

# Research trend on TPACK through bibliometric analysis

*by* Sukarmin Sukarmin

---

**Submission date:** 05-Jun-2023 07:42PM (UTC+0700)

**Submission ID:** 2109474088

**File name:** EJ1328119.pdf (436.07K)

**Word count:** 6059

**Character count:** 34427

## Research trend on TPACK through bibliometric analysis (2015-2019)

Nadi Suprpto<sup>1</sup>, Sukarmin Sukarmin<sup>2</sup>, Rinie Pratiwi Puspitawati<sup>3</sup>, Erman Erman<sup>4</sup>, Dian Savitri<sup>5</sup>,  
Chih-Hsiung K<sup>14</sup>, Husni Mubarak<sup>7</sup>

<sup>1</sup>Physics Education Programme, Universitas Negeri Surabaya, Indonesia

<sup>2</sup>Chemistry Education Programme, Universitas Negeri Surabaya, Indonesia

<sup>3</sup>Biology Education Programme, Universitas Negeri Surabaya, Indonesia

<sup>4</sup>Science Education Programme, Universitas Negeri Surabaya, Indonesia

<sup>5</sup>Mathematics Programme, Universitas Negeri Surabaya, Indonesia

<sup>10</sup><sup>6</sup>Graduate Institute of Science Education, National Dong Hwa University, Taiwan

<sup>7</sup>Graduate Institute of Digital Learning and Education, National Taiwan University of Science and Technology, Taiwan

### Article Info

#### Article history:

Received Apr 24, 2021

Revised Aug 23, 2021

Accepted Sep 12, 2021

#### Keywords:

Bibliometric study

Indonesia

Research trend

Scopus

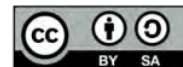
TPACK

### ABSTRACT

This paper aims to analyze the scientific trend of research on Technological Pedagogical Content Knowledge (TPACK) through bibliometric study and explore how the contribution of Indonesian researchers in the Scopus database from 2015 to 2019. The sample was composed of 2075 documents in total. The results revealed that scientific publication on TPACK has been increasing. United States contributed the most documents on TPACK as well as Singapore's institutions dominated in this area. Meanwhile, Indonesia put its two representative's institutions: Universitas Sebelas Maret and Universitas Pendidikan Indonesia, among the big ten institutions in the world. All Indonesian documents produced by teacher-producing universities and public universities. United States and Taiwan have also contributed to the most productive authors of TPACK. Then, the visualization of research trend on TPACK resulted in four major clusters: i) TPACK as a system; ii) TPACK in relating to its scale; iii) TPACK in connecting with quantitative parameters; and iv) TPACK under beliefs, intention, and technology acceptance. The research findings could aid related researchers to recognize the trend of TPACK research and recommend directions for further research.

18

This is an open access article under the [CC BY-SA](#) license.



### Corresponding Author:

11 Nadi Suprpto

Physics Education Programme

Universitas Negeri Surabaya

Kota Surabaya, Jawa Timur, Indonesia

Email: nadisuprpto@unesa.ac.id

## 1. INTRODUCTION

35  
The era of the 4th generation industrial revolution, or what is known as the 4.0 industrial revolution, directs all areas of life to digital technology, artificial intelligence, big data, and robotic. There is no exception in education; entering the world 4.0 industrial revolution, education is required to construct learning that involves technology. Education 4.0 is a term used by education experts to describe how to implement cyber technology into learning [1]. Education 4.0 requires teachers to master technology to be integrated into the learning process. The teacher's ability to master technology in learning can be seen through the Technological Pedagogical Content Knowledge (TPACK) owned by the teacher. TPACK is a theoretical framework for integrating technology, pedagogy, and subject matter in learning. It is substantial to

examine the three elements of TPACK knowledge and the interactions between each TPACK element and their relationships with the industrial revolution 4.0 [2].

The ability of TPACK is crucial for prospective teachers because they have to teach all subject matters. Prospective teachers who have TPACK abilities can integrate technology in the learning process is following the learning material and the appropriate learning strategy according to the characteristics of students [3]. The use of technology in the learning process is beneficial for students in understanding subject matter, especially mathematics and science. It is common knowledge that some mathematics and science materials are abstract. The task of prospective teachers is to design abstract learning to be more concrete, contextual, or more realistic according to the students' level of thinking through technology. Effective teachers are expected to exploit the potential of technology to develop student understanding, stimulate interest in learning, and improve student skills.

TPACK is a framework for researchers and education practitioners, in an effort to package and develop learning models in order to achieve learning objectives through a better process. Knowledge of technology, pedagogy, and content knowledge, should be collected in a teacher or prospective teacher [2], [3]. Despite the importance of TPACK, there have been few attempts to gather data about the worldwide scientific production of TPACK. One of the methods used by researchers is a literature review with bibliometric analysis.

The bibliometric analysis provided a precise method to evaluate the contribution of a paper to the advancement of knowledge [4]-[6]. Bibliometric indicators, including research fields, document sources, publication outputs, document sources, language sources, distribution of countries and institutions, top authors, number of citations, and author keywords, have been frequently used to analyze the trends [4]-[8]. This study aims to analyze the trends of TPACK research in the last five years (2015-2019) to help educational researchers comprehend the landscape of global TPACK. Through this research, the researchers explored some parameters or interrelationships among variables on TPACK, such as the product of TPACK, the use of research design in TPACK, TPACK and beliefs, TPACK relating to gender and science, technology, engineering, and mathematics (STEM), the most influenced researcher of TPACK, and the policy about TPACK. Thus, this study focused on the research trend on technological pedagogical content knowledge on interval 2015-2019 with six research questions:

- i) To what extent did the publication output, document sources, and language sources of TPACK in 2015-2019?
- ii) To what extent did the distribution of publication of TPACK across countries and institutes in the world?
- iii) Who were the top authors in researching of TPACK in the world?
- iv) How did the publication patterns of TPACK base on source titles?
- v) How did the visualization results of the research trend of TPACK?
- vi) To what extent did the contribution of Indonesian researchers on researching TPACK?

26

## 2. LITERATURE REVIEW

### 2.1. Overview of technological pedagogical content knowledge

TPACK is teacher knowledge and competence that Shulman first developed in 1986-1987 [9]. TPACK describes scientific insights in technology, education, and fields of study and their use in learning [3], [9], [10]. TPACK framework can be seen in Figure 1(a). Furthermore, the most influential on TPACK, [9] describe TPACK in more detail on its elements, including TK, CK, PK, PCK, TCK, and TPK, which subsequently form TPACK as shown in Figure 1(b).

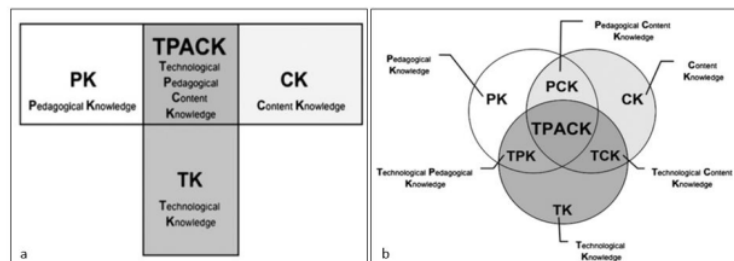


Figure 1. The TPACK framework [3], [9]

In developed countries, teacher competence is known as TPACK [11]-[13]. TPACK consists of three essential components, namely Pedagogical Knowledge (PK), Content Knowledge (CK), and Technological Knowledge (TK). The three components form a specific subject pedagogy, including TPK, TCK, and PCK forming TPACK.

The TPACK framework is increasing in use by education and educational technology researchers worldwide who were interested in issues related to technology integration. Recently, "a conceptual model called technological pedagogical content knowledge (TPACK) was introduced to the educational research community" [14]. Researchers have involved the model with significant initial enthusiasm, as evidenced by the rapid growth of special interest groups and TPACK strands at the educational association and conferences. Many researchers recognize the broad appeal and potential of the TPACK model.

### 3. RESEARCH METHOD

The study was utilized a desk study with a bibliometric analysis of papers that we expect provides a valuable reference for future research [4]-[8], [15], [16]. The term bibliometrics was first by Pritchard [17], "hoping that the term would be used explicitly in all studies which seek to quantify the processes of written communication and would quickly gain acceptance in the field of information science" [18]. The researchers optimized Elsevier's Scopus database, the largest academic database in the world. In scientific research, it is crucial to get a broader perspective of research already being conducted concerning relevant content and a bibliometric analysis profile on the research trajectory and dynamics of the research activities worldwide. "TPACK" and "mathematics or physics or chemistry or biology or science education" were used as the filter to search titles, abstracts, and keywords from 2015 to 2019. The search strategy was a title:

*"tpack" AND physics OR mathematics OR chemistry OR biology OR science AND (LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2015))*

The data collection was conducted in October 2020. It was 2075 documents that fulfilled the searching criteria. Microsoft Excel was used to analyze the data. The investigation was conducted to analyze the research trends, including characteristics of publication outputs, document sources, language sources, distribution of countries and institutions, distribution of outputs in subject categories, top authors, top citations, and publication trends from 2015 to 2019. VoSViewer software was used to figure out the research trend on TPACK [19].

### 4. RESULTS AND DISCUSSION

#### 4.1. Publication output, document sources, and language sources

There were 2,075 papers associated with TPACK research in the Scopus database, including five document sources. The publications devoted to TPACK research throughout 2015 to 2019 are demonstrated in Figure 2. The number of documents of TPACK across the 5-year period was increased significantly. It was about 312 articles in 2015 and became double in 2019 (610 articles). It can be predicted that the number of articles in the next five years will increase dramatically.

Meanwhile, the number of articles based on sources indicated the dominance of articles in the journal (1344 documents). It was followed by a book and conference proceeding. The book series and trade journal accounted for the fewest sources of documents. Then, out of a total of 2,075 documents, most articles used English as the language of articles (1997 documents or 96%). The rest documents were using Spanish (3%). While it was in a small number, the documents used Turkish, Russian, Portuguese, and Chinese with a percentage less than 1%.



Figure 2. The number of documents on TPACK during 2015-2019

*Research trend on TPACK through bibliometric analysis (2015-2019) (Nadi Suprpto)*

#### 4.2. Publication distribution of countries and institutes

Based on the number of documents across countries, the USA's dominance with 584 documents from 2015 to 2019. The countries such as Australia and Turkey contributed to this topic with 157 and 150 documents, respectively. Meanwhile, with almost the same number, China, Indonesia, and Spain contributed documents between 120-130. The rest of the ten countries that contributed the most to research on TPACK were Taiwan, Malaysia, the UK, and the Netherlands with total of 50-100 documents.

The number of documents of TPACK (2015-2019) across the institution could be seen in Table 1. Singapore places its two institutions in the first and second rank. Nanyang Technological University (NTU), Singapore has ranked first with 44 documents and was followed by the National Institute of Education (NIE), Singapore and National Taiwan Normal University (NTNU), Taiwan. Indonesia has placed two of its representatives (Universitas Sebelas Maret and Universitas Pendidikan Indonesia) among the ten world institutions that have contributed the most to research on TPACK. Meanwhile, other institutions were dominated by the USA and the Netherlands.

Table 1. Number of documents of TPACK (2015-2019) across institution

| No | Institution  | Number of documents |
|----|--|---------------------|
| 1  | Nanyang Technological University, Singapore        | 44                  |
| 2  | National Institute of Education, Singapore         | 39                  |
| 3  | National Taiwan Normal University, Taiwan          | 33                  |
| 4  | The University of North Carolina at Charlotte, USA | 30                  |
| 5  | Michigan State University, USA                     | 26                  |
| 6  | Oregon State University, USA                       | 25                  |
| 7  | University of Twente, Netherlands                  | 23                  |
| 8  | Universitas Sebelas Maret, Indonesia               | 23                  |
| 9  | Universitas Pendidikan Indonesia, Indonesia        | 22                  |
| 10 | Universiteit van Amsterdam, Netherlands            | 21                  |

#### 4.3. Top authors in researching of TPACK

In terms of most productive authors, Chai (29 documents), Polly (25), Tondeur (21), Niess (20), Voogt (20), Koh (16), Zhang (16), Mishra (14), Tsai (12), and Wang (12) were the most productive authors on this topic. Among those top ten authors, the most of them are from the USA. Meanwhile, Chai and Tsai are the representative top authors from Taiwan. Generally, the performance of authors in line with the top citation of the article all years, as indicated in Table 2. For example, Voogt (515 citations) and Tondeur (250 citations) recorded their work with the top five citations until October 2020. Meanwhile, Table 3 depicts the top citation of articles in the duration of 2015-2019. It was listed that authors such as [20]-[23] resulted in their articles as the top 5 citations in 2015-2019.

Table 2. Top citation of article all years

| Author(s)                        | Journal                             | Number of citations |
|----------------------------------|-------------------------------------|---------------------|
| Schmidt, <i>et al.</i> [24]      | 36 Res. Tech. Educ. 42(2), 123-149  | 515                 |
| Harris, Mishra, and Koehler [25] | 45 Res. Tech. Educ. 41(4), 393-416  | 373                 |
| Voogt, <i>et al.</i> [26]        | J. Comp. Ass. Lear., 29(2), 109-121 | 261                 |
| Tondeur [27]                     | Comp. & Educ., 59(1), 134-144       | 250                 |
| Graham [14]                      | Comp. & Educ., 57(3), 1953-1960     | 248                 |

Table 3. Top citation of article in 2015-2019

| Author (s)                     | Journal                                 | Number of citations |
|--------------------------------|---|---------------------|
| Gil-Flores, <i>et al.</i> [22] | Comp. Hum. Behav. 68, 441-449           | 91                  |
| Ghavifekr and Rosdy [21]       | Int. J. Res. Educ. & Sci., (2), 175-191 | 88                  |
| Kim, <i>et al.</i> [23]        | Comp. & Educ., 91, 14-31                | 83                  |
| Angeli, <i>et al.</i> [20]     | Educ. Tech. & Soc., 19(3), 47-57        | 76                  |
| Valtonen, <i>et al.</i> [28]   | Comp. & Educ., 81, 49-58                | 70                  |

#### 4.4. Publication patterns: Source titles (Journal or Proceeding)

Table 4 illustrates the most contribution journal or proceeding on the research of TPACK. Journal of Physics Conference was a leading conference series that contains articles about TPACK. Meanwhile, Computer and Education-Elsevier and Education and Information Technologies-Springer were the leading journals covering TPACK in their content. The remaining journals were Australasian Journal of Educational

Technology, British Journal of Educational Technology, Eurasia Journal of Mathematics, Science, and Technology Education, Technology, Pedagogy and Education, Journal of Educational Computing Research, and TechTrends.

Table 4. Number of documents of TPACK (2015-2019) across source titles

| No | Name of Journal or Proceeding                       | Number of documents |
|----|---|---------------------|
| 1  | J. Phys. Conf. Ser.                                 | 63                  |
| 2  | Comp. & Educ.                                       | 48                  |
| 3  | Educ. & Inform. Tech.                               | 46                  |
| 4  | Teach. Train. & Prof. Dev. Conc. Meth. Tools & App. | 36                  |
| 5  | ACM Int. Conf. Proc. Ser.                           | 28                  |
| 6  | Australasian J. Educ. Tech.                         | 28                  |
| 7  | British J. Educ. Tech.                              | 27                  |
| 8  | Eurasia J. Math. Sci. & Tech. Educ.                 | 23                  |
| 9  | Tech. Ped. & Educ.                                  | 23                  |
| 10 | J. Educ. Comp. Res.                                 | 22                  |
| 11 | TechTrends  | 22                  |

#### 4.5. Visualisation of research trends on TPACK based on VoSViewer software

Among those 2,075 papers related to TPACK research in the Scopus database, the researchers visualized the research trends on this topic assisted with VoSViewer software. This effort helps find the novelty of the research on this domain. The findings indicated it was some parameters or interrelationships among variables on TPACK, such as researching on TPACK, PCK, TPACK and service teachers, the product of TPACK, the use of research design in TPACK, TPACK and beliefs, TPACK relating to gender and STEM, the most influenced researcher of TPACK, the policy relating TPACK.

Figure 3 indicates the whole picture research on TPACK. Researchers on the world produced six clusters. Four of six clusters were the significant clusters. The first cluster was TPACK as a system related to the platform and approach guiding the teaching and learning process. The second cluster was TPACK concerning its scale, validity, reliability, and statistics mode. The third cluster was TPACK connecting with quantitative parameters such as test, sample, treatment, and measurement. The fourth cluster indicated TPACK relating to beliefs, intention, and technology acceptance.

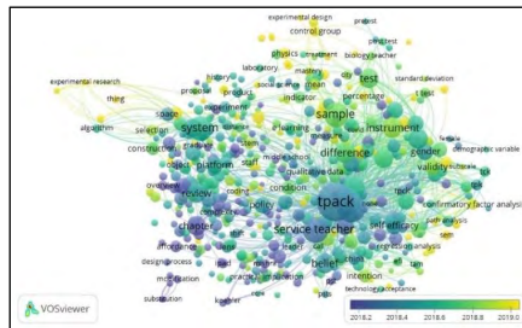


Figure 3. The whole picture of research on TPACK during 2015-2019

If we broke down into the specific connection among variables to capture the trend and novelty researching TPACK, we found some findings. Figure 4(a) emphasizes that research on TPACK focused on pre-service and in-service teachers. It is logical due to teacher need knowledge concerning technology, pedagogic, and specific content. The development of TPACK for teachers resulted in some product for further validation, as indicated in Figure 4(b).

In terms of the paradigm research used, in the 2015-2019 period, research on TPACK used quantitative and qualitative paradigms as shown in Figure 5(a). However, the positivist paradigm with the type of quantitative research as can be seen in Figure 5(b) still dominates. It can be seen from the picture of how the dominance of tests in researching on TPACK, the selection of samples in the experimental research design in examining TPACK.

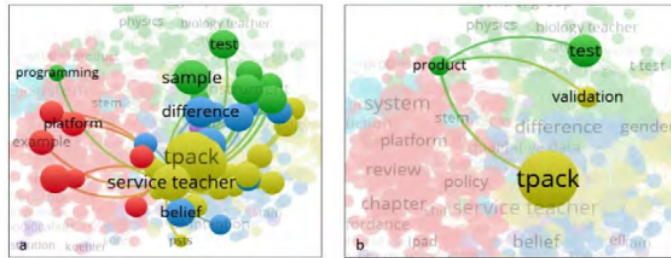


Figure 4. TPACK in relating to service teacher (pre-service and in-service) and its product

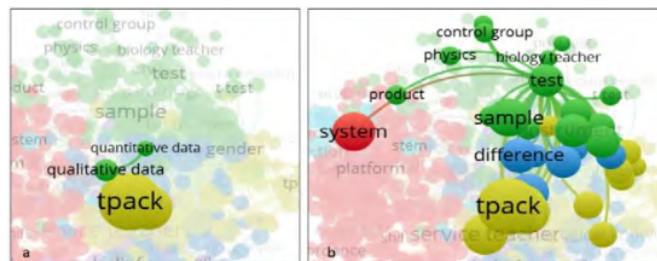


Figure 5. TPACK in relating to research paradigm

<sup>1</sup> Research on TPACK has also related to STEM and gender as shown in Figure 6. Research by Chai [29] reviewed how teacher professional development for STEM education in the Perspectives of TPACK. However, Castéra, *et al.* [30] reported TPACK of teacher educators across gender in six countries in Asia and Europe. Their research indicated there was an independence of gender or academic level and TPACK. The study of beliefs systems and policies also have an essential part of research on TPACK during 2015-2019. Figure 7 proofs that researchers considered the connection of TPACK and beliefs and TPACK and policy. Teacher' belief is essential in classroom practice because it is the principle that teachers hold to be accurate and the rationale of the attitude in the classroom. In applying the TPACK framework, the teacher has to believe in it [31]. Preservice teachers' TPACK beliefs and attitudes toward simulations were also researched by previous researchers [32]. A systematic review on TPACK has also become a concern among researchers globally. Figure 8 shows the top researcher and its cluster in researching TPACK. Chai and Tondeur have become a leader in each cluster [27], [30]. On the other hand, Mishra and Koehler were the most influenced researchers on TPACK in 2015-2019 [9], [11].

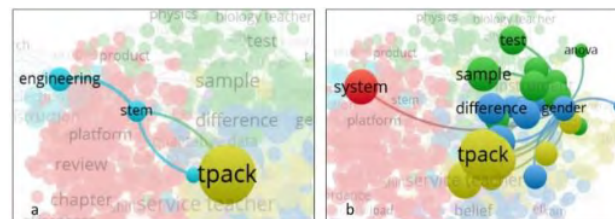


Figure 6. TPACK in relating to STEM and gender

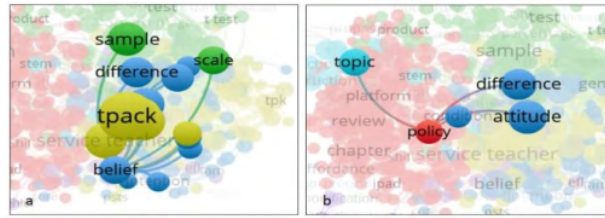


Figure 7. TPACK in relating to beliefs and policy

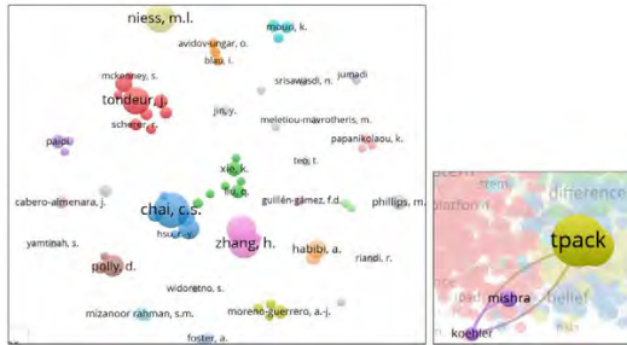


Figure 8. Top researchers and the most influenced researchers on TPACK

**4.6. The contribution of Indonesian researchers on TPACK**

In total, Indonesia contributed 127 documents related to TPACK in the last five years from 2015 to 2019. Of this number, it was 64% published in the proceedings or the results of the conference paper, while the remaining 36% is in the form of journal papers.

If researchers in the world produced six clusters related to trends research on TPACK, there were only four clusters produced by Indonesian researchers. The first cluster (red color) was TPACK in relating to skills. Meanwhile, the second cluster (yellow) was TPACK concerning its competence, needs, practice, impact, and challenge. The third cluster (green) was TPACK in connecting with quantitative parameters such as test, value, instrument, assessment, and statistics. The last cluster (blue) indicated TPACK under its component and framework.

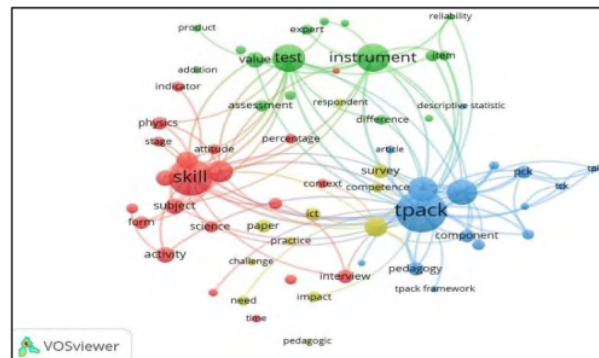


Figure 9. The whole picture of research on TPACK performed by Indonesian researchers during 2015-2019



Table 5 illustrates how the rank of Indonesian institution in producing documents on TPACK. All the top 10 are teacher-producing universities. Except for number seven and ten, all universities above are public universities of documents of TPACK across Indonesian institution (2015-2019). Meanwhile, the top Indonesian researcher on TPACK listed the name such as Paidi (7 documents), Astuti (5), Pradana (5), Riandi (5), Sinaga (5), and Widoretno (5) were the most productive authors in this topic from Indonesia.

It was no different rank from the world in terms of TPACK from Indonesia (2015-2019) source titles; Journal of Physics Conference was a leading conference series that contains articles about TPACK. AIP Conference Proceeding followed this most significant number. Meanwhile, for the journal category, Jurnal Pendidikan IPA Indonesia (number 3), also from Indonesia, is also superior in producing TPACK documents. Table 6 also indicates that Indonesia's contribution to research on TPACK is more in the proceedings than in the journal.

Table 5. Number of documents of TPACK across Indonesian institution (2015-2019)

| No | University                         | Number of documents |
|----|------------------------------------|---------------------|
| 1  | Universitas Sebelas Maret          | 23                  |
| 2  | Universitas Pendidikan Indonesia   | 22                  |
| 3  | Universitas Negeri Yogyakarta      | 17                  |
| 4  | Universitas Negeri Malang          | 7                   |
| 5  | Universitas Negeri Jakarta         | 6                   |
| 6  | Universitas Negeri Semarang        | 4                   |
| 7  | Universitas Muhammadiyah Surakarta | 3                   |
| 8  | Universitas Negeri Surabaya        | 3                   |
| 9  | Universitas Musamus Merauke        | 3                   |
| 10 | Surya University                   | 2                   |

Table 6. Number of documents on TPACK from Indonesia (2015-2019) across source titles

| No | Name of Journal or Conference             | Number of documents |
|----|---|---------------------|
| 1  | J. of Phys. Conf. Ser.                    | 60                  |
| 2  | AIP Conf. Proc.                           | 9                   |
| 3  | J. Pend. IPA Indo.                        | 5                   |
| 4  | Int. J. Innov. Creativity & Change        | 4                   |
| 5  | IOP Conf. Series Mat. Sci. & Eng.         | 4                   |
| 6  | Int. J. Learn. Teach. & Educ. Res.        | 3                   |
| 7  | IOP Conf. Ser. Earth & Env. Sci.          | 3                   |
| 8  | J. Turkish Sci. Educ.                     | 3                   |
| 9  | 5th Int. Conf. on Educ. & Tech. ICET 2019 | 2                   |
| 10 | Asian EFL J.                              | 2                   |

## 5. DISCUSSION

Some researches on TPACK have been conducted by several researchers [33]-[38]. However, a few studies focused on systematic review and bibliometric analysis [39]-[41]. The results of this research give a new lens of research trends of TPACK through bibliometric analysis. The authors continued previous researchers' experiences conducting a literature review [42]-[46] to capture all variables related to scientometrics on TPACK. The results of this study complemented the study by Soler-Costa, *et al.* [47], who researched TPACK based on the Web of Science. In contrast, this study used the Scopus database, the most popular database in the world. Therefore, future research can compare data from the Web of Science and Scopus.

In simple, in the last five years (2015-2019), the number of documents of TPACK across the year was increased significantly, most articles used English as the language of articles (1997 documents or 96%) as well as the study performed by Soler-Costa, *et al.* [47]. It was clear the dominance of the USA and followed by Australia and Turkey in this domain. In the middle numbers of documents, China, Indonesia, and Spain have also contributed to research on TPACK. Nanyang Technological University (NTU), Singapore, contributed the most documents on TPACK. Meanwhile, Indonesia has placed two of its representatives (Universitas Sebelas Maret and Universitas Pendidikan Indonesia). This result was also in-lined with the study of Nuangchalerm [34] and Arifin [35]. Indonesian institutions expressed their dominance on the research on TPACK in relating to skills, TPACK concerning its competence, needs, practice, impact, and challenge, TPACK in connecting with quantitative parameters such as test, value, instrument, assessment, and statistics. However, Indonesian institutions should improve their research on TPACK regarding research design, TPACK and beliefs, TPACK relating to gender and STEM, and the policy relating to TPACK.

Chai, Polly, Tondeur, Niess, Voogt, Koh, Zhang, Mishra, Tsai, and Wang were the most productive authors on this topic. These lists have also supported the findings of Soler-Costa, *et al.* [47]. It means both Scopus and Web of Science gave similar map research on TPACK. Journal of Physics Conference was a leading conference series that contains articles about TPACK. Meanwhile, Computer and Education- Elsevier and Education and Information Technologies – Springer were the leading journals covering TPACK in their content. The findings were also indicated that it was some parameters or interrelationships among variables on TPACK, such as researching on TPACK, PCK, TPACK and service teachers, the product of TPACK, the use of research design in TPACK, TPACK and beliefs, TPACK relating to gender and STEM, the most influenced researcher of TPACK, the policy relating TPACK. Indonesia itself contributed 127 documents related to TPACK in the last five years from 2075 documents. All the top ten are teacher-producing universities. It was noted that the authors such as Paidi, Astuti, Pradana, Riandi, Sinaga, and Widoretno were the most productive in this topic from Indonesia.

This study has several limitations as a standard limitation of conducting bibliometric analysis: i) A scholar may produce several units of scientific output (books, journals), but this small work may become seminal for a particular field and significantly impact the scholarship of a discipline. Standard metrics, such as h-index, will have difficulty accounting for such situations; ii) Large research teams across multiple disciplines can produce dozens or hundreds of research papers, each with tens or hundreds of authors. These team members will often exhibit very high impact metrics that may not accurately reflect their advantage on the pitch. This limitation is also related to previous studies, namely [48]-[51]. Therefore, researchers gave three recommendations for future research: i) the following 46 researchers should take into account to two limitations above; ii) It is suggested to compare data from the Web of Science and Scopus in researching TPACK; and iii) It is essential to research on the broader coverage year. For example, research on TPACK in 2011-2020, research on TPACK in 2020-2024, and the prediction of research on TPACK in the future. However, the results of this study can contribute to enriching the treasure trove of special knowledge related to the literature on TPACK.

## 6. CONCLUSION

Some significant points have been attained on the research trends on TPACK during the period from 2015 to 2019. The number of documents of TPACK across the year was increased, which were dominated by articles in the journal. Considering the countries of origin, it was clear that the dominance of the USA. The number of documents of TPACK across institution indicated the dominance of institution from Singapore. Meanwhile, Indonesia put their two representative's institutions: Universitas Sebelas Maret and Universitas Pendidikan Indonesia, among the big 10 institutions in the world that contributed to researching on TPACK. Taiwan and the USA have also contributed the most productive authors of TPACK. Journal of Physics Conference was a leading conference series that contains articles about TPACK. Meanwhile, Computer and Education-Elsevier were the leading journals covering TPACK in this topic. Regarding the visualization of research trend on TPACK resulted in four major clusters: i) TPACK as a system; ii) TPACK in relating to its scale; iii) TPACK in connecting with quantitative parameters; iv) TPACK under beliefs, intention, and technology acceptance.

Indonesia contributed 127 documents related to TPACK in the last five years from a total of 2075 documents. All these documents most resulted from universities that are teacher producing universities and public universities in Indonesia. It was no different rank from the world in terms of TPACK from Indonesia (2015-2019) across source titles. This research can help related researchers recognize the trend of TPACK research in the world and give directions for further research. Future researchers should pay attention to the three recommendations outlined in the discussion section to overcome the limitations of this study.

## ACKNOWLEDGEMENTS

This research was supported by FMIPA Universitas Negeri Surabaya through the policy research grant (*Penelitian Kebijakan*) in 2020 during the COVID-19 pandemic.

## REFERENCES

- [1] D. Lase, "Education and Industrial Revolution 4.0," *Jurnal Handayani*, vol. 10, no. 1, pp. 48-62, 2019.
- [2] T. Hartati, D. Heryanto, N. Annisa, R. Nuriyanti, A. H. Saputra, and R. Sutedi "Technological Pedagogical Content Knowledge (TPACK) in the context of improving the quality of learning for pre-service PPG elementary school students," *EDUTECH*, vol. 18, no. 2, pp. 174-181, 2019, doi: 10.17509/e.v18i2.15092.

- [3] G. Finger, R. Jamieson-Proctor, and P. Albion, "Beyond Pedagogical Content Knowledge: The Importance of TPACK for Informing Preservice Teacher Education in Australia," in N. Reynolds and M. Turcsányi-Szabó, eds., *Key Competencies in the Knowledge Society. KCKS 2010. IFIP Advances in Information and Communication Technology*, vol. 324. Springer, Berlin, Heidelberg, 2010, pp. 114-125.
- [4] H. Chen and Y. S. Ho, "Highly Cited Articles in Biomass Research: A Bibliometric Analysis," *Renewable and Sustainable Energy Reviews*, vol. 49, pp. 12-20, 2015.
- [5] W. T. Chiu and Y. S. Ho, "Bibliometric Analysis of Tsunami Research," *Scientometrics*, vol. 73, pp. 3-17, 2007.
- [6] L. Yang, T. Sun, and Y. Liu "A Bibliometric Investigation of Flipped Classroom Research During 2000-2015," *International Journal of Emerging Technologies in Learning*, vol. 12, no. 6, pp. 178-186, 2017.
- [7] K. Y. Chuang, Y. Huang, and Y. Ho, "A Bibliometric and Citation Analysis of Stroke-Related Research in Taiwan," *Scientometrics*, vol. 72, pp. 201-212, 2007.
- [8] B. Dong, G. Xu, X. Luo, Y. Cai, and W. Gao, "A Bibliometric Analysis of Solar Power Research from 1991 to 2010," *Scientometrics*, vol. 93, pp. 1101-1117, 2012.
- [9] P. Mishra and M. J. Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," *Teachers College Record*, vol. 108, no. 6, pp. 1017-1054, 2006.
- [10] T. Shin, M. J. Koehler, P. Mishra, D. A. Schmidt, E. Baran, and A. D. Thompson, "Changing Technological Pedagogical Content Knowledge (TPACK) Through Course Experiences," in *Proc. Soc. Inform. Tech. Teach. Edu. Int. Conf.*, 2009, pp. 52-59.
- [11] M. J. Koehler and P. Mishra, "What is Technological Pedagogical Content Knowledge (TPACK)?" *Contemporary Issues in Technology and Teacher Education*, vol. 9, no. 1, pp. 60-70, 2009.
- [12] L. S. Shulman, "Those Who Understand: Knowledge Growth in Teaching," *Educational Researcher*, vol. 15, no. 2, pp. 4-31, 1986.
- [13] Y. F. Yeh, Y.-S. Hsu, H.-K. Wu, and S.-P. Chien, "Exploring the Structure of TPACK with Video-Embedded and Discipline-Focused Assessments," *Computers & Education*, vol. 104, pp. 49-64, 2017.
- [14] C. R. Graham, "Theoretical Considerations for Understanding Technological Pedagogical Content Knowledge (TPACK)," *Computers & Education*, vol. 57, no. 3, pp. 1953-1960, 2011.
- [15] A. Kulakli and V. Osmanaj, "Global Research on Big Data in Relation with Artificial Intelligence (A Bibliometric Study: 2008-2019)," *International Journal of Online and Biomedical Engineering*, vol. 16, no. 2, pp. 31-46, 2020.
- [16] S. Thanuskodi, "Journal of Social Sciences: A Bibliometric Study," *Journal of Social Science*, vol. 24, no. 2, pp. 77-80, 2010.
- [17] A. Pritchard, "Statistical Bibliography or Bibliometrics," *Journal of Documentation*, vol. 25, pp. 348-349, 1969.
- [18] M. E. Parra-González, A. Segura-Robles, M.-R. Vicente-Bújez, and J. López-Belmonte, "Production Analysis and Scientific Mapping on Active Methodologies in Web of Science," *International Journal of Emerging Technologies in Learning*, vol. 15, no. 20, pp. 71-86, 2020.
- [19] N. J. Van-Eck and L. Waltman, "VOSviewer Manual," CWTS Meaningful metrics, 2020. [Online]. Available: [https://www.vosviewer.com/documentation/Manual\\_VOSviewer\\_1.6.16.pdf](https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.16.pdf).
- [20] C. Angeli, et al., "A K-6 Computational Thinking Curriculum Framework: Implications for Teacher Knowledge," *Education Technology and Society*, vol. 19, no. 3, pp. 47-57, 2016.
- [21] S. Ghavifekr and W. A. W. Rosdy, "Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools," *International Journal of Research in Education and Science*, vol. 1, no. 2, pp. 175-191, 2015.
- [22] J. Gil-Flores, J. Rodríguez-Santero, and J. Torres-Gordillo, "Factors that Explain the Use of ICT in Secondary-Education Classrooms: The Role of Teacher Characteristics and School Infrastructure," *Computer in Human Behaviour*, vol. 68, pp. 441-449, 2017.
- [23] C. Kim, D. Kim, J. Yuan, R. B. Hill, P. Doshi, and C. N. Thai, "Robotics to Promote Elementary Education Pre-Service Teachers' STEM Engagement, Learning, and Teaching," *Computer & Education*, vol. 91, pp. 14-31, 2015.
- [24] D. A. Schmidt, E. Baran, A. D. Thompson, P. Mishra, M. J. Koehler, and T. S. Shin, "Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers," *Journal of Research on Technology in Education*, vol. 42, no. 2, pp. 123-149, 2009.
- [25] J. Harris, P. Mishra, and M. Koehler, "Teachers' technological pedagogical content knowledge and Learning Activity Types: Curriculum-Based Technology Integration Refrained," *Journal of Research on Technology in Education*, vol. 41, no. 4, pp. 393-416, 2009.
- [26] J. Voogt, P. Fisser, N.N.P. Roblin, J. Tondeur, and J. van Braak, "Technological Pedagogical Content Knowledge - A Review of the Literature," *Journal of Computer Assisted Learning*, vol. 29, no. 2, pp. 109-121, 2013.
- [27] J. Tondeur, et al., "Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence," *Computer & Education*, vol. 59, no. 1, pp. 134-144, 2012.
- [28] T. Valtonen, et al., "The impact of authentic learning experiences with ICT on pre-service teachers' intentions to use ICT for teaching and learning," *Computer & Education*, vol. 81, pp. 49-58, 2015.
- [29] C. S. Chai, "Teacher Professional Development for Science, Technology, Engineering and Mathematics (STEM) Education: A Review from the Perspectives of Technological Pedagogical Content Knowledge (TPACK)," *The Asia-Pacific Education Researcher*, vol. 28, pp. 5-13, 2019.
- [30] J. Castéra, et al., "Self-reported TPACK of teacher educators across six countries in Asia and Europe," *Education and Information Technologies*, vol. 25, pp. 3003-3019, 2020.
- [31] L. L. Taopan, N. A. Drajadi, and Sumardi "Discovering the teacher's beliefs in TPACK framework for teaching English in high school," *Indonesian Journal of Informatics Education*, vol. 3, no. 1, pp. 1-11, 2019.

- [32] A. Lehtinen, P. Nieminen, and J. Viiri, "Preservice Teachers' TPACK Beliefs and Attitudes Toward Simulations," *Contemporary Issues in Technology and Teacher Education*, vol. 16, no. 2, pp. 151-171, 2016.
- [33] H. Setiawan, S. Phillipson, Sudarmin, and W. Isnaeni, "Current trends in TPACK Research in Science Education: A systematic review of literature from 2011 to 2017," *Journal of Physics Conference Series*, vol. 1317, 2019.
- [34] P. Nuangchalerm, "TPACK in ASEAN perspectives: Case study on Thai pre-service teacher," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 4, pp. 993-999, 2020.
- [35] Z. Arifin, M. Nurtanto, W. Warju, R. Rabiman, and N. Kholifah "The TAWOCK conceptual model at content knowledge for professional teaching in vocational education," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 3, pp. 697-703, 2020.
- [36] L. Irmitya and S. Atun, "The Influence of Technological Pedagogical and Content Knowledge (TPACK) Approach on Science Literacy and Social Skills," *Journal of Turkish Science Education*, vol. 15, no. 3, pp. 27-40, 2018.
- [37] T. Kartal and Ö. Afacan, "Examining Turkish Pre-service Science Teachers' Technological Pedagogical Content Knowledge (TPACK) Based on Demographic Variables," *Journal of Turkish Science Education*, vol. 14, no. 1, pp. 1-22, 2017.
- [38] T. Valtonen, *et al.*, "Fresh perspectives on TPACK: Pre-service teachers' own appraisal of their challenging and confident TPACK areas," *Education and Information Technologies*, vol. 25, pp. 2823-2842, 2020.
- [39] S. Seufert, Josef Guggemos, and M. Sailer, "Technology-related knowledge, skills, and attitudes of pre- and in-service teachers: The current situation and emerging trends," *Computers in Human Behavior*, vol. 115, 2021.
- [40] H. Gur and A. Karamete, "A Short Review of TPACK for Teacher Education," *Educational Research and Review*, vol. 10, no. 7, pp. 777-789, 2015.
- [41] J. J. Tseng, C. S. Chai, L. Tan, and M. Park, "A critical review of research on technological pedagogical and content knowledge (TPACK) in language teaching," *Computer Assisted Language Learning*, 2020, doi: 10.1080/09588221.2020.1868531.
- [42] N. Suprpto, *et al.*, "A systematic review of photovoice as participatory action research strategies," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 3, pp. 675-683, 2020.
- [43] A. P. Sasmito, D. Kustono, P. Purnomo, and H. Elmunsyah "Conceptual model for improving quality of teacher in Indonesian vocational school," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 1, pp. 39-44, 2020.
- [44] W. Sumarni, Z. Faizah, B. Subali, W. Wiyanto, and E. Ellianawati "The urgency of religious and cultural science in STEM education: A meta data analysis," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 4, pp. 1045-1054, 2020.
- [45] A. E. Kesici, D. Güvercin, and H. Küçükakça, "Metacognition researches in Turkey, Japan and Singapore," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, pp. 535-544, 2021.
- [46] L. Li, F. Huang, S. Chen, L. Pan, W. Zeng, and X. Wu, "Exploring the curriculum development in content and language integrated learning: A systematic review," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 9, no. 4, pp. 1102-1113, 2020.
- [47] R. Soler-Costa, A. Moreno-Guerrero, J. López-Belmonte, and J. Marín-Marín "Co-Word Analysis and Academic Performance of the Term TPACK in Web of Science," *Sustainability*, vol. 13, no. 3, p. 1481, 2021.
- [48] R. M. Yilmaz, F. B. Topu, and A. T. Tulgar, "An examination of the studies on foreign language teaching in pre-school education: A bibliometric mapping analysis," *Computer Assisted Language Learning*, 2019.
- [49] A. K. Shukla, M. Janmajaya, A. Abraham, and P. K. Muhuria, "Engineering applications of artificial intelligence: A bibliometric analysis of 30 years (1988–2018)," *Engineering Applications of Artificial Intelligence*, vol. 85, pp. 517-532, 2019.
- [50] F. Aricia, P. Yildirima, Ş. Caliklar, and R. M. Yilmaz, "Research Trends in the Use of Augmented Reality in Science Education: Content and Bibliometric Mapping Analysis," *Computers & Education*, vol. 142, 2019.
- [51] M. Pinto, R. Fernández-Pascual, D. Caballero-Mariscal, and D. Sales, "Information Literacy Trends in Higher Education (2006–2019): Visualizing the emerging field of mobile information literacy," *Scientometrics*, vol. 124, pp. 479-1510, 2020.

# Research trend on TPACK through bibliometric analysis

## ORIGINALITY REPORT

13%

SIMILARITY INDEX

8%

INTERNET SOURCES

11%

PUBLICATIONS

3%

STUDENT PAPERS

## PRIMARY SOURCES

|   |  |     |
|---|--|-----|
| 1 | <a href="http://knepublishing.com">knepublishing.com</a><br>Internet Source  | 1%  |
| 2 | <a href="http://ore.exeter.ac.uk">ore.exeter.ac.uk</a><br>Internet Source  | 1%  |
| 3 | <a href="http://www.scp.nl">www.scp.nl</a><br>Internet Source  | 1%  |
| 4 | Li, J.. "Trends in research on global climate change: A Science Citation Index Expanded-based analysis", <i>Global and Planetary Change</i> , 201105<br>Publication              | 1%  |
| 5 | L Fitriasari, A M Abadi. "A survey on the perception of students against technology in learning mathematics", <i>Journal of Physics: Conference Series</i> , 2019<br>Publication | <1% |
| 6 | Submitted to University of Glamorgan<br>Student Paper  | <1% |
| 7 | Jie Hu, Yuwei Ma, Liang Zhang, Fuxing Gan, Yuh-Shan Ho. "A historical review and   | <1% |

bibliometric analysis of research on lead in drinking water field from 1991 to 2007",  
Science of The Total Environment, 2010

Publication

8

[open.metu.edu.tr](http://open.metu.edu.tr)

Internet Source

<1 %

9

Submitted to Coventry University

Student Paper

<1 %

10

[ease2016tokyo.theease.org](http://ease2016tokyo.theease.org)

Internet Source

<1 %

11

N Suprpto, W Nandyansah. "PicsAR: A Physics Visualisation to Enhance Students' Thinking Skills in Abstract Concepts", Journal of Physics: Conference Series, 2021

Publication

<1 %

12

Srđan Bojović, Rada Matić, Zorica Popović, Miroslava Smiljanić, Milena Stefanović, Vera Vidaković. "An overview of forestry journals in the period 2006–2010 as basis for ascertaining research trends", Scientometrics, 2013

Publication

<1 %

13

Submitted to University of Western Sydney

Student Paper

<1 %

14

[www.journalfkipunipa.org](http://www.journalfkipunipa.org)

Internet Source

<1 %

|    |  |      |
|----|--|------|
| 15 | Noor Amirudin, Mohammad Ahyan Yusuf Sya'bani, Triyo Supriyatno, Samsul Susilawati. "Strengthening the Existence of Islamic Education in the Industrial Revolution Era 4.0", Asian Journal of Applied Sciences, 2020<br>Publication | <1 % |
| 16 | Submitted to Universitas Negeri Jakarta<br>Student Paper   | <1 % |
| 17 | <a href="http://data.editlib.org">data.editlib.org</a><br>Internet Source  | <1 % |
| 18 | <a href="http://ijphs.iaescore.com">ijphs.iaescore.com</a><br>Internet Source  | <1 % |
| 19 | <a href="http://eprints.lancs.ac.uk">eprints.lancs.ac.uk</a><br>Internet Source  | <1 % |
| 20 | <a href="http://lib.euser.org">lib.euser.org</a><br>Internet Source  | <1 % |
| 21 | Atik Kulakli. "chapter 2 Integration of Data Mining and Business Intelligence in Big Data Analytics", IGI Global, 2021<br>Publication  | <1 % |
| 22 | Norliza Kushairi, Aidi Ahmi. "Flipped classroom in the second decade of the Millenia: a Bibliometrics analysis with Lotka's law", Education and Information Technologies, 2021<br>Publication                                      | <1 % |

23

Su-Ru Chen, Wen-Ta Chiu, Y.S. Ho. "Asthma in children: mapping the literature by bibliometric analysis", *Revue Française d'Allergologie et d'Immunologie Clinique*, 2005

Publication

<1 %

24

Tat-Dat Bui, Feng Ming Tsai, Ming-Lang Tseng, Raymond R. Tan, Krista Danielle S Yu, Ming K. Lim. "Sustainable supply chain management towards disruption and organizational ambidexterity: a data driven analysis", *Sustainable Production and Consumption*, 2020

Publication

<1 %

25

[acce.edu.au](http://acce.edu.au)

Internet Source

<1 %

26

[erepo.uef.fi](http://erepo.uef.fi)

Internet Source

<1 %

27

[jyx.jyu.fi](http://jyx.jyu.fi)

Internet Source

<1 %

28

"HCI International 2021 - Posters", Springer Science and Business Media LLC, 2021

Publication

<1 %

29

Agariadne Dwinggo Samala, Ika Parma Dewi, Lativa Mursyida. "'E-LabSheet Project" 4Cs-Based Supplementary Media for Flexible Learning: Is it Well Implemented?",

<1 %



# International Journal of Online and Biomedical Engineering (iJOE), 2023

Publication

30

Qiang Wang, Rongrong Li, Gang He. "Research status of nuclear power: A review", *Renewable and Sustainable Energy Reviews*, 2018

Publication

<1 %

31

[www.constructionism2018.fsf.vu.it](http://www.constructionism2018.fsf.vu.it)

Internet Source

<1 %

32

[www.yumpu.com](http://www.yumpu.com)

Internet Source

<1 %

33

Hatice Sancar Tokmak. "Pre-service teachers' perceptions on TPACK development after designing educational games", *Asia-Pacific Journal of Teacher Education*, 2014

Publication

<1 %

34

IFIP Advances in Information and Communication Technology, 2010.

Publication

<1 %

35

Maryam Mustika, Sapriya. "The readiness of social studies teacher in e-learning based", *Proceedings of the 10th International Conference on E-Education, E-Business, E-Management and E-Learning - IC4E '19*, 2019

Publication

<1 %

36

Turgut Yıldız. "A comparison of pre-service, in-service and formation program for teachers

<1 %

perceptions of technological pedagogical content knowledge (TPACK) in English language teaching (ELT)", Educational Research and Reviews, 2017

Publication

37

Yi Jin, Denise Schmidt-Crawford. "Preservice teacher cluster memberships in an edtech course: A study of their TPACK development", Computers and Education Open, 2022

Publication

<1 %

38

[acec2012.acce.edu.au](http://acec2012.acce.edu.au)

Internet Source

<1 %

39

[ar.scribd.com](http://ar.scribd.com)

Internet Source

<1 %

40

[download.garuda.kemdikbud.go.id](http://download.garuda.kemdikbud.go.id)

Internet Source

<1 %

41

[mlsb.asia.edu.tw](http://mlsb.asia.edu.tw)

Internet Source

<1 %

42

[scholarworks.uttyler.edu](http://scholarworks.uttyler.edu)

Internet Source

<1 %

43

[www.elixirpublishers.com](http://www.elixirpublishers.com)

Internet Source

<1 %

44

[www.igi-global.com](http://www.igi-global.com)

Internet Source

<1 %

45

Ayla Cetin-Dindar, Yezdan Boz, Demet Yildiran Sonmez, Nilgun Demirci Celep. "Development

<1 %

of pre-service chemistry teachers' technological pedagogical content knowledge", Chemistry Education Research and Practice, 2018

Publication

---

46

Ching-Yi Chang, De-Chih Lee, Kai-Yu Tang, Gwo-Jen Hwang. "Effect sizes and research directions of peer assessments: From an integrated perspective of meta-analysis and co-citation network", Computers & Education, 2021

Publication

---

<1 %

47

[scholarcommons.sc.edu](https://scholarcommons.sc.edu)

Internet Source

---

<1 %

Exclude quotes Off

Exclude matches Off

Exclude bibliography On