TPACK RESEARCH IN SCOPUS AND WEB OF SCIENCE: A BIBLIOMETRIC ANALYSIS FROM 2018 TO 2022

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Keyword	Abstract
TPACK, Bibliometric Analysis, Scopus, Web of Science	*This study is to determine TPACK research from 2018-2022 with bibliometric analysis using the Scopus and Web of Science databases. The method used is PRISMA and the application used in analyzing is Bibliomterix R. Based on the results of the bibliometric analysis that has been carried out on 1094 publications of articles, proceedings papers, and books. It was found that there was a consistent increase in publications every year from 2019 to 2022. It is also obtained that the authors with the most publications are Chai CS and Zhang H, and the most impactful author is Chai CS. The publications of Shulman and Misrha became the most influential co-citation. Indonesia is the country with the most TPACK publications and the United States is the most cited country. The most relevant journal is Journal of Physics: Conference Series and Education and Information Technologies for Impactful Source. Research that can be further developed on TPACK (research that teaching rarely does) includes technological pedagogical content knowledge, engineering education, people, articles, and teachers. And the last trending topic is people, articles, and learning*

INTRODUCTION

In the era of rapidly developing technology, rapid and significant changes also occur in various sectors of life, one of which is the world of education. The development of information and communication technology has a huge impact on the way we learn, teach, and interact with information. With the inception of technology in education teachers are easier to convey knowledge and easier for students to acquire (Raja et al, 2018). Therefore, teachers have an important role as facilitators of effective learning and must be able to adapt quickly to the technological changes that occur.

The need for teachers to adapt to rapid technological change is particularly important because technology has opened up access to unlimited educational resources. Through the internet, teachers and learners can access various sources of information, teaching materials, and learning tools that are relevant to the topic being studied. In addition, technology also enables collaborative and interactive learning with online learning platforms, discussion forums, and communication tools that facilitate interaction between teachers and learners.

This rapid technological change is a challenge for teachers, as they need to optimally utilize the potential of technology by mastering relevant tools and applications and integrating technology with innovative learning methods. Teachers need to know about technology relevant to the content being taught, knowledge of effective learning strategies and methods, as well as knowledge of the content being taught.

In addition, teachers' adaptation to technological changes is also important to prepare students for a changing world. In today's digital age, technology skills are essential for success in the workforce and everyday life. Teachers who can integrate technology into learning can help

students develop these skills early on. They can help students understand how to use technology effectively and innovatively, utilizing it to find information, communicate, collaborate and solve problems.

One approach that can help teachers face this challenge is by using the TPACK (Technological Pedagogical Content Knowledge) Framework. TPACK is a framework based on the concept of Pedagogical Content Knowledge (PCK) proposed by Shulman in 1986. The development of TPACK was publicized by Mishra and Koehler (2006) by including the Technology dimension.

Overall, the need for teachers' adaptation to rapid technological changes is crucial in today's world of education. By utilizing the TPACK Framework, teachers can develop the necessary knowledge and skills effectively and innovatively by utilizing technology in learning. In this process, teachers act as learning facilitators who are able to integrate technology with effective and innovative methods, prepare learners for the future with constantly evolving digital trends, and create interesting and meaningful learning experiences for learners (Wuryaningtyas & Setyaningsih, 2020).

The importance of TPACK for change and adaptation in the world of education is necessary to explore and portray the big picture of TPACK research that has been conducted and current TPACK research trends. To achieve this goal, this study uses bibliometric analysis developed by previous researchers by Echchakoui (2020). Bibliometrics is a systematic method for analyzing written and unwritten journals and other scientific publications (Harande, 2001).

Many studies using bibliometrics have been conducted. Some bibliometric research on TPACK has been conducted by Karampelas (2023), Su J (2023), Zou et al (2022), Gracia-Lazaro et al (2022), Lee et al (2022), Supraprto et al (2022), Soler Costa et al (2021). However, after reviewing these studies, it was found that no one has conducted research using the years 2018-2022 and combining two databases, namely Scopus and WoS. So this research will conduct bibliometric analysis by combining data from Scopus and WoS in the last 5 years, namely from 2018-2022.

METHOD

The databases were retrieved from Scopus and WoS, using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method introduced by Moher et al. There were 4 steps: identification, screening, eligibility, and inclusion.

First, we identified them separately in Scopus and WoS databases. The retrieved term "TPACK" yielded 1529 publications in WoS, and 1862 in Scopus. Second, we filtered both databases, selecting publications from 2018-2022, document types of articles, proceedings, and books, and retaining only documents in English. This screening resulted in 749 publications in Scopus and 743 publications in WoS. The two data were combined through CSV data by taking and adjusting the Scopus format, especially on author data, from the merger obtained in 1492 publications. From these 1492 publications, data cleaning was carried out, we removed 375 duplicate publications and 22 publications in 2023. Third, Eligibility excludes one data that does not include publication data. Thus the data to be processed are 1094 publications from Scopus and WoS. After collecting the data and performing the 4 steps of PRISMA, the data was then processed using bibliometrix r-tool to help represent the data.
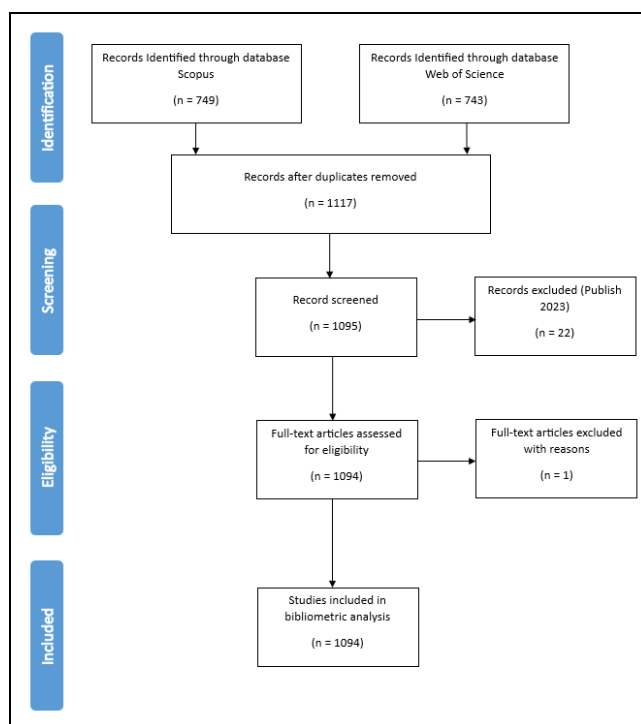
Figure 1. Data retrieval process

RESULTS

Annual scientific production and average citations per year

As in Figure 1, the 2018 publication was 212 then decreased in 2019 to 139 but after that the TPACK publication continued to increase gradually until 2022. This shows that the trend of research on TPACK is growing and is in great demand by researchers On the other hand, citations continued to rise from 2018-2020, then fell until 2022.
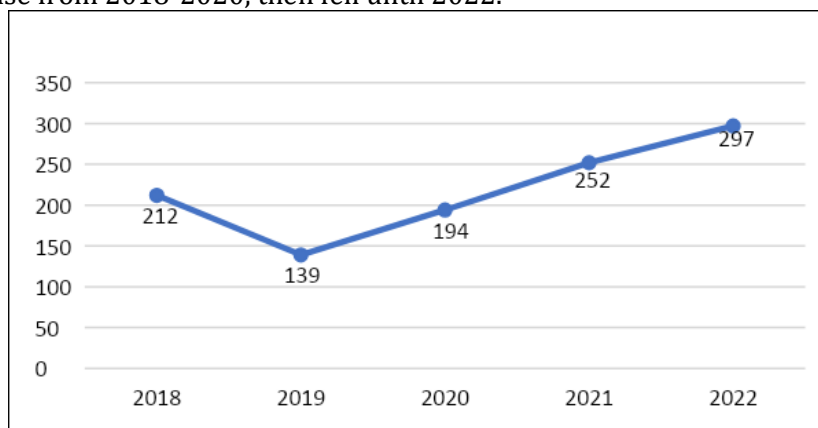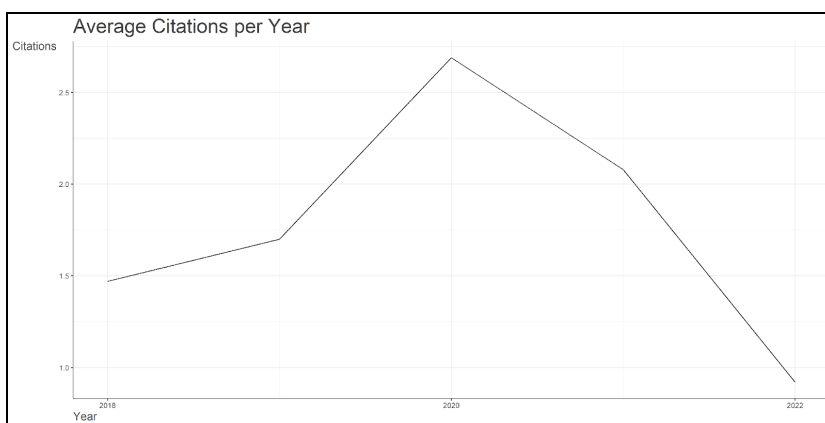

Figure 1. Annual scientific production

Figure 2. Average Citations per Year

Author, Countries, and Their Affiliated Institutions

The 10 authors with the most TPACK publications from 2018-2022 are Chai CS and Zhang H 17, followed by Wang Y (15), Srisawasdi N (9), Tondeur J (9), Niess ML (8), Bakri F (7), Jin Y (7), Baran E (6), Habibi A (6). In line with the most publications, in Figure 3 Chai CS is also the most influential author in the TPACK field. Figure 4 shows the citation network on TPACK. Mishra (2006) and Shulman (1986) publications are the most cited and most influential over the past 5 years.
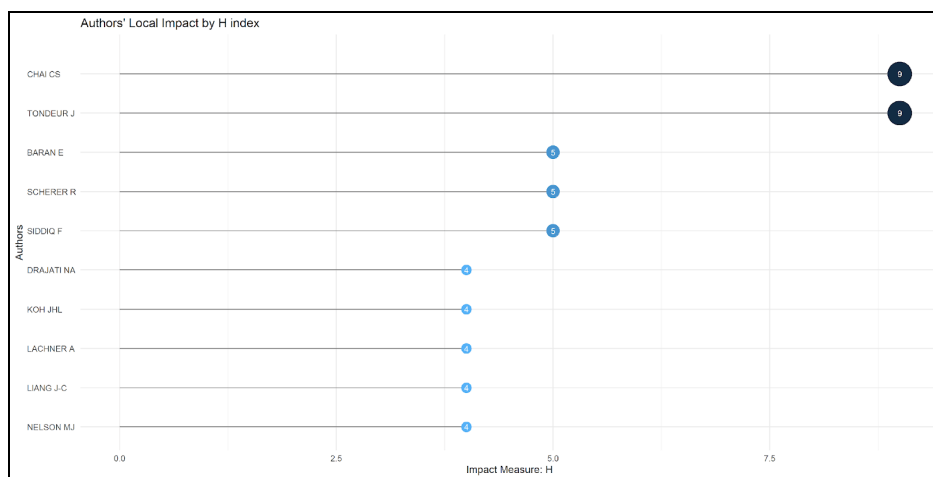

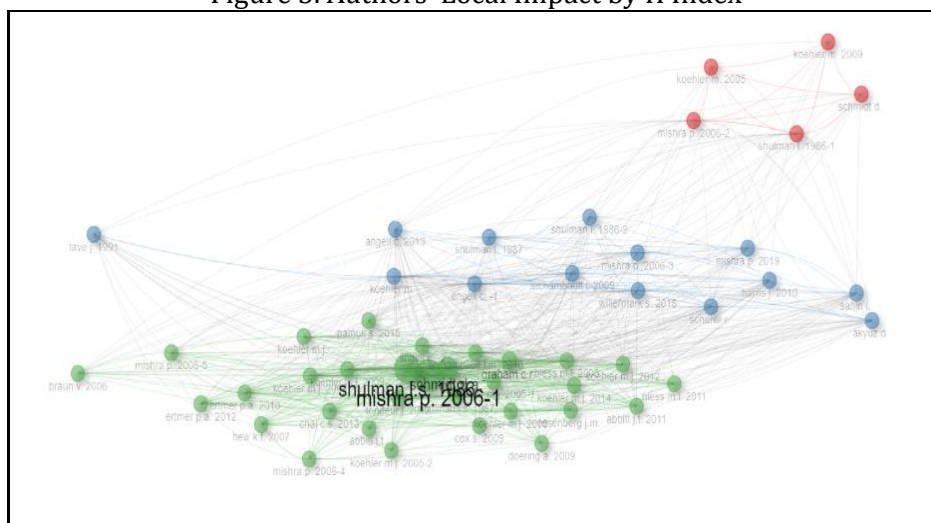Figure 3. Authors' Local Impact by H Index

Figure 4. Co-citation Network

The bibliometric analysis results summarize 10 institutions that have the most publications in TPACK. First place is Northeast Normal University with 36 publications, second is Jakarta State University with 27 publications, National Taiwan Normal University and Universitas Pendidikan Indonesia with 24 publications. 50% of the 10 institutions are from Indonesia, which is in line with the country's scientific production results in Figure 5 below, the darker the color of the country area, the more publications produced. Indonesia occupies the first position with 458 publications, followed by the United States (348), China (265), Turkey (91), Malaysia (87), Germany (74), South Africa (66), Australia (43), Finland (41), Thailand (41).
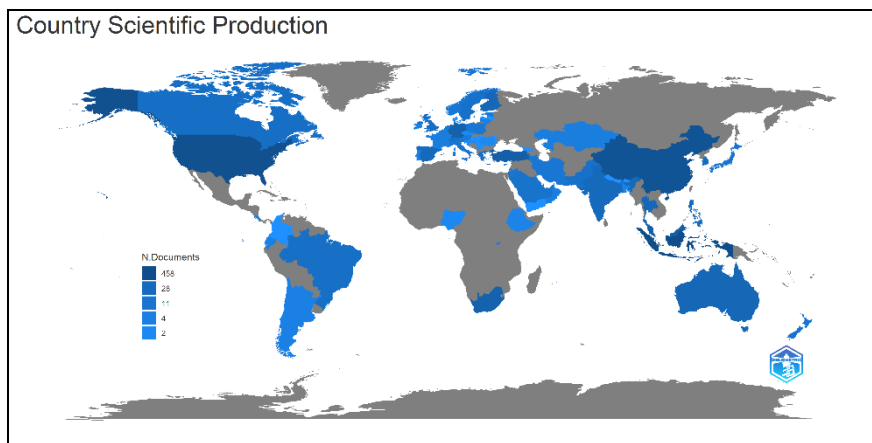
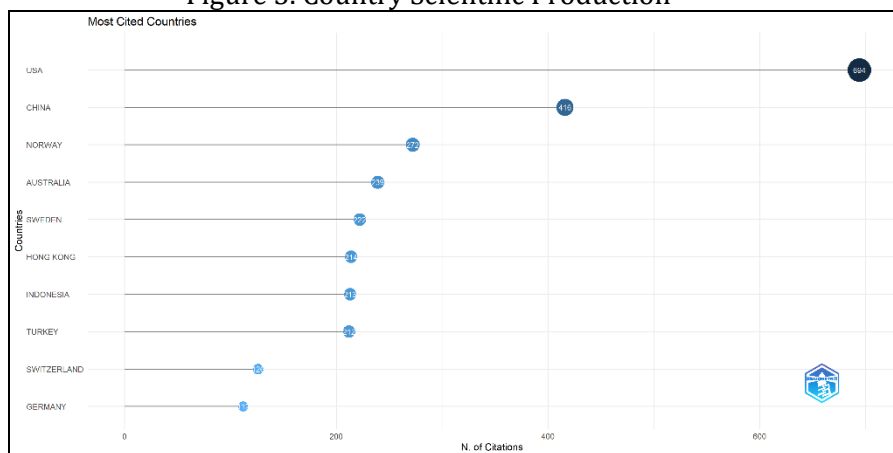

Figure 5. Country Scientific Production

Figure 6. Most Cited Countries

The Most Relevant and Impactful Source

Based on Figure 7, the top 10 sources are contributing to the publication of TPACK. Journal of Physics: Conference Series with 55 publications, compiled by Education and Information Technologies with 42 publications, and Teacher Training and Professional Development with 28 publications. Based on these sources, TPACK is published more through journals than proceedings. The most impactful journals are Education and Information Technologies.
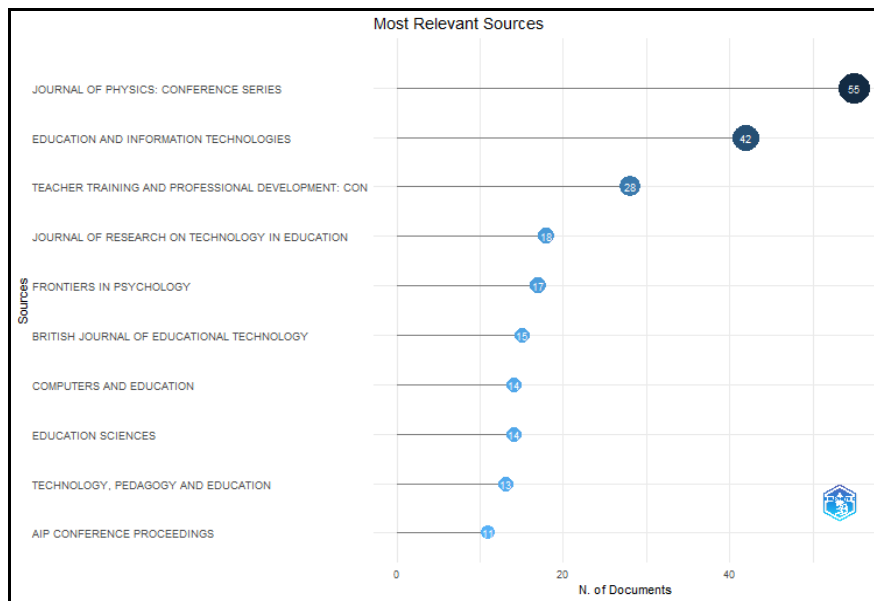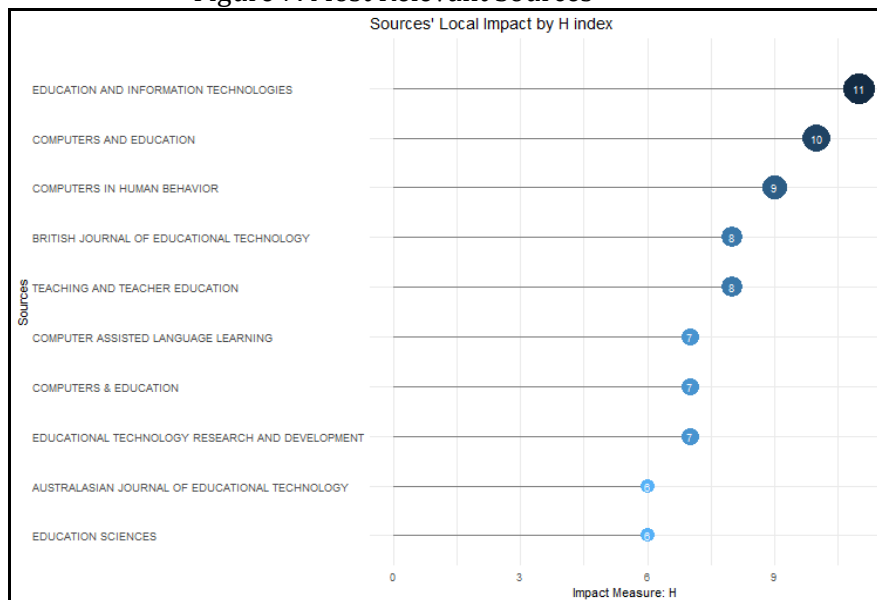
Figure 7. Most Relevant Sources

Figure 8. Sources' Local Impact by H Index

Keyword analysis and trend topic in TPACK

Based on students' Figure 9, technology and knowledge integration is located in quadrant 4, which belongs to the basic scheme in this study. While in quadrant 3 there is TPACK, preservice teacher, and integration which shows a decreasing theme. In quadrant 2 there is pedagogical content knowledge, frameworks, and education, this shows that research can still be developed. In quadrant 1 there are teaching, technological pedagogical content knowledge, technical education, humans, articles, and teachers, meaning that research with these themes can still be developed (research that is rarely done).
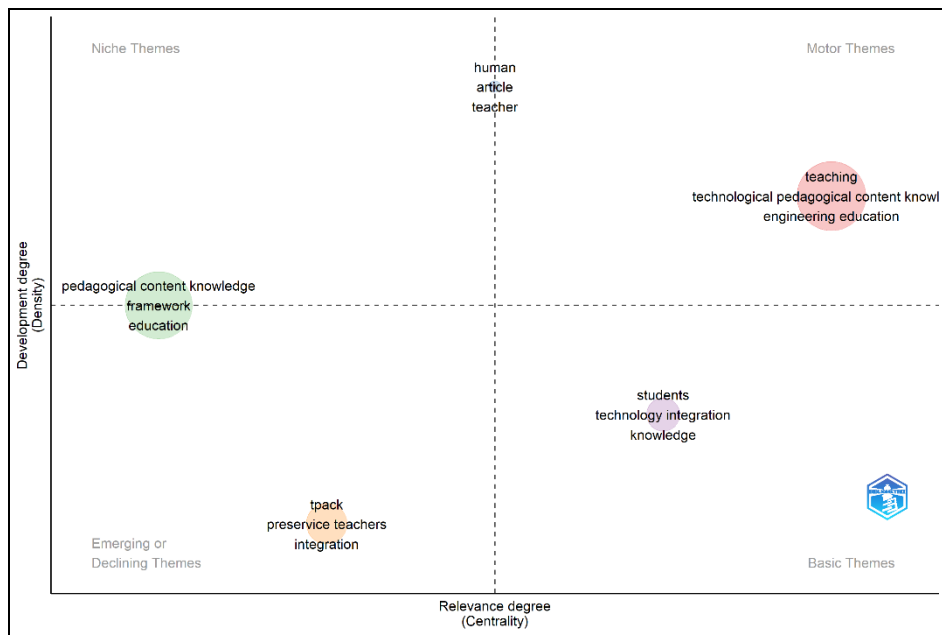
Figure 9. Thematic Map

Topic trends change every year. In 2018 engineering and school research were the most popular topics. 2019 there was science, teacher, and framework. The 2020 trending topics were PCK, teaching, and education. 2021's trending topics were TPACK and students, then last year's trending topics were people, articles, and learning.
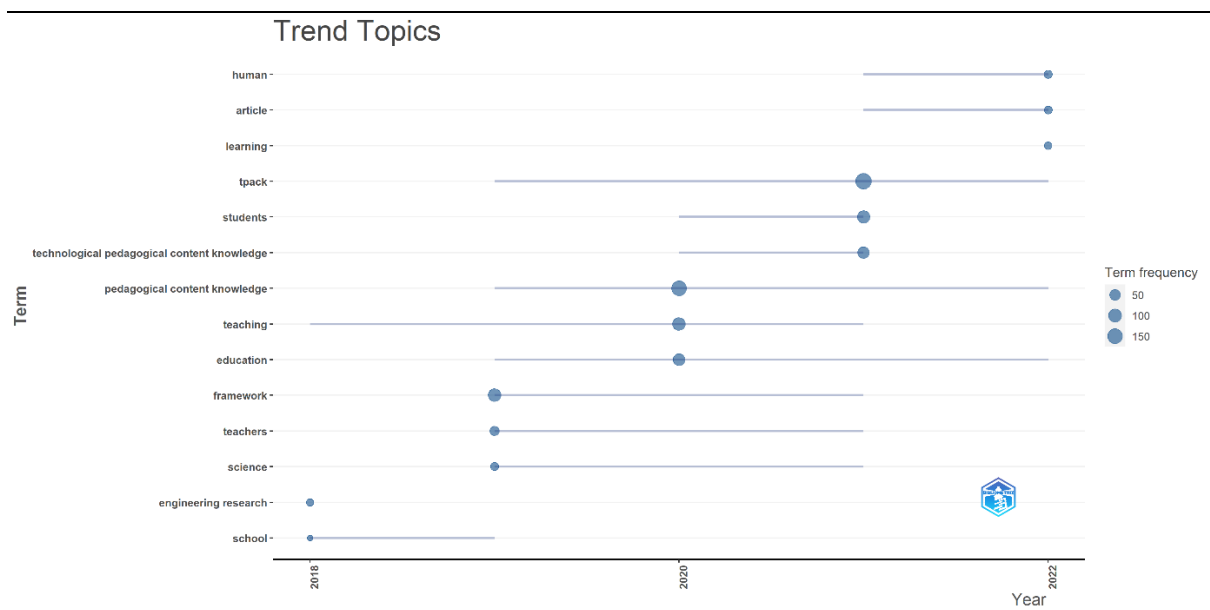
Figure 10. Trend Topic

DISCUSSION

Karampelas (2023), Su J (2023), Zou et al (2022), Gracia-Lazaro et al (2022), Lee et al (2022), Supraprto et al (2022), Soler Costa et al (2021) have all undertaken research on a specific area of the TPACK literature. However, after examining these research, it was discovered that no study includes data from 2018 to 2022 and uses two major scientific databases, namely Scopus and Web of Science (WoS). As a result, the purpose of this study is to close the gap by doing a

bibliometric analysis covering this time period and merging data from both databases to provide a more thorough view of TPACK research trends over the last five years.

There has been a noteworthy movement in academic creation on TPACK since 2018. The bibliometric results support Mishra and Koehler's (2006) conceptual framework by demonstrating that research interest in TPACK has grown over time. This pattern corresponds to prior findings in this study (Machmud et al., 2022). Despite the fact that scholarly work is expanding. However, the data demonstrate that while TPACK publications grow, citations do not increase proportionally, and citations continue to decline from 2020 to 2022.

Prominent authors such as Chai CS and Zhang H have had a significant impact on the development of TPACK. The most cited sources, namely Mishra (2006) and Shulman (1986), played a key role in building the TPACK framework. This is consistent with the findings of Machmud et al (2022) and underscores the importance of the conceptual basis in this study.

A number of institutions, such as Northeast Normal University, Universitas Negeri Jakarta, National Taiwan Normal University, and Universitas Pendidikan Indonesia, have played an important role in the scholarly production of TPACK. The increasing contribution of Indonesian institutions reflects the rapid growth of research in the country, as analysed by the country's scientific production (Machmud et al., 2022). Although Indonesia has the most publications, the United States remains the most cited country, confirming the global influence of TPACK research, in line with Cobo et al.'s conceptual framework. (2012) on knowledge framework analysis.

Journal of Physics: Conference Series, Education and Information Technology, and Teacher Training and Professional Development have played a significant role in TPACK research, with the Education and Information Technology journal standing out as the most influential, illustrating the importance of journals as publication platforms (Cobo et al., 2011).

Keyword analysis and thematic maps show the evolution of topic trends in TPACK, in accordance with the theoretical approach of Cobo et al. (2011). Year after year, research topics change, reflecting the dynamics within the TPACK field, as identified in the topic trend analysis (Cobo et al., 2011). Thematic maps show fairly clear graphics and research topics are assessed with analysis quadrants. Thematic maps explain how to evaluate and visualise specific topics within a field of study (Cobo et al., 2011). The X-axis of the thematic map shows centrality and the Y-axis shows density. Density measures the progress of the selected topic, and centrality measures the importance of the central topic (Machmud et al. 2022).

CONCLUSION

This study was conducted to obtain an overview and information on TPACK research that has been conducted and TPACK research themes that need to be developed. Based on the results of a bibliometric analysis conducted on 1094 publications of articles, proceedings papers, and books. There was a consistent increase in publications every year from 2019 to 2022.

It was also obtained that the authors with the most publications were Chai CS and Zhang H, and the most impactful author was Chai CS. The publications of Shulman and Misrha became the most influential co-citation. Indonesia is the country with the most TPACK publications and the United States is the most cited country. The most relevant journal is Journal of Physics: Conference Series and Education and Information Technologies for Impactful Source. Research that can be further developed on TPACK (research that teaching rarely does) includes technological pedagogical content knowledge, engineering education, people, articles, and teachers. And the last trending topic is people, articles, and learning.

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