Research Trend on Technological Pedagogical Content Knowledge (TPACK) through Bibliometric Analysis (2015-2021)

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ABSTRACT

The Technological Pedagogical Content Knowledge (TPACK) framework has been widely acknowledged as a crucial theoretical foundation for integrating technology in educational technology research, particularly in investigating the use of technology by English as a Foreign Language (EFL) teachers. This study employs a bibliometrics research method to review EFL articles published on TPACK in the Scopus database from 2018 to 2022. 4,589 articles were collected based on the keywords "Technological Pedagogical Content Knowledge" or "TPACK". Next, 791 articles on TPACK in the EFL context were selected based on the keyword search, including "EFL", "English as Foreign Language", and "TPACK". The study aims to review the current research trends in TPACK research and its development in the EFL context. Regarding TPACK in the English as a Foreign Language (EFL) context, there has been a significant increase in the number of articles published in recent years. While EFL TPACK received relatively little attention in 2018, the publication number has increased significantly since then, indicating a growing interest in this area. The top five countries contributing to EFL TPACK research are the United States, China, Turkey, Spain, and Malaysia. In addition, The researchers utilized VoSViewer software to visualize the research trends that can be categorized into four main clusters, which are preservice teachers, in-service teachers, platform and approach, and e-learning.

Key words-*Technological Pedagogical Content Knowledge (TPACK); English as Foreign Language (EFL) Context; Bibliometric Review; Research Trends, E-learning, Platform*

1. Introduction

E-Learning environment, use of technology across content areas, micro class teaching opened up innovations in all learning classrooms, including English Foreign Language (EFL) classrooms where technology is widely used in the teaching and learning in classrooms (Gunbatar & Kerala, 2018; Siefert et al., 2019; Silberman, 2015). In EFL classrooms, language teachers need to consider ways to use technology to attract interest and motivation among English learners by retooling and accommodating technology into their classroom teaching. However, traditional teachers generally lack experience in using technology in teaching and are not ready to conduct technology in their classrooms, and even more importantly, teachers lack the awareness to relate technology and teaching (Wang & Zhu, 2019).

Based on this situation, Koehler & Mishra (2006) applied Shulman's model of Pedagogical Content Knowledge (Shulman, 1986), which incorporates technical knowledge as part of the teacher's knowledge structure, resulting in the theory known as Technical Pedagogical Content Knowledge (TPCK or TPACK). The American Association of Colleges of Teacher Education Committee (AACTE) on Innovation and Technology changed the original abbreviation TPCK to TPACK. The insertion of the letter 'A' in the acronym signaled the interdependence of the three types of knowledge (Thompson & Mishra, 2007).

Since the inception of TPACK in 2006 (Koehler & Mishra, 2006), the concept of TPACK has grown rapidly in professional development and technology integration (Irwanto, 2021; Widowati, 2019). Studies have been conducted to explore the use of TPACK and solve the problem of teachers' suitability for technology use in teaching, revealing the relationship between the TPACK cognitive level and their teaching experience, gender, and age (Alharbi, 2020; Özgür, 2020). In view of the vast research conducted on TPACK, this study aims to analyze latest research trends of TPACK from 2018 to 2022 in order to gain insight into the most recent trends in TPACK research and within the context of EFL. For this purpose, a bibliometric of 4,589, peer-reviewed journal articles on TPACK and 791 TPACK in the context of EFL was analyzed limiting the keywords of "Technological Pedagogical Content Knowledge" and "TPACK as well as "English as a Foreign Language" and "EFL" in the Scopus database. To fill this gap, the researcher intends to seek more accurate insights into TPACK research trends with the following research questions:

1) What are the countries that focus on TPACK and TPCAK in the EFL context?

2) What is the statistical trend on TPACK and TPCAK in the EFL context?

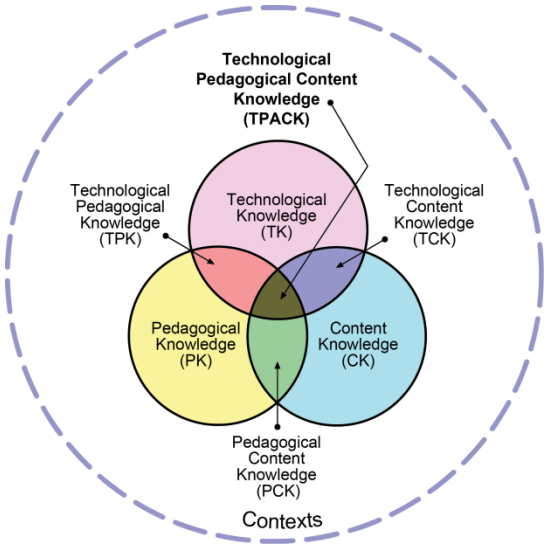
3) What are the visualized research trends on TPACK?

2. Literature Review

Technological Pedagogical Content Knowledge (TPACK) originates from Koehler and Mishra in 200 by studying Pedagogical Content Knowledge (PCK) (Shulman, 1986). Mishra & Koehler (2006) summarized the theoretical framework of TPACK, which includes three core elements (Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK)) and four composite elements (Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK) and Pedagogical Content Knowledge (PCK)), while Technological Pedagogical Content Knowledge (TPACK) is the result of the interaction of these seven elements (Sariçoban, 2019).

Figure 1

The TPACK Framework (Mishra & Koehler, 2006)



Note. From "*Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge,*" by Mishra and Kohler, 2006, *Teachers College Record*, *108*(6), 1017-1054.

Figure 1 (Mishra and Koehler, 2006) provides a visual representation of the TPACK framework. The TPACK framework consists of two or three overlapping circles that create intersections, forming seven dimensions illustrated in Figure 1 titled "The TPACK Framework". These dimensions include: i) Technology Knowledge (TK), which covers both traditional and modern information technology; ii) Pedagogy Knowledge (PK), which pertains to knowledge about the teaching and learning process; iii) Content Knowledge (CK), which refers to subject matter knowledge; iv) Pedagogy Content Knowledge (PCK), which involves the integration of subject matter and teaching methods; v) Technology Content Knowledge (TCK), which encompasses the relationship between technology and English Content Knowledge; vi) Technology Pedagogy Knowledge (TPK), which relates to how different technologies can be used in teaching and learning and how they influence teaching strategies and methods; and vii) Technological Pedagogical Content Knowledge (TPACK), which represents the integration of knowledge, technology, pedagogy, and content.

Hung et al. (2022) conducted a bibliometric review of TPACK research from 2011 to 2020, analyzing the annual publication trends, top publishing countries and journals, highly cited authors, and co-occurrences in TPACK research. The results show the United States, Turkey, and Australia were the three leading countries and American institutions published more articles than others. Moreover, when conducting TPACK studies, the highly cited keywords were PCK, teacher education, skill, and pedagogy.

Anjarani (2020) investigated the general characteristics of TPACK studies and the ways of teachers' TPACK was identified in the EFL context from 2015 to 2019. The finding shows that most studies conducted mixed-method to triangulate findings and took in-service teachers as their participants in TPACK research in the EFL context. Tseng et al. (2022) reviewed the TPACK research conducted from 2011 to 2019 to indicate issues and trends in TPACK research. The 51 articles have been classified into four distinct categories: (a) examination of TPACK, (b) evaluation of TPACK, (c) enhancement of TPACK, and (d) utilization of TPACK.

Setiawan et al. (2019) reviewed the characteristics and emerging topics of TPACK in Science context from

2011 to 2017. The finding shows pre-service teachers were the main research targets and almost constitute two-thirds of the total participant. Besides, since the TPACK was introduced, most of the studies were conducted in a science context and fewer in Biology, Chemistry, and Physics.

Suprapto et al. (2021) analyzed research trend on TPACK through a bibliometric from 2015 to 2019. The four aspects under which TPACK has been studied are: i) TPACK viewed as a system, ii) TPACK analyzed in terms of its magnitude, iii) TPACK explored in relation to quantitative measures, and iv) TPACK examined in the context of beliefs, intentions, and technology acceptance. The four aspects under which TPACK has been studied are: i) TPACK viewed as a system, ii) TPACK analyzed terms of its magnitude, iii) TPACK explored in relation to quantitative measures, and iv) TPACK examined in the context of beliefs, intentions, and technology acceptance.

3. Methodology

A bibliographic research method is a research approach that involves conducting a comprehensive review and analysis of existing literature, including books, journal articles, conference proceedings, and other sources, on a specific topic of interest. It is a type of secondary research method that does not involve collecting primary data from research participants but instead relies on existing data sources (Rashid et al., 2021). Bibliographic coupling is a neglected approach with great potential for further use in the management domain (Zupic & Čate, 2015). Bibliometrics is a well-established technique for measuring specific areas of publications (Borregan et al., 2020; Garousi, 2015) and it can be used to detect the most outstanding and productive topics and areas (Cobo et al., 2011; Muhuri et al., 2019). In general, bibliographic research is a valuable research method that can help to identify key findings and trends in existing literature, inform the development of research questions, and support the development of effective research strategies and approaches (Guenther, 2017; Mishra et al., 2017).

Therefore, To grasp the research status of TPACK more intuitively, the author uses the bibliometrics method to analyze the relevant literature and summarizes the measurement of TPACK to provide a reference for the follow-up study of TPACK. Furthermore, this research examines articles on TPACK and TPACK in the EFL

context that were published between 2018 and 2022 in order to gain insight into the most recent trends in TPACK research. A total of 6,592 articles were initially collected, but only 4,589 articles were ultimately included in the study, as they met the inclusion criteria of being journal articles published within the specified time frame.

To cover as many studies as possible, the search was limited to the keywords of "Technological Pedagogical Content Knowledge" and "TPACK". Initially, 4,589 articles were imported into NoteExpress, which is used to extract the keywords, authors, institutions, journals, and other information of the sample literature for measurement statistics (Anjarani, 2020). After generating variables, they are imported into the network analysis tool for mapping, revealing the current development status and characteristics of TPACK research.

4. Findings

This study attempts to explore the actual situation of English teachers' TPACK by accessing the measurement of the studies to realize the development and improvement of English teachers' TPACK with a focus on literature from 2018 to 2022. There were 4,589 articles associated with TPACK research and 791 articles demonstrated TPACK in an English context in the Scopus database from 2018 to 2022. arch and 791 articles demonstrated TPACK in an English context in the Scopus database from 2015 to 2021. Based on the following themes, evident in the TPACK research trends are: i) countries focusing on TPACK and TPCAK in the EFL Context, ii) statistical trends on TPACK and EFL TPACK and iii) visualized research trends on TPACK.

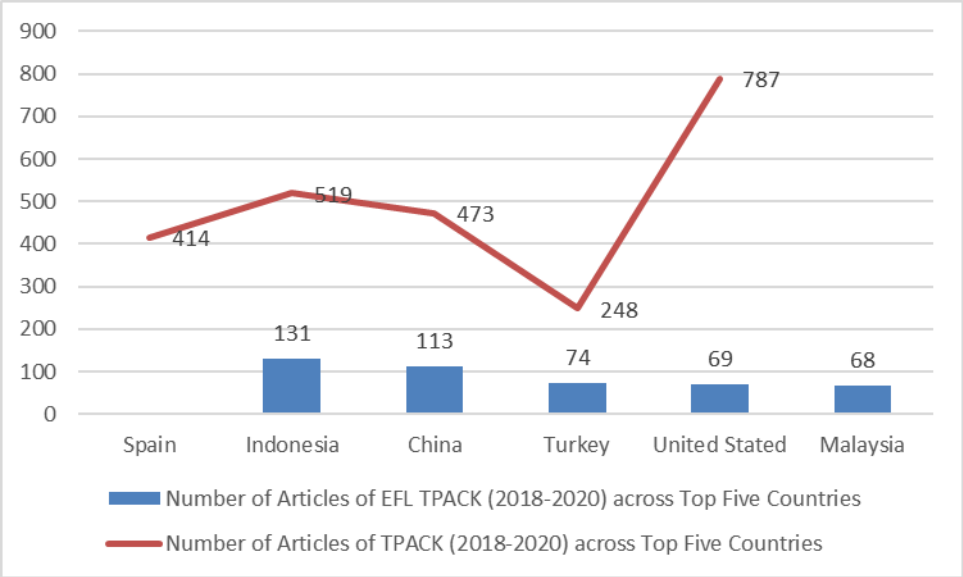
Theme 1: Countries Focusing on TPACK and TPCAK in the EFL Context

From Figure 4 titled "The Top Five Countries on Publishing TPACK and EFL TPACK Articles during 2018-2022" and based on the number of articles across countries, Indonesia, China, Turkey, and the United States are the top four countries that published the TPACK and EFL TPACK Articles during 2018-2022. Comparing Spain issued 414 TPACK articles but the researchers focused see on EFL TPACK, Malaysia researchers take EFL TPACK seriously and published 68 EFL articles during the five years.

The United States was found to be the dominant country in TPACK research, followed by Indonesia. China and Spain have also made significant contributions to TPACK research, as reflected by the number of documents published. This is consistent with the findings of Suprapto et al. (2021), who reported that these five countries were also at the forefront of TPACK research from 2015 to 2019. The United State published 787 articles from 2018 to 2022, which is far higher and almost tripled the publication number of the fifth country, Turkey, on TPACK, respectively. Indonesia, China, and Spain also made significant contributions to TPACK research, with a total of 519-414 documents combined. Moreover, Indonesia and China published the most in EFL TPACK which has 131 and 113 respectively. Meanwhile, with almost the same number, Turkey, the United States, and Malaysia contributed documents between 74-68.

Figure 3

The Top Five Countries on Publishing TPACK and EFL TPACK Articles during 2018-2022



Theme 2: Statistical Trend on TPACK and EFL TPACK

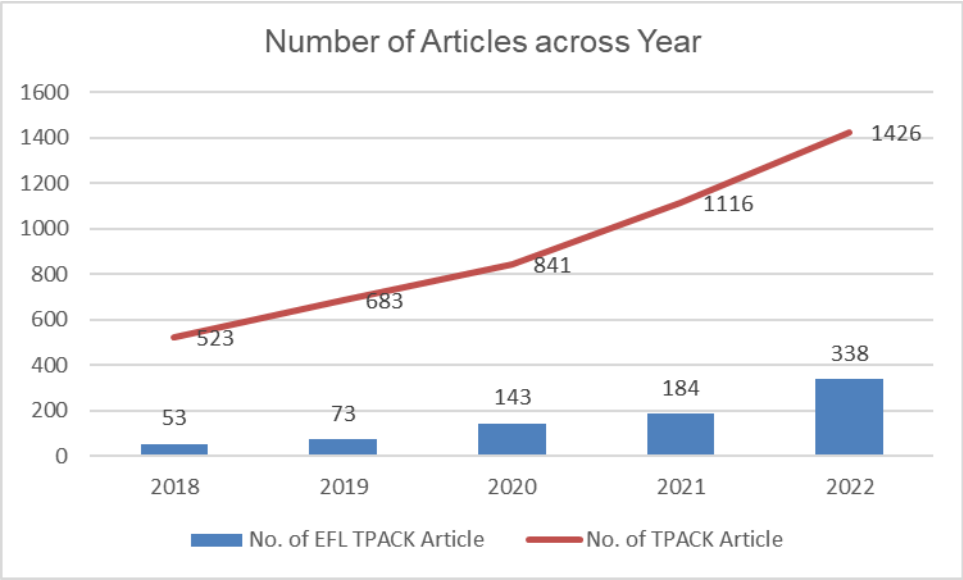
This study examines the trend of research on Technological Pedagogical Content Knowledge (TPACK) and its application in teaching English as a foreign language (EFL) over the past five years. The number of research

papers on TPACK has shown a significant increase year by year, especially in the EFL context, where the publication number even doubled in 2022. This trend is in line with previous studies by Anjarani et al. (2020), Tseng et al. (2021), and Chai et al. (2022) that suggest TPACK will continue to gain importance in education as technology continues to play an increasingly crucial role in teaching and learning.

Figure 2, titled "The number of documents on TPACK during 2018-2022," illustrates that there were 4,589 articles related to TPACK research in the Scopus database between 2018 and 2022. The number of TPACK articles increased significantly over the years, with around 523 articles in 2018 and tripling to 1,426 articles in 2020. This indicates that there is a high probability of a significant increase in the number of TPACK-related articles in the next five years. Furthermore, the number of articles related to EFL TPACK also increased rapidly, although EFL TPACK received relatively little attention, with only 53 articles published in 2018. However, the situation changed in 2020 when the publication number was increased to 143 and the trend continued as the number was raised to 338.

Figure 2

The number of documents on TPACK during 2018-2022



Theme 3: Visualized Research Trends on TPACK

The researchers utilized VoSViewer software to visualize the research trends in the 4,589 papers related to TPACK research in the Scopus database. This allowed them to identify any novel or emerging research trends in this area (Hou, 2023; McAllister, 2022). Figure 4 shows that the significant clusters were related to TPACK as a system for preservice and in-service teachers, platform and approach, and e-learning. Three of these clusters were found to be significant. The first two clusters were related to TPACK as a system for preservice teachers (represented in red) and in-service teachers (represented in yellow). The remaining two clusters were associated with platform and approach (depicted in green) and e-learning (shown in blue).

Figure 4

Visualization of Research Trends on TPACK during 2018-2022 based on VoSViewer software

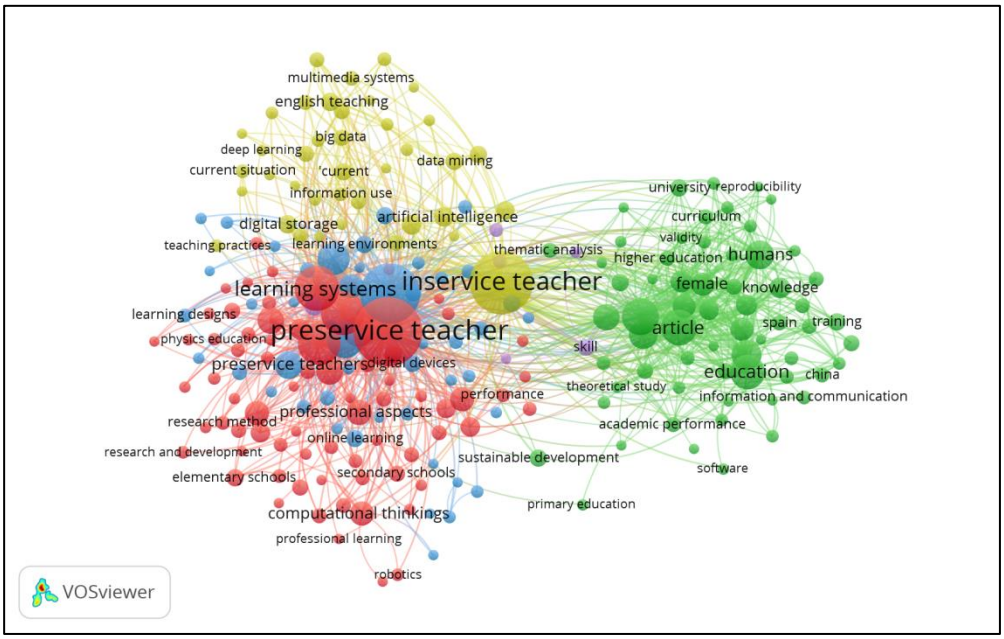


Figure 4 suggests that TPACK research has primarily focused on pre-service and in-service teachers, with equal attention being given to both groups. In addition, the platform and approach are also important aspects that suggest interacting significantly with technological education and curriculum, and theoretical study. E-Learning suggests a growing interest in the use of technology for distance learning and online education, which has become increasingly important during the COVID-19 pandemic

5. Discussion

While TPACK was initially focused on Mathematics and Science teachers, the increasing number of studies in the EFL context indicates a growing interest in its applicability in other subjects. After the introduction of the TPACK framework, it was predominantly implemented by Mathematics and Science educators, while studies in the EFL context were comparatively limited (Anjarani, 2020; Setiawan et al., 2019). However, with the high publication on TPACK studies, it indicates a growing interest in its applicability in other subjects and especially in developing TPACK theoretical framework, theories, and concepts to be completed and relatively mature.

Theme 1: Countries Focusing on TPACK and TPCAK in the EFL Context

The situation described in Figure 4 suggests that there is a significant variation in the number of TPACK and EFL TPACK articles published across countries between 2018 and 2022. Indonesia, China, Turkey, and the United States are the top four countries that published TPACK and EFL TPACK articles during this period. The differences in publication numbers across countries may be attributed to several factors.

Firstly, the growing importance of technology in education in these countries. As technology becomes more integral to teaching and learning, there is a greater need for TPACK and EFL TPACK research to identify best practices and effective approaches to enhancing teacher competencies in technology integration. Furthermore, the high number of TPACK articles published in the United States may be attributed to the country's strong tradition of educational research and the prominence of TPACK as a concept in American education.

Secondly, the high level of publishing of TPACK journals in the English context in Spain and Malaysia is due to the growing importance of English as a global language and the need for teachers to effectively integrate technology into language teaching practices (Paschal, 2022; Santosa, 2022). The EFL TPACK suggests a growing recognition of the potential benefits of using technology to enhance language learning outcomes (Almaiah, 2022; Hsu, 2022).

Overall, the variation in publication numbers across countries reflects differences in the importance of technology in education, the availability of funding for educational research, and the prominence of TPACK and EFL TPACK as concepts in different educational contexts. As technology continues to play an increasingly important role in teaching and learning, TPACK and EFL TPACK research will likely continue to be an important area of educational research across different countries and contexts.

Theme 2: Statistical Trend on TPACK and EFL TPACK

The situation described indicates a significant increase in the number of articles related to TPACK research in the Scopus database from 2018 to 2022. This increase may be attributed to several factors. Firstly, the growing importance of technology in education, combined with the increasing availability of user-friendly digital

technologies, has led to a greater demand for research related to TPACK (Song, 2020). Secondly, as technology becomes more integral to teaching and learning, there is a need for teachers to be proficient in using technology to enhance learning outcomes, leading to a need for TPACK-focused research (Susanto, 2020; Winter, 2021). Finally, the growing recognition of the importance of teacher professional development in enhancing student learning outcomes has spurred educators and researchers to seek out best practices and effective approaches to enhancing teacher TPACK competencies (Philipsen, 2019).

Additionally, the growing number of articles related to technology-enhanced teaching in English as a Foreign Language (EFL) suggests a rising interest in applying TPACK principles to language teaching. This interest may be attributed to the increasing importance of English as a global language and the potential benefits of using technology to enhance language learning outcomes, as noted by Chen (2020).

Overall, the growth of research on technology integration skills in teaching, reflected by the increase in related articles in the Scopus database between 2018 and 2022, highlights the rising importance of technology in education. Developing digital pedagogical competencies is becoming increasingly essential for teachers, and is expected to remain crucial as technology continues to play an expanding role in teaching and learning (Ahmad, 2020; Xie, 2020).

Theme 3: Visualized Research Trends on TPACK

This study suggests that TPACK research can be categorized into four main clusters, three of which were found to be significant. The first two clusters were related to TPACK as a system for pre-service and in-service teachers, respectively, while the remaining two clusters were associated with platform and approach and e-learning.

This finding highlights the importance of considering different contexts and audiences when conducting TPACK research. By categorizing research into these clusters, researchers can identify gaps in knowledge and areas where further research is needed (Goyal, 2021). For example, the focus on pre-service and in-service teachers may suggest a need for more research into effective approaches for integrating TPACK into teacher education programs and professional development initiatives.

The focus on platform and approach may indicate a need for more research into the use of specific technologies and teaching methods for enhancing TPACK competencies (Akram, 2021). This research can help to identify best practices for technology integration and highlight the potential benefits and challenges of using different technologies in different educational contexts.

The trends on e-learning may suggest a growing interest in the use of technology for distance learning and online education, which has become increasingly important during the COVID-19 pandemic (Bismala, 2021). This research can help to identify effective approaches for integrating technology into online learning environments and highlight the potential benefits and challenges of using technology for remote teaching and learning.

Overall, the categorization of TPACK research into these four clusters can help to identify trends and gaps in knowledge, as well as highlight areas where further research is needed. This can help to guide future research in TPACK and support the development of effective approaches for integrating technology into teaching and learning practices.

6. Conclusion and Recommendation

In conclusion, this study systematically combed and analyzed the research literature in the TPACK field in the Scopus database between 2018 and 2022, with a particular focus on EFL TPACK. The results suggest a growing interest in the use of technology in language teaching and learning contexts. Further analysis of the research trends in TPACK was conducted using VoSViewer software, which identified four main clusters of research. Three of these clusters were found to be significant, including TPACK as a system for pre-service and in-service teachers, platform and approach, and e-learning.

The focus on utilizing technological platforms and instructional methods in TPACK instruction may indicate a need for further research into the use of specific technologies and teaching methods to enhance TPACK competencies. This research could help identify best practices for technology integration and highlight the varied potential benefits and challenges of using different technologies in diverse educational contexts.

The focus on platform and approach may indicate a need for more research into the use of specific technologies and teaching methods for enhancing TPACK competencies. This can help to identify best practices for technology integration and highlight the potential benefits and challenges of using different technologies in different educational contexts.

The focus on e-learning suggests a growing interest in the use of technology for distance learning and online education. This research can help to identify effective approaches for integrating technology into online learning environments and highlight the potential benefits and challenges of using technology for remote teaching and learning.

Overall, the increase in TPACK research and the identification of these four clusters of research highlight the importance of considering different contexts and audiences when conducting TPACK research. By identifying gaps in knowledge and areas where further research is needed, researchers can guide future research in TPACK and support the development of effective approaches for integrating technology into teaching and learning practices.

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