State-of-the-art in teachers' online pedagogical competencies in higher education from 2011 to 2022

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ABSTRACT

University teachers play an important role in teaching and learning activities in the online environment. However, the emerging remote education due to the COVID-19 pandemic has revealed the shortcomings of online teaching competencies of teachers. The bibliometric study investigated the knowledge base of online teacher pedagogical competencies in higher education by analyzing 131 Web of Science-indexed documents from 2011 to 2022. The findings revealed the sudden decline of the number announced in the two years 2021 and 2022. Spain, Russia, the United States, and Canada are emerging countries in the network of international collaboration. The research community is based on small research groups and has emerged in recent years. Sources focus on subjects such as education, e-learning, computer science, developmental and educational psychology, among which education sciences is the most prominent one in the last years. With nine identified themes, these of interest are online teacher roles, remote emergency teaching, online professional development, and online teaching in COVID-19. Emerging keywords highlighted potential topics in the foreseeable future such as competency frameworks, global education, and teaching professionalism.

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1. INTRODUCTION

Technological innovation leads to the formation of forms of learning. At the university level, slide projectors and television-based classes have been in use since the 1950s. Students at the University of Illinois, United States, learnt by computer terminals within their local network [1]. The first online course was held by the University of Toronto in 1984. In the 1990s, one of the first universities in the world to launch online distance learning was the Open University in Britain [2]. In addition to the technological factor, there is an important factor driving the spread of online learning around the world; It is the COVID-19 pandemic. On the one hand, it promotes the popularity of this form of learning as an emergency remote mode, on the other it also reveals many challenges in the online teaching process [3], [4].

The lack of faculty competency effects online teaching and learning activities. In Malaysia, teachers and students are in separate locations that challenge the teacher to facilitate collaborative learning [5]. The results suggest that teachers must be trained in communication skills to help their students achieve their online learning goals. According to the in-service teachers at the Fiji National University [6], inadequate

technological skills are one of the main challenges of online learning and teaching during the second phase of the COVID-19 pandemic. Improving this could help improve students' technical skills and up-skilling higher education staff and systems. A study [7] investigated the relationship between digital competencies and teacher experience in e-learning, e.g., the choice of e-learning environment, using e-resources, forms of e-assessment. Inexperienced teachers could affect the quality e-learning provides for students.

So far, online pedagogy has not had a clear definition. Researchers approach this concept in many different ways. For example: i) see online pedagogy as the pedagogy of online learning [8]; ii) teaching methods using digital information and communication technology for digital learning activities [9]; iii) or teaching and learning strategies developed in online environments or a combination of traditional and online learning environments [10].

With regard to this subject, there are three terms mentioned in previous studies, i.e., e-pedagogy [8], online pedagogy [11], digital pedagogy, and they can be used alternately. In recent years, many papers have studied online teaching of teachers and proposed online pedagogical competencies for teachers in different approaches. In a model approach, the European Commission [12] proposed a digital competence framework for educators consisting of three component competency groups: educators' professional competencies, educators' pedagogical competencies, and learners' competencies. The educational pedagogical competencies of educators consist of four pedagogical competition groups, including i) digital resources (related to digital educational resources for teaching); ii) teaching and learning (enhance teaching and learning strategies by using digital technologies); iii) assessment (create or/and improve existing assessment strategies); and iv) empower learners (to facilitate active engagement). A professional digital competency framework was proposed for Norway teachers [13]. Pedagogy and subject didactics are one of the eight competence groups of this framework. Teachers must have digital skills to develop the content of the subjects, integrate digital resources into learning processes, and improve the digital skills of their learners. Falloon [14] proposed the teacher digital competency framework which combined the technological pedagogical content knowledge (TPACK) model and three dimensions in Janssen *et al.* [15], namely teacher digital competency, personal-ethical competency, and personal-professional competencies.

In a teacher role approach, Goodyear *et al.* [16] identified eight roles of teachers in an online teaching environment, namely process facilitator, adviser/counselor, assessor, researcher, content facilitator, technologist, designer, and manager/administrator. In each of the different roles, the proposed faculty must have the corresponding component competencies. For example, as an assessor, teachers must have the skills to i) use online techniques to assess learning outcomes and processes; ii) ensure the authenticity of student work; iii) appreciate ethical issues; and iv) distribute grades and scores according to legal statutes. In a more detailed approach, many studies identify specific competencies for each teaching activity in an online learning environment. For example, Kordrostami and Seitz [17] concerned the interactions between teachers and students. Dabbagh [18] identified scaffolding as a key competence of pioneers in online teaching. Lastly, Ng *et al.* [19] proposed AI digital competencies and 21st century skills for teachers in the post-pandemic context.

Despite the growing popularity of online learning, along with the growing interest in the online pedagogical capabilities of university faculty, so far there has been no comprehensive study on the subject. To fill this research gap, we conducted this study to explore research trends, themes, and potential research directions in the field of teachers' online pedagogical competencies in higher education (TOPCHE). This purpose is specified in the five research questions:
-    What are the trends in TOPCHE? Which country is the most relevant?
-    What are the characteristics of the research community in TOPCHE? Who are the leading scholars?
-    Which sources are the most important in TOPCHE in recent years?
-    What are the research themes in TOPCHE?
-    What are the emerging topics in TOPCHE?

2.   METHOD

Bibliometrics is a methodology based on bibliographic information of the publication [20]. This approach is in line with research that explores fields and has been carried out on various topics in higher education, for example, higher tourism education and curriculum [21], academic engagement [22], [23]. So, we chose bibliometrics to conduct this research.

We chose the Web of Science as the source of data for this research. There are three reasons for this: i) the Web of Science is a popular and reputable database in the scientific research community; ii) the data are systematically organized and suitable for directory analysis applications, e.g., VOSviewer, Microsoft Excel; and iii) it is used in many publications in the field of science in higher education, for example, projection of e-learning in higher learning [24], artificial intelligence in higher education [25].

The data collection process is based on the PRISMA guidelines, preferred reporting items for systematic reviews and meta-analyses [26]. The guidelines was recommended to gather eligibility data for bibliometric research [20], [22], [23]. The step-by-step process is described in Table 1. In the initial phase, based on the scope of the study topic, we defined keywords/keyword phrases as search criteria. The documentation of the study subject must simultaneously ensure four conditions relating to competence/skills, teacher, higher education level, online pedagogy in which the conditions are simultaneously linked by the AND operator, the thesaurus/similar keywords connected by the OR operator. Search criteria by title, abstract, and keyword information fields of Web of Science-indexed documents. The initial dataset yielded 1,696 records. In the screening phase, the initial dataset was narrowed by published year, document types, Web of Science category, and language. The screening dataset consists of 937 relevant records. In the eligibility phase, we check the title and abstract of each record to determine the suitability of the document. At the same time, we identify research papers in the context of COVID-19 by labelling them as 'COVID19 context', and vice versa, non-COVID-19 papers are labelled as 'non-COVID-19 contexts.' The final data set had 131 eligibility records to perform bibliometric analysis in which the first article in this field was [27].

Table 1. Data gathering process

Step	Description	Query	Records
1	Search initial dataset related to university teachers' pedagogical competencies in online learning	TS=((teacher* AND (universit* OR college OR "higher education") AND ("online learning" OR "online teaching" OR "online pedagog*" OR "online educat*" OR "digital learning" OR "digital teaching" OR "digital pedagog*" OR "digital educat*" OR "e-learning" OR "e-teaching" OR "e-pedagog*") AND (competenc* OR skill*)))	1,696
2	Exclude criteria: Published year: 2023	and 2023 (Exclude – Publication Years)	1,603
3	Inclusion criteria: Article, Proceeding Paper	and Article or Proceeding Paper (Document types)	1,567
4	Exclude criteria: Early access, retracted publication	and Early Access or Retracted Publication (Exclude – Document Types)	1,538
5	Inclusion criteria: Education Educational Research	and Education Educational Research (Web of Science Categories)	1,041
6	Inclusion criteria (Language): English	and English (Languages)	937
7	Eligibility	- Review eligibility content of each document - Labelled: COVID-19 context	131

Note: The string query was searched on Jun 29 2023, 14:45:13 GMT+0700 (Indochina time)

We use VOSviewer software and Microsoft Excel to highlight relevant objects and their patterns in the bibliometric networks. The objects to present were authors, sources, documents, and keywords. The relevant objects were investigated by the number of documents and/or number of citations. Patterns of objects were visualized by bibliometric analysis.

The analysis methods were used according to the research questions. First, we statistically estimated the number of publications that were published annually to determine the publication trend of the field as shown in Figure 1. Co-author analysis was applied to identify cooperation networks by country as shown in Figure 2. Second, relevant authors were determined based on statistical analysis of the number of documents and citations as shown in Table 2. The author collaboration network was visualized by co-author analysis as shown in Figure 3. Third, relevant sources were identified by bibliography coupling analysis with overlay visualization as shown in Figure 4. Forth, the top 10 relevant documents were listed by citation index and themes were clustered by bibliography coupling analysis as shown in Figure 5. Lastly, the popular topics were shown by the frequency of author keywords. Co-word analysis was applied to depict emerging topics and highlight research topics in the COVID-19 context as shown in Figure 6.

3. RESULTS

3.1. The TOPCHE trends from 2011 to 2022

The TOPCHE data set included 131 Web of Science-indexed documents. The articles were published between 2011 and 2022, with three published in 2011, including one article [27] and two conference papers [28], [29]. Figure 1 depicts the annual publication of the TOPCHE research area from 2011 to 2022. The data suggested that the number of annual publications could divide the field into two phases. The first phase is from 2011 to 2020 in which the number of annual publications does not exceed 10 documents per year. A total of 60 documents (corresponding to 45.80% of the total) were published during 10 years, with an average number of documents published annually of 6 documents per year. The second phase from 2021 to 2022 in which the number of published annually is more than 30 documents per year. The total documentation published over 2 years was 71 documents (33 documents in 2021, 38 documents

in 2022), representing 54.20% of the total. In the context of the study, the total number of documents related to the background of COVID-19 was 47, representing 37.40% of the total. On the contrary, there are 84 documents that are not related to the background of COVID-19, accounting for 62.60% of the total.

In the TOPCHE knowledge base, there were 52 countries that have published at least one document. The top 10 countries sorted by number of documents and number of citations were listed in Table 2. According to the number of documents, Spain (19 documents) was the most published country in TOPCHE between 20011 and 2022, followed by Russia (17), Ukraine (9), China (9), Romania (8), England (8). According to the number of citations, the US was the most cited country in this field with 245 citations, followed by Canada (227), Spain (124), China (76), and Ukraine (57). There were eight countries on both sides of Table 2, such as the US, Spain, China, Ukraine, Australia, England, Russia and Finland.

Figure 2 visualizes the collaboration of 52 countries of TOPCHE from 2011 to 2022 that was rendered by co-author analysis. According to Figure 2, there were 26 independent countries, none with links to others. (e.g., Romania, Italy, Thailand, Turkey, Slovenia). In the center, there was a cluster of 24 countries that work together, highlighting Spain, Russia, England, Australia, Peoples R China. Besides, there were two cooperating countries on the left of Figure 2 that are Malaysia and the UAE. Based on the color of nodes in Figure 2, the countries with long study periods are Romania (from 2011 to 2022), the US (2011-2022), and the emerging countries in this field were India (2021-2022) as presented in Table 2. As shown in Figure 2, most emerging nations appeared from 2020 onwards.

3.2. Characteristics of the research community in TOPCHE from 2011 to 2022

Table 3 listed the top 10 TOPCHE authors between 2011 and 2022 based on the number of documents and the number of citations. The most productive author was Sangra (Open University of Catalonia, Spain) with three documents. There were five authors who had two documents, i.e., Gonzalez-Sanmamed, Ricardo-Barreto, Badiozaman, Segar, Rodriguez. Others just had one document, i.e., Baran, Correia, Thompson, Selles. In terms of the number of citations, the group of three authors (Baran, Correia, Thompson) had the most cited documents (198 citations). Next were the groups of Gonzalez-Sanmamed, Selles, Carril (54 citations), the group of Kohnke, Moorhouse (40 citations), the group of Mcgee, Torres (35 citations). Four groups only had one document per each.
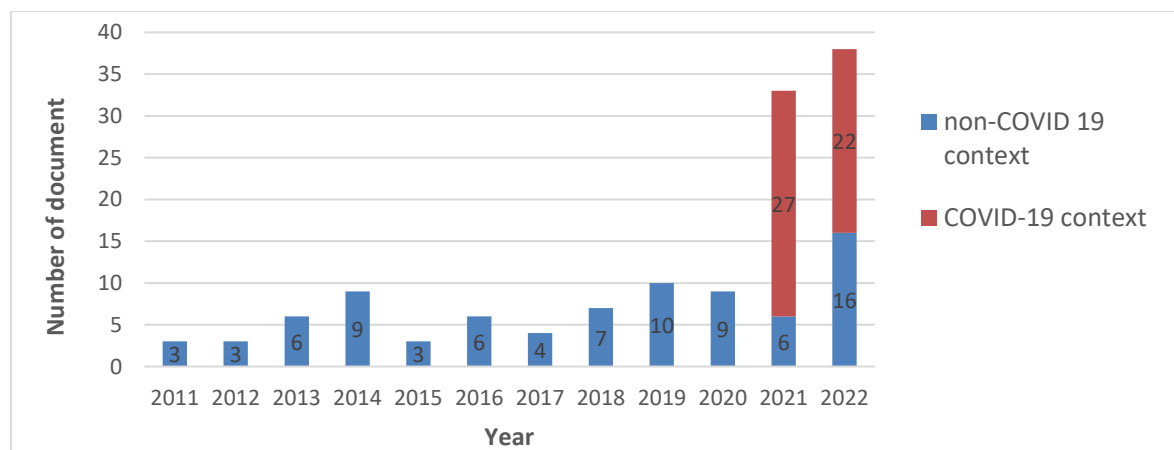

Figure 1. Annual publication of TOPCHE from 2011 to 2022

Table 2. Top 10 countries of TOPCHE from 2011 to 2022 sorted by documents and citations

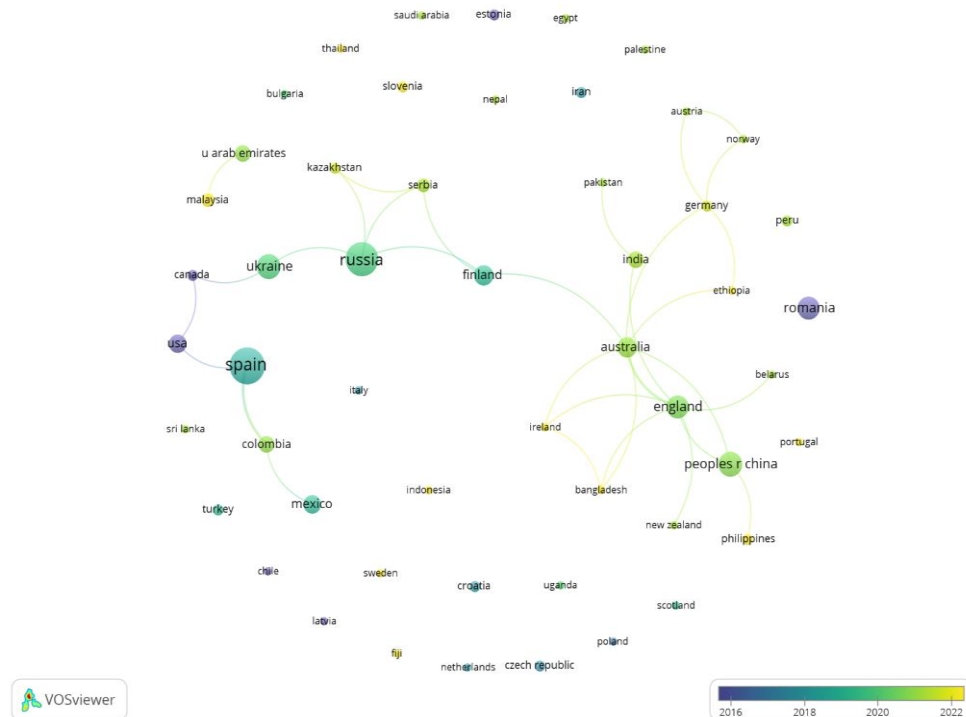| No	Country	Documents	Year	No	Country	Citations	Year
1	Spain	19	2013-2022	1	US	245	2011-2021
2	Russia	17	2014-2022	2	Canada	227	2011-2018
3	Ukraine	9	2017-2022	3	Spain	124	2013-2022
4	China	9	2013-2022	4	China	76	2013-2022
5	Romania	8	2011-2021	5	Ukraine	57	2017-2022
6	England	8	2014-2022	6	Australia	54	2021-2022
7	Finland	6	2016-2022	7	England	49	2014-2022
8	Australia	6	2021-2022	8	Russia	47	2014-2022
9	Mexico	5	2012-2022	9	Finland	42	2016-2022
10	US	5	2011-2021	10	India	35	2021-2021

Figure 2. Countries' collaboration of TOPCHE from 2011 to 2022 (52 countries)

Table 3. Top 10 TOPCHE authors from 2011 to 2022 sorted by documents and citations

No	Author (Affiliation)	Documents	Years	No	Author (Affiliation)	Citations	Years
1	Sangra, Albert (Open University of Catalonia)	3	2014-2016	1	Baran, Evrim (University of British Columbia)	198	2011
2	Gonzalez-Sanmamed, Mercedes (Universidad de a Coruña)	3	2014-2014	2	Correia, Ana-Paula (Iowa State University)	198	2011
3	Ricardo-Barreto, Carmen (Universidad del Norte)	2	2020-2022	3	Thompson, Ann (Iowa State University)	198	2011
4	Badiozaman, Ida Fatimawati Adi (Swinburne University of Technology Sarawak Campus)	2	2022-2022	4	Gonzalez Sanmamed, Mercedes (University of a Coruña)	54	2013
5	Segar, Augustus Raymond (Swinburne University of Technology Sarawak Campus)	2	2022-2022	5	Hernandez Selles, Nuria (Centro Superior de Estudios La Salle)	54	2013
6	Palacios-Rodriguez, Antonio (Sevilla University)	2	2022-2022	6	Munoz Carril, Pablo Cesar (University of Santiago de Compostela)	54	2013
7	Baran, Evrim (University of British Columbia)	1	2011	7	Kohnke, Lucas (The Hong Kong Polytechnic University)	40	2021
8	Correia, Ana-Paula (Iowa State University)	1	2011	8	Moorhouse, Benjamin Luke (Hong Kong Baptist University)	40	2021
9	Thompson, Ann (Iowa State University)	1	2011	9	Mcgee, Patricia (The University of Texas at San Antonio)	35	2017
10	Hernandez Selles, Nuria (Centro Superior de Estudios La Salle)	1	2013	10	Torres, Maria (The University of Texas at San Antonio)	35	2017

Figure 3 represents the collaboration of 407 TOPCHE authors from 2011 to 2022 by co-author analysis. The research community is formed on the basis of small-scale research groups. The most active group was Zahrani (11 members) and Ricardo-Barreto (11), followed by Miguel (10), Haarala-Muhonen (9). There were 288 authors, 70.67% of the total, in small research groups (one to five members). According to the shadows of the circles, the majority of the research community (239 authors, 58.72% of the total) appeared in the two years 2021-2022, e.g., the group of Xue, the group of Ali, the group of Anton-Sancho. The top three most cited authors, Baran, Correia, Thompson as listed in Table 4, were three of the first members of the TOPCHE community.
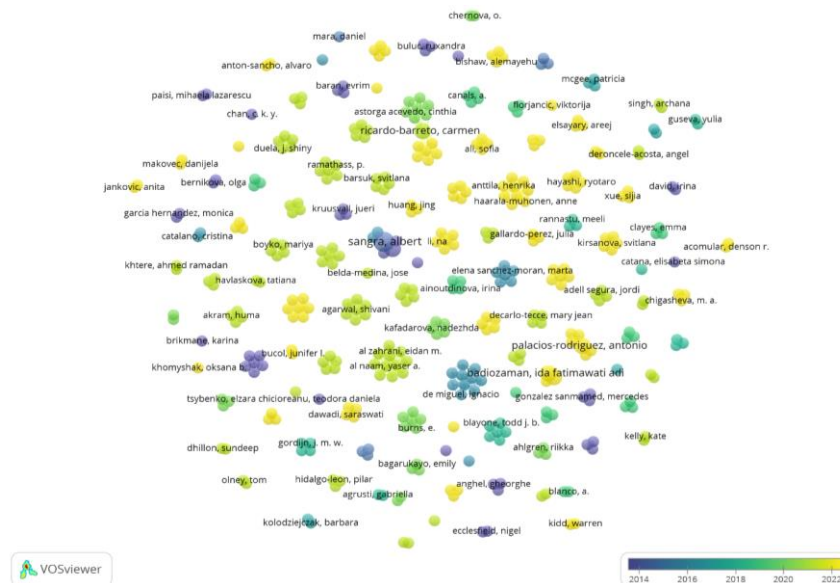
Figure 3. TOPCHE research community from 2011 to 2022 (407 authors)

Table 4. Top 10 TOPCHE sources from 2011 to 2022 sorted by documents and citations

No	Source	Documents	Years	No	Source	Citations	Years
1	Education Sciences	10	2021-2022	1	Distance Education	198	2011-2022
2	Obrazovanie I Nauka [Education and Science]	4	2020-2022	2	International Review of Research in Open and Distributed Learning	68	2013-2022
3	International Review of Research in Open and Distributed Learning	3	2013-2022	3	Education Sciences	57	202-2022
4	Journal of Information Technology Education: Research	3	2020-2022	4	Asia-Pacific Education Researcher	40	2021-2021
5	Frontiers in Education	3	2021-2022	5	Journal of Computing in Higher Education	35	2017
6	Education and Information Technologies	3	2022-2022	6	Journal of Information Technology Education: Research	31	2020-2022
7	Australasian Journal of Educational Technology	3	2019-2022	7	Frontiers in Education	29	2021-2022
8	Edulearn18: 10th International Conference on Education and New Learning	3	2018-2018	8	Technology Pedagogy and Education	29	2018-2018
9	Journal of Applied Research in Higher Education	2	2021-2022	9	BMC Medical Education	27	2021-2021
10	Information Technologies and Learning Tools	2	2022-2022	10	Instructional Science	26	2012-2012

3.3. The most important sources in TOPCHE in recent years

There were 98 sources in the TOPCHE knowledge base from 2011 to 2022, and the top 10 sources based on the number of documents and citations are detailed in Table 4. The most relevant source was Education Sciences which have published 10 TOPCHE documents. Next were Obrazovanie I Nauka (4 documents), International Review of Research in Open and Distributed Learning (3), Journal of Information Technology Education: Research (3). On the other hand, Distance Education was the most cited source (198 citations), following International Review of Research in Open and Distributed Learning (68), Education Sciences (57), Asia-Pacific Education Researcher (40). There were three sources appearing on the both sides of Table 5, i.e. Education Sciences, International Review of Research in Open and Distributed Learning, Journal of Information Technology Education: Research. These sources still published TOPCHE documents in 2022. In terms of TOPCHE sources' scope, the top 10 focused on five areas including Education, E-learning, Computer science, Developmental and Educational Psychology, Medicine as shown in Table 5.

Figure 4 visualized the relationship among the top 50 TOPCHE sources over time from 2011 to 2022, in which the link between the two was identified by bibliographic coupling analysis. According to the number of links to others, Education Sciences was the most connected source with 32 links and 88 total link strengths. Next were Frontiers in Education (27 links, 68 total links strength), Journal of Information Technology Education: Research (20, 38), Education and Information Technologies (20, 35), Journal of Applied Research in Higher Education (19, 40), Australasian Journal of Educational Technology (19, 37). They were the hubs of TOPCHE in recent years.

3.4. The emerging topics in TOPCHE from 2011 to 2022

Table 6 lists 20 relevant keywords in a total of 423 author keywords in the TOPCHE knowledge base from 2011 to 2022. E-learning was the most frequent one (27 times), the following were higher education (26), COVID-19 (20), online learning (18), online teaching (15), digital competency (13), ICT (10). Figure 6 depicts the topics of TOPCHE from 2011 to 2022 grouped by different contexts including COVID-19 context, non-COVID 19 context, and both. The yellow nodes represent the emerging keywords in the field. The research community was concerned with these contexts in a variety of approaches. Research issues related to COVID-19 directed to emergency remote education, for example, challenges and barriers (online teaching challenges, psychological barrier, technical barriers, causal factors), engagement (social/emotional engagement, students' engagement, behavioral engagement, cognitive engagement), mental health (mental health, mental wellbeing, digital resilience), technological applications (internet, information technology, network environment, digital learning ecology, new technology, asynchronous, technology adoption models), preparedness and readiness for online education (technology acceptance, readiness, student attitude, faculty preparedness), communication (student interaction, interactive classroom environment, synchronous computer-mediated communication, multimodal communication), learning organization (learning organizations, virtual learning strategies, online collaborative learning), effective learning, case study (Fiji, UAE, Sri Lanka), subjects (Mathematics education, Medical education, Chinese as a foreign language), teacher development (teacher development, continuing teacher education, initial training), teachers' digital skills/competencies (teacher digital competence, digital relational competence, self-directed learning, high order thinking skills, digital thinking, teacher presence).

On the other hand, the emerging TOPCHE keywords related to the context outside of COVID-19 were grouped by the following topics. They were the competency framework (competency framework, DigCompEdu framework), teachers' digital skills/competencies (teacher identify, intercultural competencies, teaching digital competencies, self-regulated learning, virtual classroom management, methodological competence, diversity-inclusive pedagogy, faculty competences), global education (global education, international education, digital higher education, university collaboration, sociocultural universities), digital educational technologies (digital learning technologies, educational technology, digitalization of education, digital learning tools, digital transformation, social media, the cutting-edge technology in teaching, digital educational environment, LMS), language learning (L2 learning, English for academic purposes, English as an international language, English teaching, Russian as a foreign language), humanities and special disciplines, teaching professionalism (teaching professionalism, lingo methodological training, university professors, language teacher professional development, in-service teachers). There were some emerging keywords linking to both contexts, i.e., digital competency, online learning, digital technology, digital teaching competence, online teaching competence, virtual learning environment, digitalization, Malaysia, social networks, learning technology.

Table 5. Top 10 TOPCHE documents sorted by number of citations from 2011 to 2022

| Theme	Node	Citations
Online teacher roles	Baran [27]	198
Online teacher roles	Munoz Carril [30]	54
Emergency remote teaching	Moorhouse [31]	40
Online teacher roles	Mcgee [32]	35
Online professional development	Al Zahrani [33]	27
Online professional development	Teräs [34]	26
Online professional development	Gonzalez [24]	26
Online teaching in COVID-19	Devkota [35]	21
Emergency remote teaching	Bakhov [36]	20
Online teaching competencies	Akram [37]	19
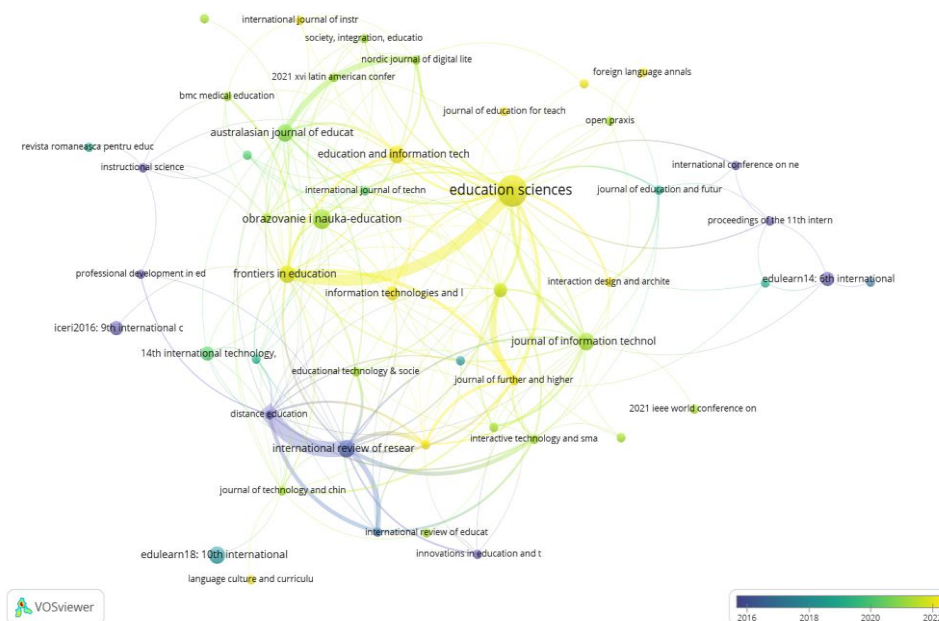
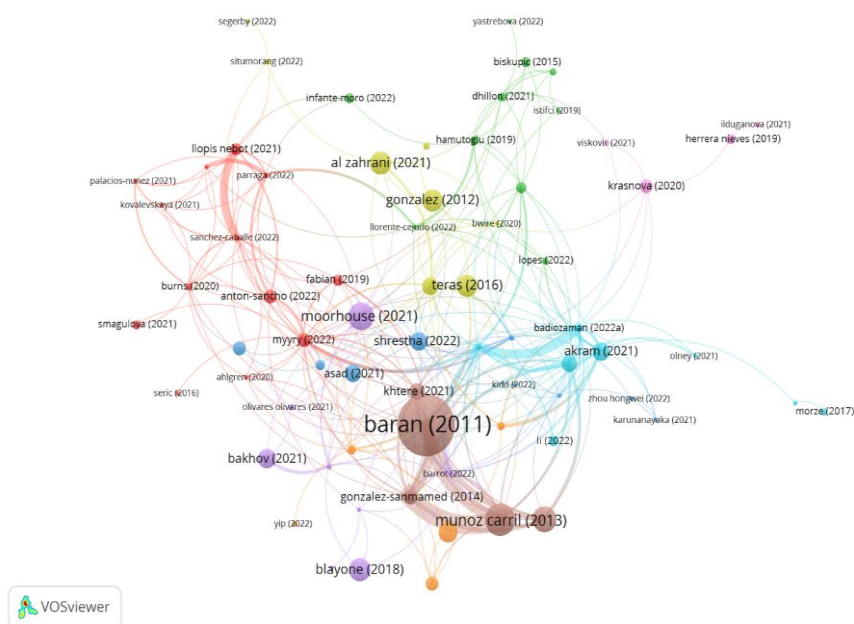Figure 4. Science mapping of 50 coupling sources related TOPCHE from 2011 to 2022

Figure 5. TOPCHE themes from 2011 to 2022 (70 documents, 9 clusters)

Table 6. Top 20 keywords of TOPCHE from 2011 to 2022

No	Keyword	Frequency	No	Keyword	Frequency
1	E-learning	27	11	Student	6
2	Higher education	26	12	Digital literacy	6
3	COVID-19	20	13	Distance learning	6
4	Online learning	18	14	Digital technology	5
5	Online teaching	15	15	Digital teaching competence	4
6	Digital competency	13	16	Educational innovation	4
7	ICT	10	17	Online Teaching and Learning	4
8	Professional development	9	18	Teacher training	4
9	Teacher	7	19	Assessment	4
10	Blended learning	7	20	Competency	4
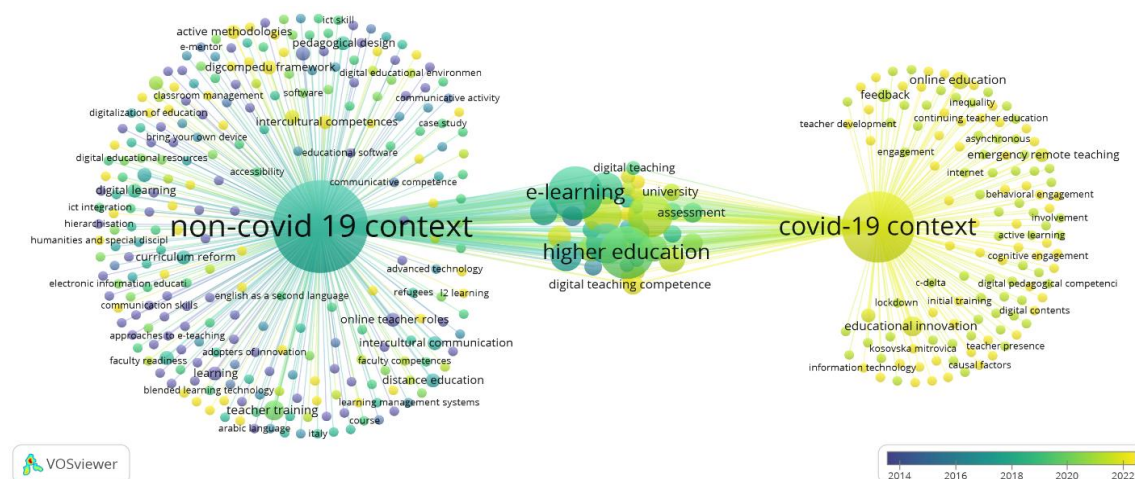
Figure 6. Science mapping of TOPCHE keywords grouped by context from 2011 to 2022 (423 author keywords)

4. DISCUSSION

The study used the quantitative methodology of the directory to analyze the 131 datasets published by TOPCHE in the period 2011-2022. Although the datasets are collected only from the Web of Science, the findings provide important information for TOPCHE. First, the COVID-19 pandemic boosts TOPCHE's announced growth trend. In the first 10 years (2011-2020), the annual publishing volume was no more than 10 papers. Two years later, the number of publications increased dramatically (more than 30 documents per year), most of which were related to the background of COVID-19. This phenomenon not only occurs in TOPCHE but also in many other research areas, e.g., economics and business [38], gender inequality [39], and mental health [40]. The COVID-19 triggered an emergency, a compulsory form of online learning as emergency remote education. Studies during this period mainly explored issues related to online teaching, e.g., using digital tools [41], teachers' digital competencies [42], experiences of online education [6].

Second, the announced growth of TOPCHE led to the emergence of new countries and improved international cooperation. For example, Australia, the most relevant emerging country, was the hub of the research community. However, not all emerging countries have research cooperation, many countries are studying TOPCHE-related issues in their own countries, for example, Thailand [43], Fiji [6], and Saudi Arabia [33]. On the other hand, traditional nations have tended to expand their network of cooperation in recent years, e.g., Spain, Russia, Finland. Despite the positive changes, the network of connections between nations is not tight.

Third, TOPCHE's research community has also been expanding in recent years. Generally speaking, communities are formed on the basis of small research groups. Additionally, to date, no scholar has considered TOPCHE as the main research direction, nor has any scholar played the role of connecting research groups to form the core research cluster of the TOPCHE field.

Fourth, education sciences was the emerging hub of TOPCHE in recent years. This source had more than one scope including education, computer science, developmental and educational psychology. In addition to the scope of the top 10 sources in TOPCHE as shown in Table 4, there are others that have not been mentioned due to few relevant publications. They are sociology and political science, engineering (educational technology and society), communication (technology, pedagogy and education), linguistics and language. (language, culture and curriculum; foreign language annals). These are the areas of research that have the potential to be exploited for this field of research.

Fifth, the TOPCHE research area has formed nine themes in which online teacher roles and online professional development are of the highest interest as shown in Table 5. There is a couple of reasons that might be relevant. First of all, the transition from traditional to online learning has changed the role of teachers in the educational model, from teacher-centered to students-centered. Besides, each role of teacher in online teaching requires the corresponding skills/competences. Goodyear et al. [16] proposed eight roles of teachers in online learning including content facilitator, technologist, designer, manager/administrator, process facilitator, adviser/counsellor, assessor, and researcher. For example, in the role of an assessor, teachers must be able to use online technologies to evaluate learning processes and outcomes, ensure accuracy in learners' activities, identify ethical issues, and score according to regulations. Finally, university teachers may encounter challenges in implementing online teaching methods due to a deficiency in

pedagogical skills and competencies, for example, ICT skills [44], communicative skills [45]. This partly explains the interest of the TOPCHE research community in these two topics.

Sixth, each emerging keyword suggests a potential research topic. However, the combination of these keywords across different contexts (COVID-19, non-COVID-19, and both) suggests a significant topic. New in the context of COVID-19 depicted issues related to online teaching from preparedness and readiness, challenger, and barriers for online education to learning organization. And the new topics not related to COVID-19 address global education issues such as international education, English as an international language. New cross-context topics can be seen as issues necessary to implement online teaching, e.g., digital skills/competence, digital educational technologies, teacher development, teaching, professionalism. Redesigning post-pandemic education and research strategies, based on a combination of the contents of emerging topics, can help higher education institutions achieve student learning outcomes and standards of educational quality [46].

Lastly, TOPCHE is now becoming a potential field of research with the acceleration of the COVID-19 pandemic. This factor has shaped the education service [47], the new normal in online education [48]. In addition, the educational technology and smart classroom market is projected to reach 232.9 billion in 2027 with a growth of 13.2% per year in the period 2022-2027 [49]. Therefore, this field of research will attract stakeholders in the adjustment, redesign of teaching activities, programs, training, nurturing, and management of educational activities in the context of post-COVID-19.

5.   CONCLUSION

Bibliometric research explored the TOPCHE knowledge base from 2011 to 2022. The findings showed a relatively stable trend for the 10 years between 2011 and 2022, and an increase in the fluctuation in 2021-2022. Of the 52 countries that are interested in TOPCHE, half of the independent research countries, Spain and Russia are the two countries with the most publications, and the United States and Canada are the most cited. In terms of the number of papers, the authors of the research community have not published much, the two most published authors (Sangra, Gonzalez-Sanmamed) have only three papers. In terms of publication sources, education sciences has the most publications, distance education has the highest number of citations. The sources focus on the areas of education, e-learning, computer science, developmental and educational psychology. The themes focus on nine areas, and the 10 most cited documents focus on online teacher roles, emergency remote teaching, online professional development, and online teaching in COVID-19. In terms of emerging keywords, topics in the context of COVID-19 are directly related to emerging remote teaching, e.g., online teaching challengers, digital relational competence, teacher presence, on the contrary, non-COVID-19 topics are concerned with TOPCHE's general issues, for example, competency framework, global education, and teaching professionalism. This study suggests that this is a new and potential field of research in the foreseeable future.

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