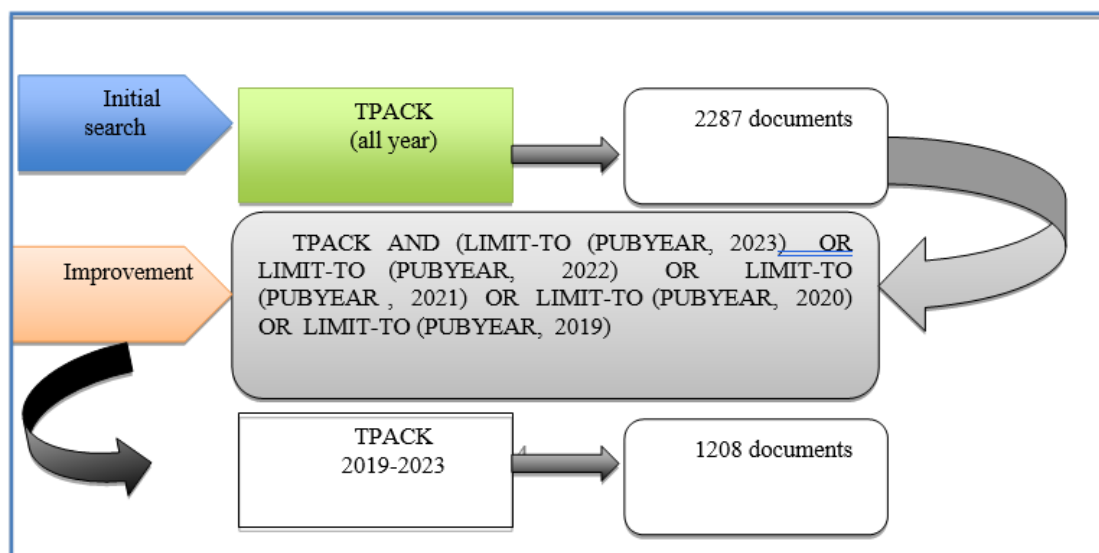


Figure 3. Number of publication by year 2019-2023

Meanwhile, the number of documents based on sources type shows that journals dominate with a total of 1208, followed by Journal 832, Conferenc proceeding 245, Book 70, Book series 60, and Trade journal 1. This research found that the number of TPACK publications fluctuates, with a significant spike in 2023 with 330 publications. This trend indicates that more and more education academics and practitioners are beginning to recognise the importance of technology integration in the learning process (Akram, 2022). For more details, you can see the following diagram.

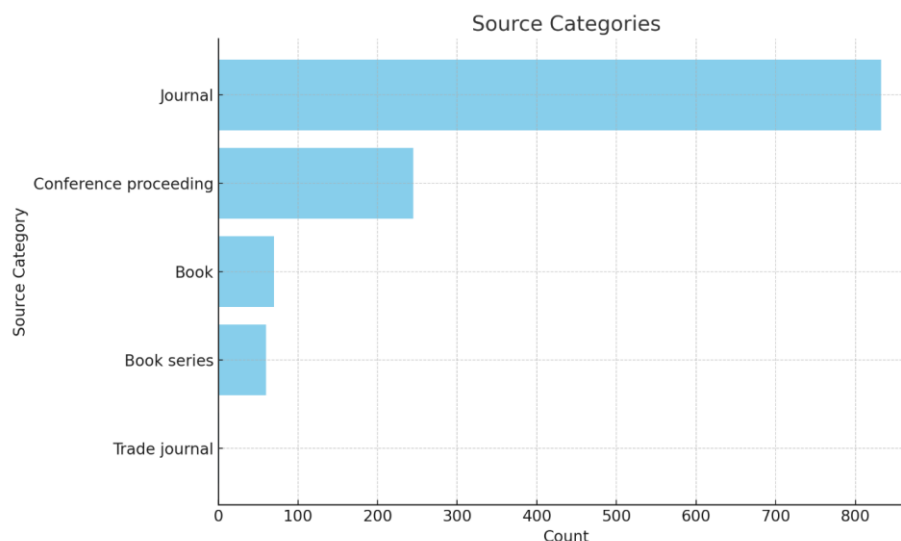


Figure 4. Number of articles by source type

Furthermore, out of a total of 1208 publications, most of the articles are written in English (1169 documents or 96.7%). Other documents used Spanish 29 (2.4%) and Portuguese 5 (0.4%). Although the number is small, the documents are in Turkish, Russian, Chinese, German, Korean, Croatian and Catalan languages with a percentage of less than 1% (see Figure 5).

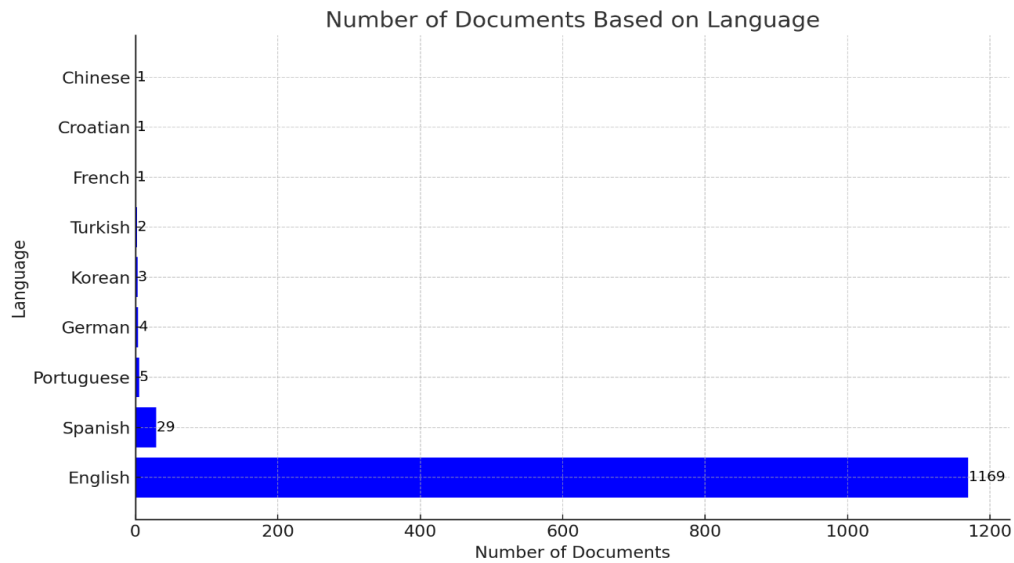


Figure 5. Percentage of articles on TPACK by language during 2017-2021

Distribution of Publications by Country and Institution

Based on the number of cross-border documents, it is clear that Indonesia dominates with 211 documents from 2019 to 2023 (Martono, 2021). Countries such as the United States, China, Turkey, Malaysia, South Africa, and Malaysia contributed to this topic with 169, 124, 70, 63, and 55, respectively. While with almost the same number, Australia, Taiwan, Spain, and Germany contributed between 51 and 49 documents. The detail can be seen in the Figure 6.

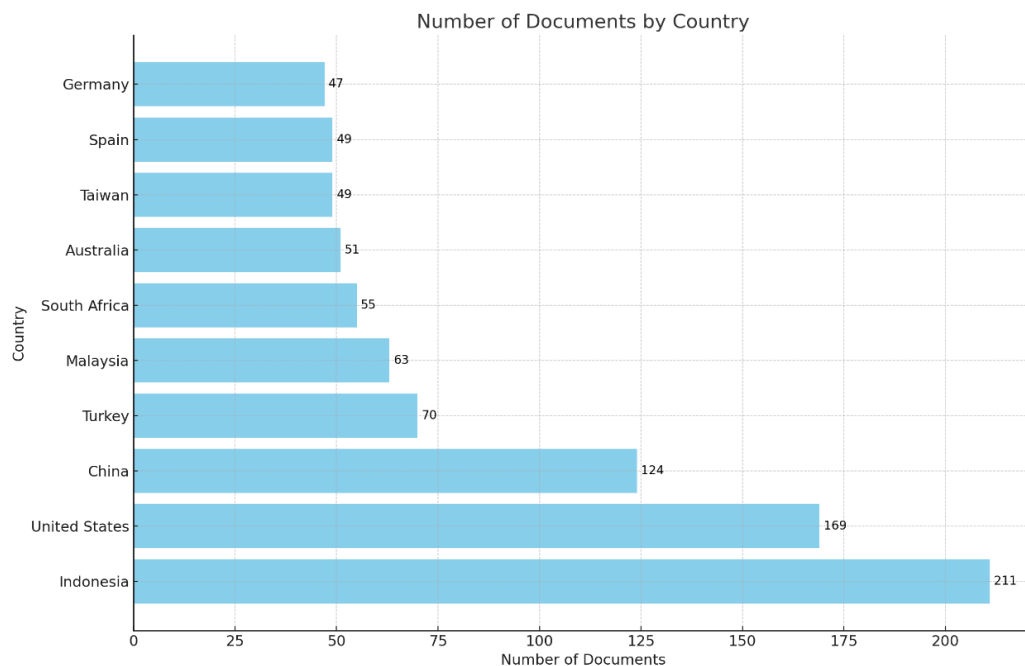


Figure 6. Number of documents by country 2019-2023

The number of TPACK documents (2019-2023) across institutions can be seen in Table 1. Indonesia is one of the countries with the largest contribution in TPACK research with 211 documents published during the study period (Chai & Rahmawati, 2020). The most productive institutions in this research include Universitas Negeri Yogyakarta, Universitas Sebelas Maret, and Universitas Negeri Malang. This dominance indicates great potential in further developing TPACK research and implementation, especially in the fields of non-formal education and history (Ciriza & Lacambra, 2022).

Bibliometric analysis shows that Yogyakarta State University leads with 30 publications, followed by

Sebelas Maret University (25 publications), and Malang State University (24 publications). Meanwhile, five other universities from Indonesia also made the list of the top ten most productive institutions in TPACK research (Suprpto, 2021).

Table 1. Cross-Institutional Documents

Institutions	Country	Total Documents
Universitas Negeri Yogyakarta	Indonesia	30
Universitas Sebelas Maret	Indonesia	25
Universitas Negeri Malang	Indonesia	24
Chinese University of Hong Kong	China	20
National Taiwan Normal University	Taiwan	20
Universitas Pendidikan Indonesia	Indonesia	20
Universitas Negeri Jakarta	Indonesia	19
Beijing Normal University	Cina	16
National Institute of Education	Singapore	15
Nanyang Technological University	Singapore	14

Top Authors in TPACK Research

In this study, it was found that several authors from Indonesia and abroad have significant contributions to TPACK research. Some of the dominant author names in this study include Chai C.S. from China, Habibi A. from Indonesia, as well as several academics from various higher education institutions in the world (Zhang, 2021). Research shows that the contribution of Indonesian researchers in TPACK has increased in the last five years, with a focus on technology-based education in various fields (Rahman, 2023).

Table 2. Top Authors on TPACK 2019-2023

Name of Author	Total Documents	Country
Chai, C.S.	16	China
Habibi, A.	10	Indonesia
Paidi	8	Indonesia
Gómez-Trigueros, I.M.	8	Spain
Zhang, H.	7	China
Tondeur, J.	7	Australia
Koh, J.H.L.	7	New Zealand
Jang, S.J.	7	Taiwan
Drajati, N.A.	7	Indonesia
Chen, W.	7	Singapore

Name of Source of Journal or Proceeding

The data in Table 4 shows that the proceedings article greatly contributed to the TPACK study (Tseng & Chai, 2020). The Journal of Physics Conference Series publishes these proceedings with 79 publications, and AIP Conference Proceedings as many as 27 publications. Other articles are published in journals, as seen in Table 4.

Table 3. Number of TPACK documents from Indonesia (2017-2021) across source titles

Name of Journal / Conference	Total Documents
Journal of Physics Conference Series	79
Education and Information Technologies	42
AIP Conference Proceedings	27
Computers and Education	21
Journal of Research on Technology in Education	17
Sustainability Switzerland	16
Frontiers in Psychology	16
Education Sciences	16
Technology, Pedagogy and Education	15
Journal of Digital Learning in Teacher Education	15

Research on Technological Pedagogical Content Knowledge (TPACK) in recent years has shown a dominance in science education studies, especially in physics and other subjects (Fakhriyah, 2022). These studies often focus on how TPACK can improve the effectiveness of science teaching and learning (Aktaş, 2020). However, it is important to realise that social studies education, especially in the context of history teaching, also has excellent potential for developing TPACK (Ciriza, 2022).

Visualization of TPACK Research Trends based on VoSViewer Software

Based on the results of data related to TPACK research in the Scopus database, 1208 articles that have been obtained are then visualized with the help of VoSViewer software (Paidican, 2022). This effort can help see the distribution map of research trends and find research gaps that have not been conducted. Figure 8 shows an overview of the TPACK study during 2019-2023, resulting in four main clusters marked with red, green, blue, and yellow.

The red cluster includes keywords such as ‘pedagogical’, ‘module’, ‘effectiveness’, ‘expert’, and ‘physics’. This cluster focuses on the development of learning models, the effectiveness of learning media, and the application of physics subject content with TPACK integration. The green cluster includes keywords such as ‘factor,’ ‘attitude,’ ‘online learning,’ ‘covid,’ and ‘distance learning.’ This cluster shows the trend of changing learning paradigms during the COVID-19 pandemic, where the TPACK framework has become a widely developed trend in the learning process. The blue cluster includes the keywords ‘validity,’ ‘service teachers,’ ‘technology content knowledge,’ ‘tck,’ and ‘select.’ Studies in this cluster focus on instrument validity and the development of technological knowledge for teacher skill development. Meanwhile, the yellow cluster includes keywords such as ‘factors,’ ‘exploratory factor analysis,’ ‘structural equation modelling (SEM),’ and ‘behavioural extension.’ This cluster focuses on complex statistical analyses and structural equation models to understand the factors that influence behaviour and use of technology in education. What is interesting about the results of this analysis is that there are no TPACK studies that focus on social studies education, specifically history learning.

The dominance of science education should not overlook the huge opportunities in social studies education (Akbayrak, M., & Kaya, 2020). A review of the literature shows that digital literacy and technology integration in social studies education can provide significant benefits (Nur’aini, 2024; Yuliani et al, 2024). History education, for example, can be significantly helped by technological approaches that allow students to access primary sources, use historical simulation applications, and participate in technology-based projects (Moseikina et al., 2022). Integrating TPACK in history learning can help teachers develop more effective pedagogical strategies. For example, the use of technology in history teaching can include interactive maps, documentary videos and augmented reality applications to bring students closer to historical experiences (Carretero et al., 2022). This approach makes learning more engaging and helps students develop the critical and analytical thinking skills needed to understand the past (Sianipar, 2024).

The development of TPACK within the history teaching community is also very important (Bruér, 2023). Teachers who deeply understand how technology can be integrated into history teaching can create richer learning experiences for their students. In addition, ongoing training and professional development can help history teachers overcome barriers to technology use and develop their confidence in implementing new strategies (Silaban, 2024).



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with the framework of TPACK.

Judging from the research paradigm used in the 2017-2021 period, the research trend on TPACK is polarized between bibliometric studies, as shown in Figure 8(c), and also SEM/PLS-SEM and technology acceptance model (TAM), as shown in Figure 8(d).

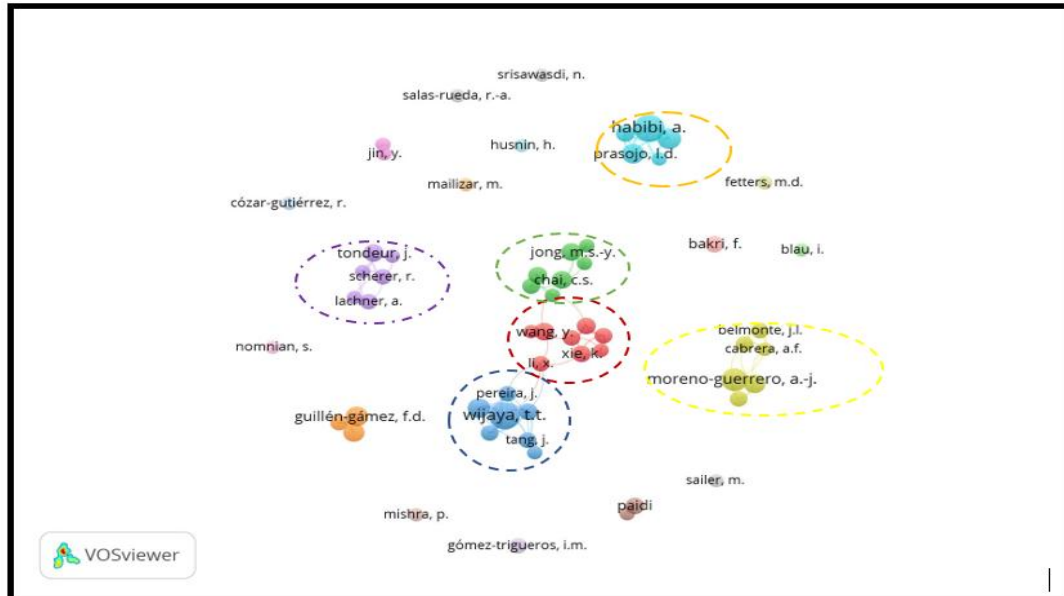


Figure 9. Top authors, co-authors, and most influential authors in TPACK

Figure 9 shows the top researchers and their groups who are researching TPACK. There are six dominant author groups: Wijaya et al., Habibi et al., Moreno-Guerrero et al., Chai et al., Wang et al., and Tondur et al. Wijaya, a researcher from Indonesia, is at the forefront among all clusters. Meanwhile, Habibi was the most influential ethnoscience researcher in 2019-2023, marked by the largest circle.

Contribution of Indonesian Researchers in TPACK

In total, Indonesia contributed 211 documents related to TPACK in 2019-2023 out of a total of 1208 documents. From this data, proceedings contributed 103 publications, and the journals contributed 103 publications, too; the rest were data papers, reviews, and notes.

Table 5. Number of Inter-Institutional TPACK Documents in Indonesia (2017-2021)

University	Total Documents
Universitas Negeri Yogyakarta	30
Universitas Sebelas Maret	25
Universitas Negeri Malang	23
Universitas Pendidikan Indonesia	20
Universitas Negeri Jakarta	19
Universitas Jambi	12
Universitas Syiah Kuala	8
Universitas Negeri Semarang	8

Table 5 illustrates how Indonesian institutions rank in the research study on TPACK. The top eight universities are dominated by educational universities. Universitas Negeri Yogyakarta led the TPACK research study. Meanwhile, Figure 10 depicts Indonesia's leading researchers and colleagues studying TPACK. Based on this analysis, Habibi is the most prolific in TPACK. For more details, you can see the following picture.

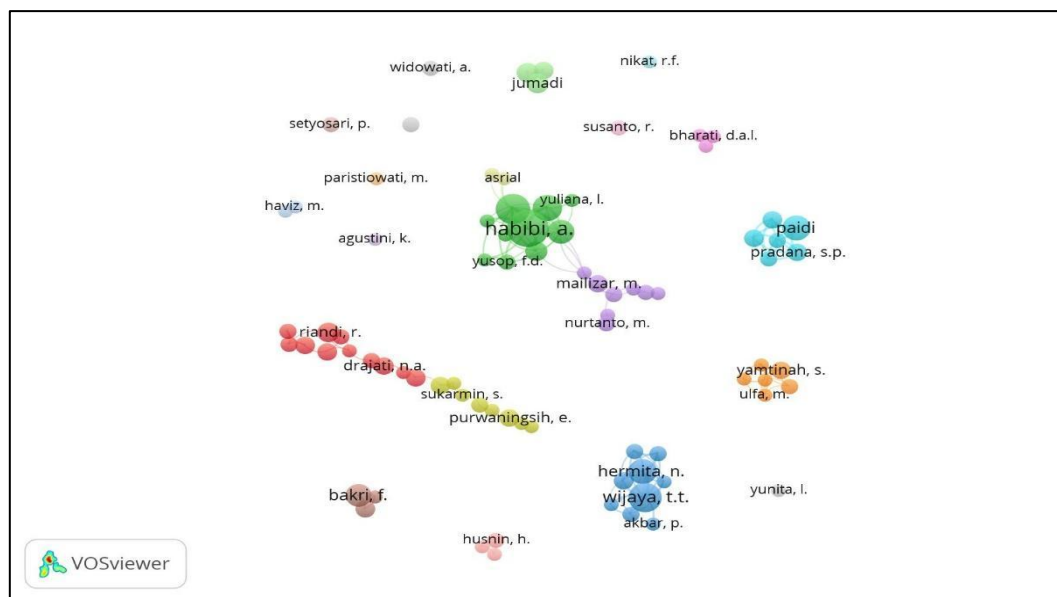


Figure 10. Indonesia's top researchers on TPACK and its co-authorships

Globally, Indonesia has taken the lead in the number of TPACK-related publications. This fact shows the great potential the country has in developing and implementing TPACK not only in science education but also in social studies education (Miguel, 2020). The development of TPACK in Indonesia can be further extended to the field of history learning and history teacher community development. This approach will significantly improve digital literacy and integrate technology into the pedagogical process, thus creating better and more relevant learning experiences for students (Kasperski, 2022). The development of TPACK within the history teaching community can significantly impact the learning process, enabling students to understand the past in a deeper and more meaningful way. (Ciriza-Mendivil et al., 2022). Therefore, researchers and educators need to pay more attention to the potential of TPACK in social studies education and develop effective strategies to integrate technology in history teaching.

CONCLUSION

Indonesia's domination in publications related to Technological Pedagogical Content Knowledge (TPACK), shows great potential in the development and application of TPACK in various fields of education, including social studies education. Although TPACK research is dominated by science education, there are significant opportunities for the development of TPACK, particularly in history teaching. History education has great potential to take advantage of TPACK. Technologies such as interactive maps, video documentaries, and augmented reality apps can make history learning more engaging and help students develop the critical thinking skills necessary to understand the past. Through the analysis of the results of this study, it is hoped that best practices and innovative approaches can be found that can be applied in the context of history education in Indonesia. By strengthening collaborative networks between history teachers, they can support each other and work together to overcome challenges in technology integration. This will create a dynamic learning community where teachers can continue to learn and grow together.

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