Mehmet Kemal Aydin
PhD, Assist. Prof. Dr.
Hitit University, Distance Education Application and Research Centre, Çorum, Turkey
ORCID ID 0000-0002-5611-5515
mehmetkemalaydin@hitit.edu.tr

Turgut Yildirim
PhDc, Doctorant
Hitit University, Faculty of Sports Sciences, Çorum, Turkey
ORCID ID 0000-0003-1392-6942
turgutyildirim19@gmail.com

TEACHERS' DIGITAL COMPETENCE: BIBLIOMETRIC ANALYSIS OF THE PUBLICATIONS OF THE WEB OF SCIENCE SCIENTOMETRIC DATABASE

Abstract. With the Online Emergency Remote Teaching (OERT) practices emerged during the outbreak of the pandemic, teachers' digital competence (TDC) has gained growing attention in educational ICT research realm. In view of this context, the present review study aimed at illuminating the current state of TDCs literature by identifying the volume, growth trajectory, geographical distribution of TDC research. It also aimed at mapping highly influential TDC scholars, documents, and journals. Retrieved from the educational research category in the Clarivate Analytics Web of Science (WoS) core collection database, the metadata of 406 articles were analyzed by employing bibliometric performance and science mapping techniques in VOSwiever 1.6. The timeframe for the study was the last two decades (from 2002 to 2021). Findings illustrated that there has been a growing increase in the number of studies focusing on TDCs. This increase is more evident in the Covid-19 pandemic period, particularly in the last two years. More specifically, more than half of all studies were published in the years 2020 and 2021. Findings also illustrated that there is a dominance of Spanish scholars and organizations in TDC research since 2 out of every 3 studies were carried out by researchers affiliated to Spanish Universities. Additionally, co-citation analysis purported the intellectual structure of TDC knowledge base by identifying the most influential authors and documents. Finally, co-occurrence analysis revealed the concept analysis topical foci of TDC research. These topics are concentrated on "teachers' digital competence", "higher education studies", teacher training programs", and "ICT in education". As a result, based on the findings of the study some recommendations were proposed that will contribute into the ICT research community by reflecting the intellectual structure of existing TDC research, thus highlighting the future research direction.

Keywords: digital competence; teachers; TDC; teacher training; science mapping; bibliometric analysis.

1. INTRODUCTION

The problem statements. Teachers Digital Competence (*hereinafter referred to as* TDC) has a pivotal role in the construction of 21st century society, and thus it is a key competence that teacher training programs should incorporate. In line with this, there is a growing interest in TDC in the last two decades. The concept of digital competence was first documented in the "2006 Recommendation of the European Parliament and of the Council", and it has been listed as one of the eight key competences that individuals should master to become effective and active citizens in the digital age [2], [3]. Particularly in the field of education, TDCs have become prominent with the publication of "The European Framework for the Digital Competence of Educators" (DigCompEdu) in 2017 [4]. The DigCompEdu framework has become a reference document for policy makers and researchers in the field of education in European and pro-European countries. In line with this context, "Digital Education at School in Europe Report" well documented that in nearly two-thirds of 43 countries, including Spain,

Norway and Ukraine, TDC is a core competence that teachers should master by the end of teacher training programs [5]. More recently, with the OERT practices implemented during the Covid-19 pandemic, TDCs have become under scrutiny as never before [6], [7].

Analysis of recent studies and publications. There is an established research literature on TDC, and it is growing at a fast and steady pace as mentioned previously. The rapid increase in the volume and diversity of digital competence research is also evident in the previous review studies [1], [8] - [13]. However, rather than presenting a broad picture of TDCs, these studies are mainly focusing on teacher training and higher education area, [1], [8], [10], [12] - [14], and some other specific areas like science teaching and ICT [10], online courses and SPOC (the small private online courses) [9], preschool and nursery [11], and teachers' digital competence [14]. Amongst them, there is only one review study focusing on TDCs conducted by [14], yet it is limited in contextual and geographical coverage since it only covers the publications in six prestigious educational sciences journals in Spain between 1983-2019. Another limitation of the previous review studies is that the number of included papers is very low varying from 56 to 286, except for the study by [9] focusing on online courses and SPOC and including 677 studies. Thus, there is a need for comprehensive review studies on TDC research that will include update studies and cover more studies to present a global perspective on TDC research.

There are three features that distinguish the present study from the previous review studies aiming at mapping TDCs research literature. First, it maps the TDC literature from the birth of the concept of digital competence to its current state, including the recent increase in volume of studies due to the Covid-19 pandemic period. Second, unlike the previous studies, the present study addressed the general teacher competences by including the keywords "digital competence" AND "teachers". Finally, it covers larger number of journal articles than used in past reviews of TDC literature. It also highlights the current state of intellectual structure of TDC knowledge base unlike the previous reviews. Despite the previous review studies addressing TDC research, there is a need for periodical review studies that will contribute in TDC literature in order to develop its theoretical and practical aspects. On the theoretical side, the present review will provide a better understanding of the TDC literature by highlighting the intellectual structure of the TDC literature. On the practical side, it will help researchers to identify research trends in TDC knowledge base and will also shed light policy makers to address TDCs as a core competence in teacher training programs.

The present study aimed at reviewing the publications between 2001-2021 on teachers' digital competence included in the Web of Science by employing bibliometric analysis method. Thus, the following research questions (RQ) were addressed within the scope of the study:

RQ1: What is the volume and distribution of the relevant studies (a) by years (2002-2021), (b) by authors (authors with at least five articles), (c) by organizations (organizations with at least 10 studies), (d) by countries (top 10 countries that have the highest study count) (e) by journals (top 10 journals with the highest published study count)?

RQ2: What authors and documents have the greatest influence on TDC literature over the past two decades?

RQ3: What are the topical foci of the TDC literature over the past two decades?

The first two (RQ1 and RQ2) provide a broad but clear picture of the state-of-the art of the TDC studies, which will help researchers to better understand the growth volume and trajectory of the TDC literature. Likewise, RQ3 will provide insightful results for researchers and policy makers to identify research trends and gaps, as well as setting future research and policy directions.

2. RESEARCH METHODS

The present study employed bibliometric analysis as a methodological approach in order to identify research evolution in TDC literature. The rationale for employing bibliometric analysis is that it allows researchers to explore, classify and analyze a large body of scientific output on a specific research topic by making it possible to retrieve entire collection of research from an objective, quantitative perspective, and evaluate the growth of literature and scientific exquisite in a particular research realm [15]. A bibliometric analysis reviews and discloses entire collection of studies in a specific area without any intervention of researcher caused biases [16]. In the basic bibliometric content analysis, researchers adopted descriptive statistics to present the "topographical" developments in knowledge base. Yet in time bibliometric analysis tools have transformed into more powerful tools that enable more comprehensive analysis including structural identification of knowledge base and advanced citation analysis tools based on social network analysis [17], [18]. In line with this the present study employed both descriptive and advanced bibliometric analysis strategies in the present review.

2.1. The Procedure

Prior to identifying the studies to be included in the bibliometric analysis, a number of inclusion and exclusion criteria were established. The inclusion criteria of the study were identified as: (1) Studies that have been published between 2001 and 2021 and in journals included in the indexes within the scope of WoS, (2) Studies under Education and Educational research category in WoS, (3) Published articles, (4) Studies published in the journals indexed in the SSCI, ESCI, SCI-E and AHCI indexes. On the other hand, the exclusion criteria were: (1) Studies published before 2000 and in 2022, (2) Studies conducted in some fields other than Education and Educational research, (3) Studies other than articles (books, book chapters, conference papers, dissertations, etc.), (4) Publications in the journals indexed other than SSCI, ESCI, SCI-E and AHCI indexes.

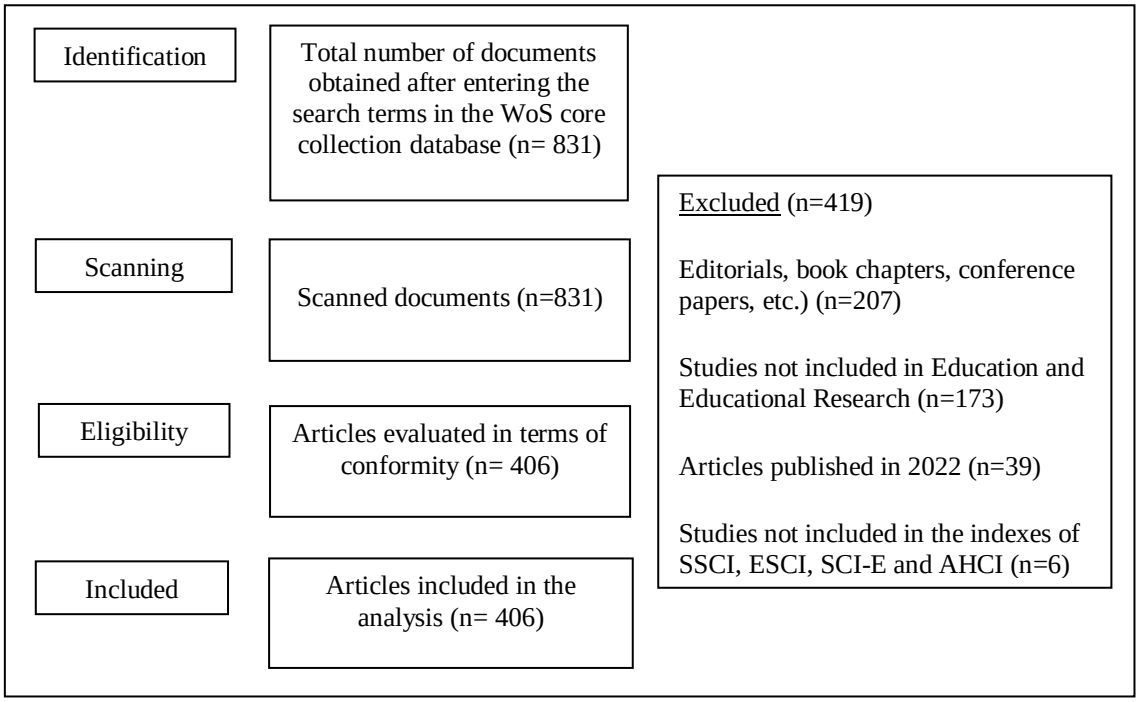

Figure 1. PRISMA flow chart of identification and selection of studies included in the bibliometric analysis

The search was conducted by entering TS= (digital competence AND teachers) in the topic search filed under the document search interface of WoS core collection. The preliminary search resulted in 831 studies. After the application of inclusion and exclusion criteria, a total of 406 studies were obtained, published between 2001-2021 in the education and educational survey categories and indexed in SSCI, ESCI, SCI-E and AHCI. Bibliometric data of these 406 studies formed the dataset of this study. Figure 1 illustrates the flow chart of the PRISMA statement [19], which depicts the process of the identification and the inclusion of the studies to be included in bibliometric analysis.

2.2. Data Extraction and Analysis

Data analysis is two strands. In the first strand, the descriptive bibliometric analysis has been conducted with the MS excel output of the "analyze results" tool in the WoS database. The excel file and analyze results menu in the WoS data base was used to identify the research trends (i.e., distribution of publications by years, authors, countries, and journals) without any intervention of the researchers.

In the second strand, the studies accessed via the WoS database for the bibliometric analysis were downloaded by selecting "full record and cited references" and "tab delimited file" under the "export" menu. The analysis of bibliometric data of the 406 studies was carried out by uploading all the records to the VOSviewer 1.6 software. In order to identify the most influential authors, documents and journals, the author co-citation analysis (ACA), document co-citation analysis (DCA), sources co-citation analysis (SCA) were conducted in VOSviewer 1.6. [20]. Additionally, in order to identify the topical trends in TDC literature co-occurrence of common keywords analysis was employed.

3. THE RESULTS AND DISCUSSION

3.1. Performance Analysis

3.1.1. Publication Trends by Year

As the distribution of the relevant publications by year is examined, we identified that there is a sharp increase in the number of publications particularly as of 2017, and this increase has been exponential especially after 2019. As can be seen in Figure 2, the number of the studies focusing on the TDCs was the highest in 2021. A total of 122 publications in 2021 counted for 30% of the total publications. On the other hand, the lowest number of studies were published in 2006 (0.2%) with only one publication. In addition, no publications were identified before 2006 in the descriptive analysis.

The first stream of the growth in the TDC literature can be linked with the publication of the DigCompEdu in 2017 [8]. DigCompEdu is an influential policy document in the realm of teachers' digital competence. On the other hand, there is an exponential increase after 2019 and this can be noted as the second stream of growth. Thus, this increase can be attributed to teachers' widespread use of online, distance and digital education tools within the OERT practices that were put into practice due to the outbreak of Covid-19 pandemic. Consequently, the TDCs have been under debate and discussion as never before.

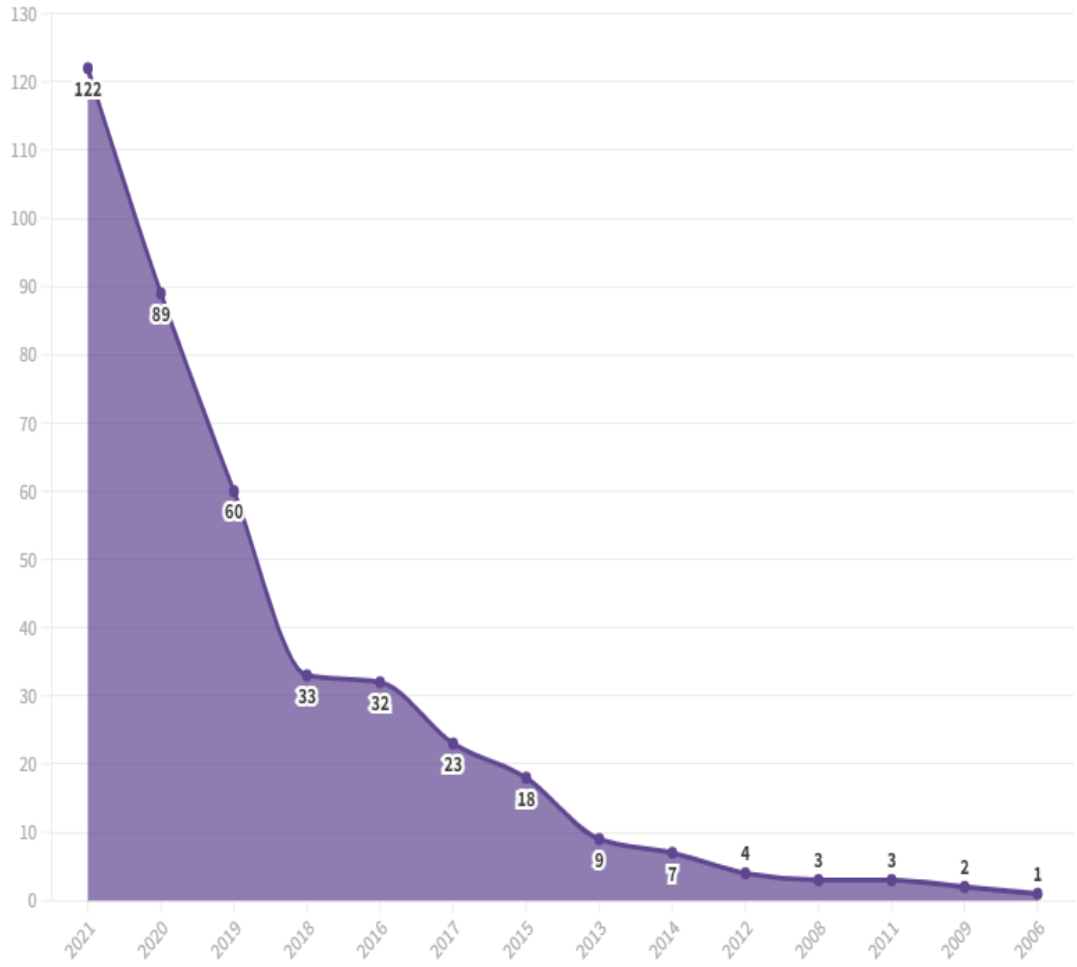

Figure 2. Publications by year

3.1.2. Top Performing Authors in TDC Literature

The author distribution was accessed through the "analyze results" menu in the WoS database to present the distribution of the relevant publications by authors. Figure 3 shows the distribution of authors that have five or more publications within the 406 studies reviewed within the scope of bibliometric analysis.

As can be seen in Figure 3, amongst the top performing authors in TDC literature, Guillien-Gamez F. D. (f=12, 3%), Cabero-Almenara J. (f=11, 3%), Palacios-Rodriguez A. (f=10, 2,5%) and Mayorga-Fernandez M. J. (F=8, 2%) outperformed all other authors. Those four authors have made some significant contributions into the development of TDC literature since they have produced 41 papers (10%) out of 406 publications in TDC literature. On the other hand, Lopez-Belmonte J., Mcgarr, O., and Rodriguez-Garcia, A. M. (f=15, 1.2%) were the bottom of our list although they produced at least five publications. All these top performing authors are very important for novice researchers interested in the TDC research realm since they have produced a significant number of publications that will provide a clear and updated picture of the TDC research. Although these are the authors with most study counts, this does not mean that they are the most influential authors. In the following sections we conducted authors co-citation analysis (ACA) the results of which can be a stronger indicator for the most influential authors in TDC literature.

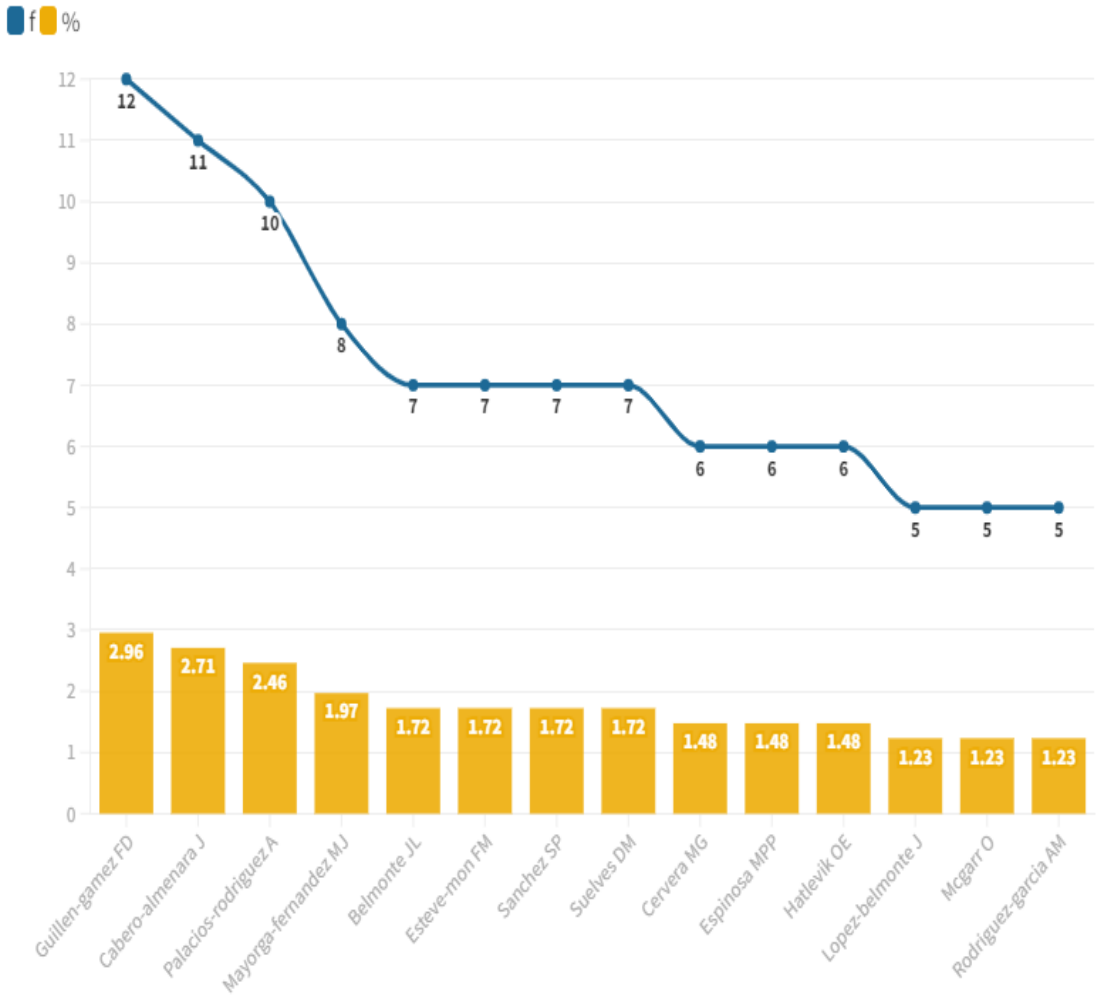

Figure 3. Publications by author (authors with five or more publications)

3.1.3. Publications by Organizations (with at least 10 publications)

In order to identify the distribution of the relevant publications by organizations, the corresponding authors' affiliations were accessed through analyzing the bibliometric data of 406 studies included in the bibliometric analysis. Figure 4 illustrates the distribution of organizations that have 10 or more publications.

With a closer look at Figure 4, when the top performing organizations in the TDC research realm are examined, there is a dominance of Spanish universities in the list. The University of Granada with a total of 27 publications (7%) outperformed all other organizations in the list. The only non-Spanish organization in the list is the Institute for Digitalisation of Education of the National Academy of Educational Sciences of Ukraine with a total of 13 publications, thus taking the fifth place in the list. On the other hand, the lowest number of publication counts were by the Complutense University of Madrid (f=10, 2.5%) and Internacional de la Rioja Unir (f=10, 2.5%).

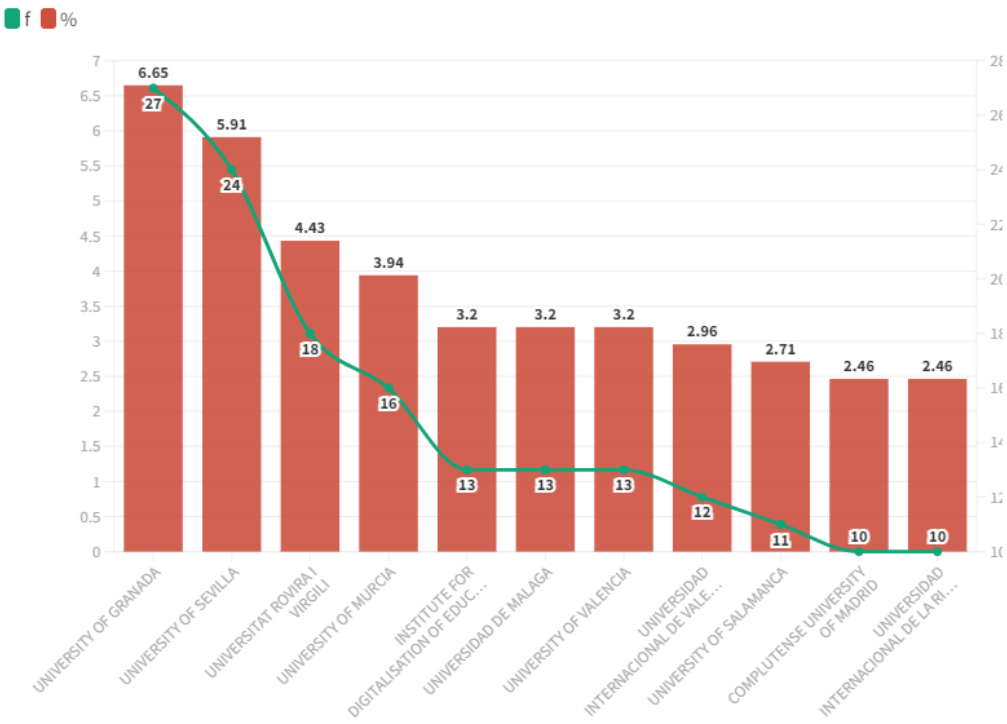

Figure 4. Publications by affiliations (with at least 10 publications)

3.1.4. Publications by Countries (the top 10 countries with the highest study count)

The distribution of the publications by countries was accessed through the "analyze results" menu in the WoS database. Figure 5 illustrates the distribution of 406 studies included in the bibliometric analysis by the top 10 countries with the highest number of study counts.

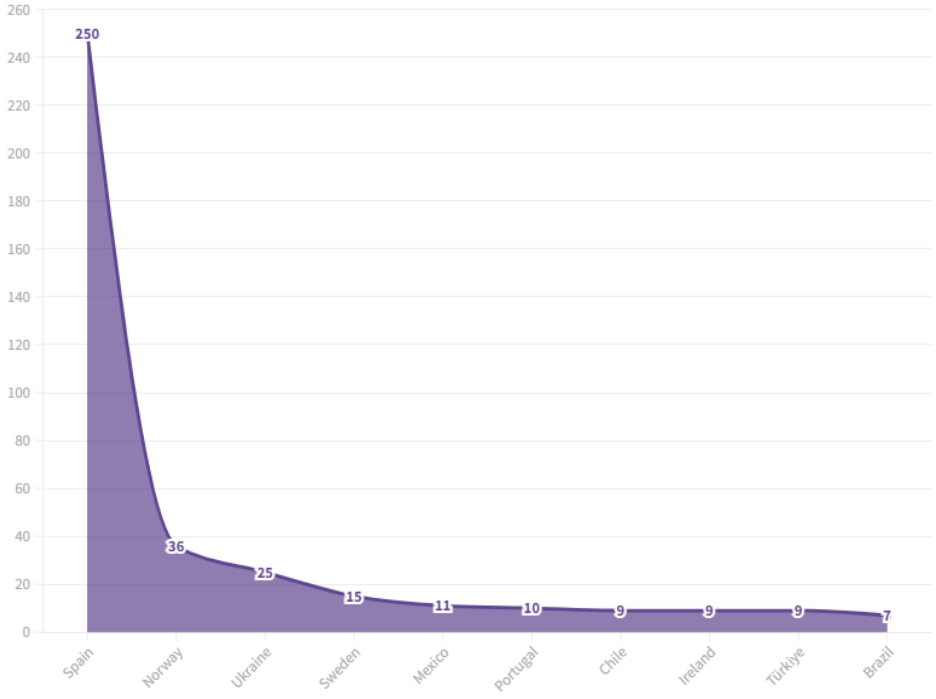

Figure 5. Publications by countries (the top 10 countries with the highest study count)

As can be seen in Figure 5, Spain, Norway and Ukraine were the top performing countries in TDC research. Spain solely produced 250 publications out of 406 studies, and this means more than half of all publications (62%) were produced by Spanish scholars and organizations. This also indicates that Spanish scholars are dominating the TDC research realm with a total of 250 publications. Norway (f=36) and Ukraine (f=25) were also other top performing countries taking the second and third place in the list, respectively. Approximately 77% of total publications were originated from the first three countries. On the other hand, Chile (f=9), Ireland (f=9), Turkiye (f=9), and Brazil (f=7) are amongst the top 10 countries regarding the total publication counts although they were ranked at the bottom.

3.1.5. Publications by Journals

The bibliometric data of journals that published at least 10 studies out of 406 were analyzed. The findings retrieved through the bibliometric analysis were presented in Table 1 and Figure 6.

Table 1

Distribution of the publication title and cite scores of the publications

№	Journal	%	*f*	H-index	Quartile	JCI Score (2021)	Publisher
1	Information Technologies and Learning Tools	4.926	20	N/A	N/A	0.46	Institute for Digitalisation of Education, NAES of Ukraine
2	Pixel Bit Revista de Medios y Educacion	4.680	19	10	Q2	0.95	Universidad de Sevilla
3	Nordic Journal of Digital Literacy	4.187	17	16	Q2	0.66	Universitetsforlaget AS
4	Revista Latino Americana de Tecnologia Educativa Relatec	4.187	17	18	Q3	0.29	Univ Extremadura
5	Education and Information Technologies	3.695	15	69	Q1	1.87	Springer
6	Profesorado Revista de Curriculum y Formacion de Profesorado	2.956	12	35	Q2	0.42	Universidad de Granada
7	Education Sciences	2.709	11	30	Q2	1.20	MDPI AG
8	Computers & Education	2.463	10	197	Q1	3.75	Elsevier
9	Comunicar	2.463	10	45	Q1	2.94	Grupo Communicar

As illustrated in Figure 6 and Table 1, the *Information Technologies and Learning Tools* journal published by the Institute for Digitalization of Education of the NAES of Ukraine outperformed all other journals with 20 published articles addressing TDCs. In the second place, *Pixel Bit Revista de Medios y Educacion* published by the University of Sevilla took place with a total of 19 publications. These two journals accounted for about 10% of total 406 publications included in the bibliometric analysis.

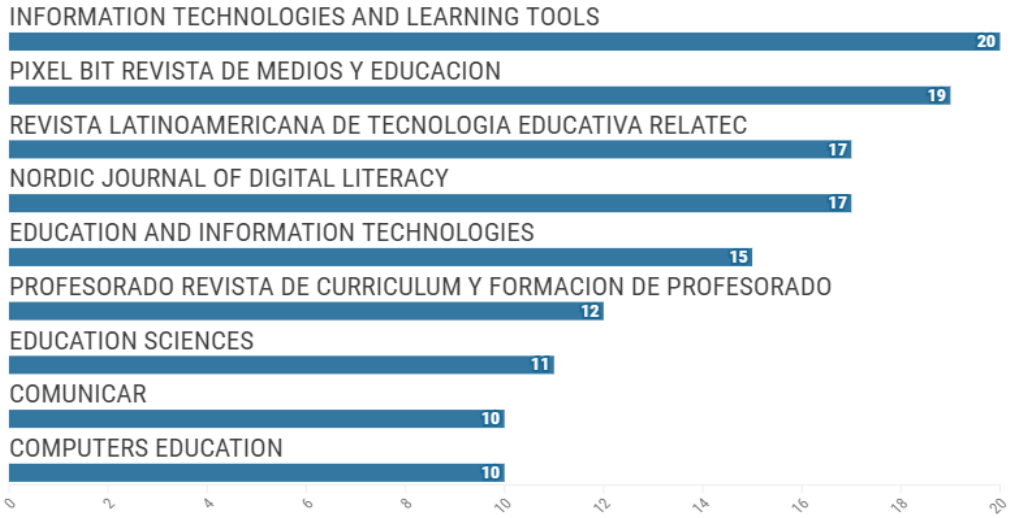

Figure 6. Distribution of the studies by publication titles

3.2. Bibliometric Science Mapping of TDC Research

In the previous section, we presented the results of comprehensive performance analysis of teachers' digital competence literature. In this section, the results of our science mapping to enable a better understanding of the research dynamics of the TDC literature will be presented based on the co-citation, co-authorship, and co-occurrence of keywords analysis.

3.2.1. The most influential authors (with the highest number of studies, citation scores and total link strength)

Of the 8582 authors 66 met the threshold value of 20 citations. The top 20 of these 66 authors were presented in Table 2.

Table 2

Authors by documents, citations and total link strength

Rank	Authors	Clusters	Links	Total link strength	Citations
1	Ferrari, A.	1	65	1219	129
2	UNESCO	2	64	1102	122
3	Krumsvik, R. J.	1	65	1336	113
4	Cabero, J.	2	60	861	106
5	Tondeur, J.	1	63	1039	93
6	INTEF	2	62	835	93
7	Cabero-Almenara, J.	2	63	800	90
8	Area, M.	2	55	380	69
9	Redecker, C.	3	63	573	67
10	Mishra, P.	1	65	657	65
11	European Commission	3	60	553	64
12	Gudmundsdottir, G. B.	1	64	630	58
13	OECD	1	58	525	56
14	Hatlevik, O. E.	1	64	624	53
15	Prensky, M.	1	58	316	48

16	Espinosa, M. P. P.	2	53	425	46
17	Instefjord, E. J.	1	61	428	44
18	Prendes, M. P.	2	51	403	44
19	Touron, J.	2	52	374	43
20	Guillen-Gamez, F. D.	2	50	347	43

In order to address the second research question, the co-authorship and co-citation analysis were employed in the VOSviewer with the bibliometric data of the 833 authors that produced the 406 studies. The authors meeting the threshold score of 4 studies were included in the analysis. The findings extracted from bibliometric analysis were provided in Figure 7 and Table 3.

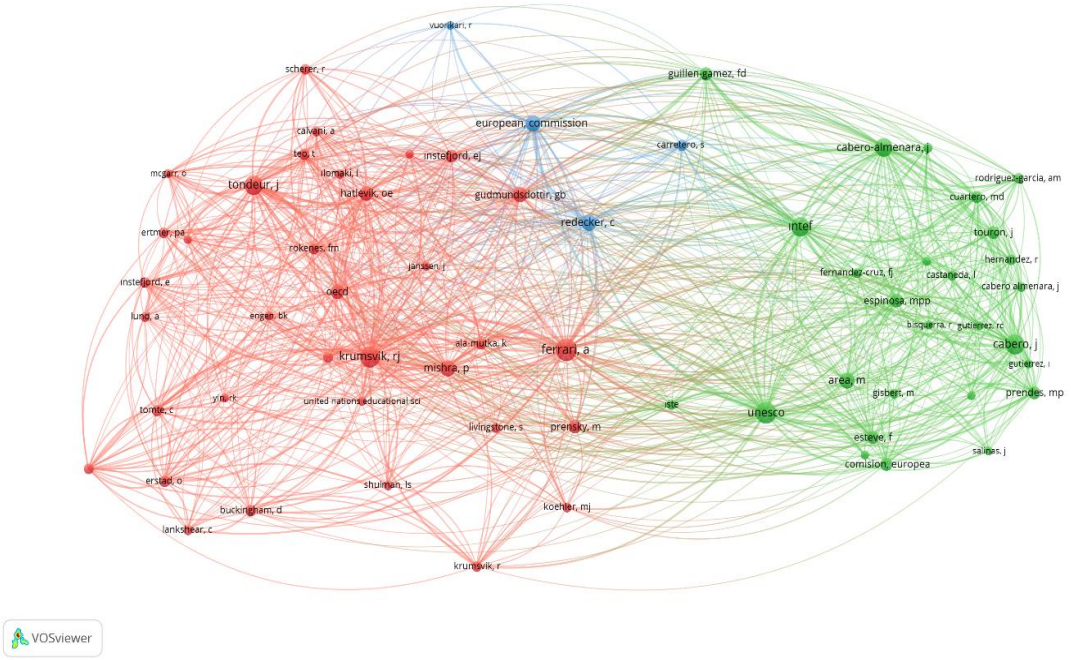

Figure 7. Co-citation network by authors

As illustrated in Figure 7, there were eight clusters. The first cluster (shown in yellow) included three authors, namely Palacios-Rodrigues A. (TLS=13), Guillen-Gamez, F. D. (TLS=6), and Cabero-Almenara, J. (TLS=13). Second cluster consists of two authors; Lopez Belmonte, J. (TLS=7) and Pozo Sanchez, S. (TLS= 7). The other authors formed a cluster.

Table 3

Author	Documents	Citations	Total link strength	Total Citations	h-index
Cabero-Almenara, Julio	11	96	44	39001	96
Palacios-Rodriguez, Antonio	10	96	44	416	11
Guillen-Gamez, Francisco D.	12	116	34	571	13
Hatlevik, Ove Edvard	5	331	16	3310	27
Esteve-Mon, Francesc M.	7	43	3	3712	27
Lopez Belmonte, Jesus	7	75	34	1321	22

Pozo Sanchez, Santiago	7	63	16	1269	21
Gisbert Cervera, Merce	6	86	3	7681	45
Marin Suelves, Diana	6	4	2	1046	14
Mcgarr, Oliver	5	12	0	2142	22

Table 3 illustrates the most influential authors regarding the TDC literature. 10 authors out of 833 have met the threshold score. Cabero-Almenara, Julio is the author with the most papers, yet regarding the citation scores Hatlevik, Ove Edvard outperformed the other authors. In addition, as to the total link strength Palacios-Rodriguez, Antonio and Cabero-Almenara, Julio were the leading authors in the TDCs literature.

3.2.2. The most influential documents

Of the 406 documents included in the bibliometric analysis, top 10 most cited articles were presented in Table 4.

Table 4

Top 10 most cited articles in TDC literature

Rank	Article Title	Authors	Source Title	TC	DOI
1	Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany (2020)	J. König, D. J. Jäger-Biela, & N. Glutsch	European Journal of Teacher Education	201	10.1080/02619768.2020.1809650
2	Teachers Generation Z and their Digital Skills (2016)	F.-J. Fernández-Cruz & M.-J. Fernández-Díaz	Comunicar	167	10.3916/C46-2016-10
3	Educating digitally competent teachers: A study of integration of professional digital competence in teacher education (2017)	E. J. Instefjord & E. Munthe	Teaching and Teacher Education	131	10.1016/j.tate.2017.05.016
4	Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion (2013)	O. E. Hatlevik & K.-A. Christophersen	Computers & Education	130	10.1016/j.compedu.2012.11.015
5	Newly qualified teachers' professional digital competence: implications for teacher education (2018)	G. B. Gudmundsdottir & O. E. Hatlevik	European Journal of Teacher Education	129	10.1080/02619768.2017.1416085
6	Models of educational integration of ICTs in the classroom (2016)	M. Area-Moreira, V. Hernández-Rivero, & J.-J. Sosa-Alonso	Comunicar	111	10.3916/C47-2016-08
7	Digital transformation in German higher education: student and teacher perceptions and usage of digital media (2018)	M. Bond, V. I. Marín, C. Dolch, S. Bedenlier, & O. Zawacki-Richter	International Journal of Educational Technology in Higher Education	97	10.1186/s41239-018-0130-1
8	Construct validation of a questionnaire to measure teachers' digital competence (TDC) (2018)	J. Tourón, D. Martín, E. Navarro Asencio, S. Pradas, & V. Íñigo,	Revista Espanola de Pedagogia	88	10.22550/REP76-1-2018-02

9	Situated learning and teachers' digital competence (2008)	R. J. Krumsvik	Education and Information Technologies	68	10.1007/s10639-008-9069-5
10	Prepared to teach ESL with ICT? A study of digital competence in Norwegian teacher education (2016)	F. M. Røkenes & R. J. Krumsvik	Computers & Education	67	10.1016/j.compedu.2016.02.014

Document citation analysis purported the most influential documents in TDC literature. The literature acknowledges that the most influential documents are called as canonical documents and they have the most contribution in the intellectual foundation of a specific research area [17], [28]. Given this, the canonical documents of the TDC literature that theoretically contribute in thrive of the TDC literature were presented in Table 4. The most influential documents list is partly overlapping the most influential authors lists given in Table 2 and 3. These documents are also representation of different research streams in TDC literature. For example, digital competence of pre-service teachers and TDC in teacher training programs are the topics that are the most addressed topics by the TDC researchers [22], [27]. Another research stream is the studies mostly scrutinizing pre-school, primary and secondary school teachers' digital competences and their adoption of ICT in their instruction [21], [23] – [25]. There is only one conceptual paper addressing TDC in the canonical documents list [26]. Consequently, new researchers interested in TDC research and post graduate students can benefit from these documents.

3.3. Publications by Co-Occurrence of Keywords

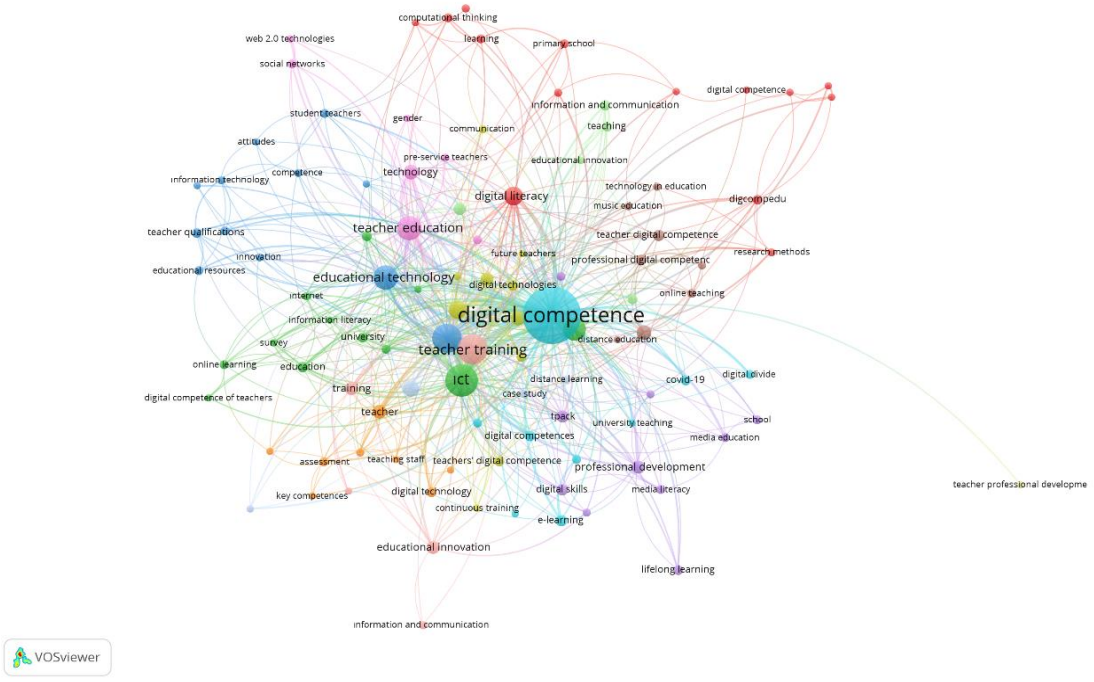

Figure 8: The co-occurrence of keywords in 406 TDC research studies from 2002-2021 (keywords that occur at least three times)

Of the 998 keywords entered by the authors in 406 studies, the co-occurring keywords analysis identified that there were 105 co-occurring keywords with a threshold of co-occurrence at least three times. The results illustrated that the most co-occurring keywords are (1) digital

competence, (2) ICT, (3) teacher training, (4) higher education and (5) teacher education. The map based on the analysis of co-occurrence results are illustrated in Figure 8 and Figure 9.

With a closer look at Figure 8, the co-occurring keywords are clustered under three colors. These are red, green, and blue. Four concepts are clustered under red. These are (1) teachers' digital competence, (2) higher education, (3) teacher, and (4) DigiCompEdu. The blue cluster included the keywords of (1) digital competence, (2) teacher education, and (3) technology. Finally, the green cluster showed that (1) teacher training, (2) ICT, and (3) teachers were the concepts. These clusters are consistent with the previous findings given in Table 4.

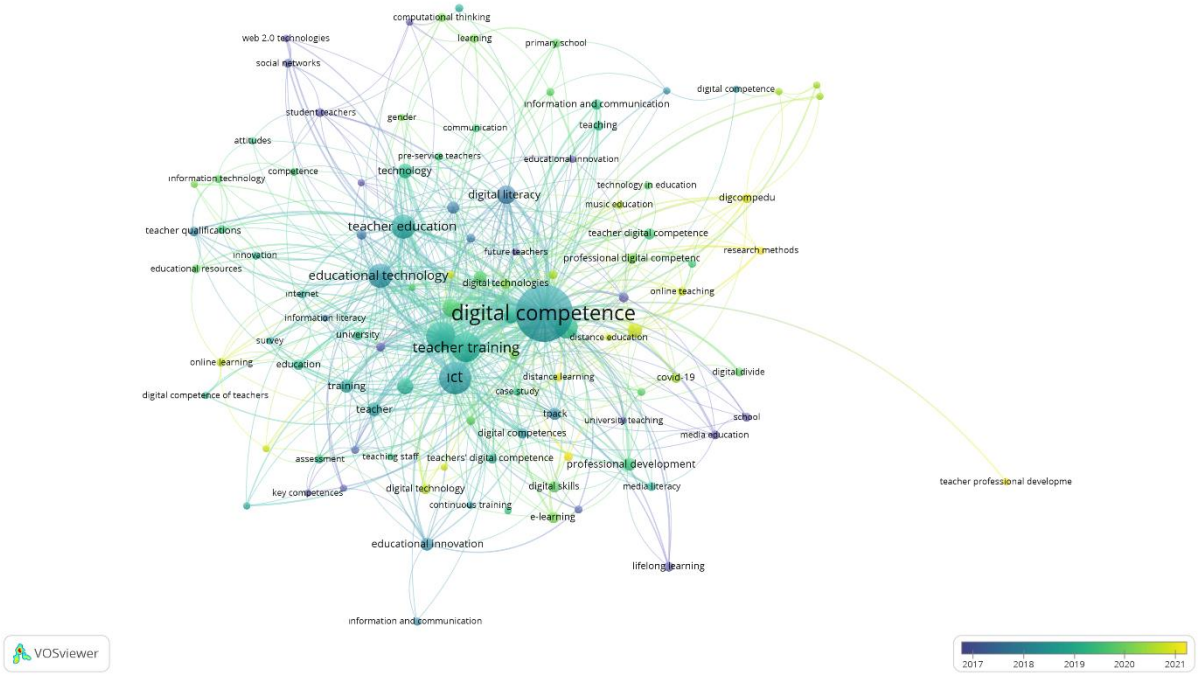

Figure 9: The co-occurrence of keywords by years from 2002-2021 (keywords that occur at least three times)

Regarding the research trends based on the co-occurrence of keywords given in Figure 9, researchers are paying more heed to TDC in a context of distance education, Covid-19, teacher training and DigiCompEdu. These concepts can be signaling the research trends in TDC literature.

4. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

In the present study, the search terms "digital competence" AND "teachers" were inserted to review the studies addressing TDCs published in the journals included in the Web of Science (WoS) database from 2002 through 2021. The bibliometric data of 406 academic studies in the educational research category in WoS formed the data set of the study and the data were analyzed in VOSwiever 1.6 employing bibliometric performance and science mapping techniques.

Based on the findings, we extracted three main results. First, there has been an exponential increase in the number of studies examining TDCs after 2019. Given this context, more than 50% of the total research has been published in the last two years (2021: f=120, 2020: f=88). This can be an indicator of that digital competence has become one of the most important teacher core competences that teachers and educational systems must face in the digital age. Another reason

for the proliferation of TDC studies can be related with the OERT practices put into practice with the Covid-19 pandemic period and in the aftermath. Thus, this can be an indicator of the research studies focusing on TDC will continue to increase due to the acceleration gained by the digitalization of education in the Covid-19 period. This conclusion is also evident in the previous studies asserting that Covid-19 lockdowns has led to a revision of educational practices including teachers' competences to adapt teaching in the digital settings [29].

Second, there is a dominance of European and Latin American countries in the TDC literature. Given the increasing importance of TDC, it would be appropriate to make more comprehensive analyzes from global studies. While there is a large literature on this topic in Spain and some other countries, more research studies are needed from other countries to present a broader picture of worldwide state of TDCs. Our results also supported that TDC literature is mainly based on European and pro-European countries. Thus, there is a need for further studies from different regions. Additionally, previous studies argued that there is a dominance of quantitative studies focusing on examining TDCs, especially through self-assessment and reflection via questionnaires [30]. However, the selected articles show that teachers have a positive attitude towards competence development; The increase in the number of articles and training projects trying to explain standards, competence frameworks and models to increase competence development proves this. The "DigicompEdu" can be ultimately useful for determining which key features and competencies teachers need to adopt technologies in their educational practices and strengthen their developmental training.

Finally, the intellectual structure of TDC knowledge base indicated that there are three research streams in TDC literature. These are (1) TDC in teacher training programs, (2) TDC at higher education studies, and (3) TDC at pre-school, primary and secondary level. Co-occurrence of keywords analysis illustrated that recent studies are focusing on TDC in teacher training programs. This is partly because the number of countries that have incorporated TDCs in the teacher-training programs are increasing in number as it is documented in [5].

As a conclusion, based on research results, our recommendations and prospects for future research can be listed as:

1. There is a proliferation in TDC research in the last two years and most studies are carried out in European context, such as Spain, Norway and Ukraine. Thus, there is a need for further studies from different countries or regions to present a global perspective.

2. Thanks to the OERT practices implemented with the Covid-19 pandemic, education at primary, secondary and tertiary levels has become digitalized, thus it is imperative for teacher training institutions to address TDCs along with the generic teacher competences in their curricula.

3. Future research should focus on TDC in a context of distance education, Covid-19, teacher training and DigiCompEdu.

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ЦИФРОВА КОМПЕТЕНТНІСТЬ УЧИТЕЛІВ: БІБЛІОМЕТРИЧНИЙ АНАЛІЗ СТАТЕЙ НАУКОМЕТРИЧНОЇ БАЗИ ДАНИХ WEB OF SCIENCE

Мехмет Кемаль Айдин
PhD, доктор, доцент
Університет Хітіт, Центр застосування та дослідження дистанційної освіти, м. Чорум, Туреччина
ORCID ID 0000-0002-5611-5515
mehmetkemalaydin@hitit.edu.tr

Тургут Йилдирим
PhD, докторант
Університет Хітіт, факультет спортивних наук, м.Чорум, Туреччина
ORCID 0000-0003-1392-6942
turgutyildirim19@gmail.com

Анотація. Із впровадженням онлайн дистанційного навчання в екстрених ситуаціях, яке розповсюдилося під час спалаху пандемії, цифрова компетентність учителів (ЦКУ) привернула ще більшу увагу в дослідженнях щодо використання ІКТ в освіті. З огляду на це представлений огляд мав на меті проаналізувати наукові розробки щодо ЦКУ шляхом визначення обсягу, траєкторії зростання, географічного розподілу досліджень. Крім того, дослідники намагалися зазначити впливових учених, документи та журнали, які висвітлюють проблеми пов'язані з ЦКУ. Метадані 406 статей, отримані з категорії освітніх досліджень у базі даних основної колекції Clarivate Analytics Web of Science (WoS), були проаналізовані за допомогою бібліометричних характеристик і методів наукового картографування у VOSwiever 1.6. Часові рамки дослідження – останні два десятиліття (з 2002 по 2021 рр.). Висновки проведеного наукового аналізу показують, що кількість досліджень, присвячених ЦКУ, зростає. Таке зростання є більш очевидним у період пандемії Covid-19, особливо за останні два роки. Більша частина проаналізованих досліджень була опублікована в 2020 та 2021 роках. Відповідно отриманим даним у дослідженнях ЦКУ домінують іспанські вчені та організації, оскільки 2 з кожних 3 досліджень проводились дослідниками, пов'язаними з іспанськими університетами. Крім того, аналіз спільного цитування визначив інтелектуальну структуру бази знань про ЦКУ шляхом виявлення найвпливовіших авторів і документів. Нарешті аналіз збігу надав можливість визначити найбільш актуальні фокуси в дослідженнях з ЦКУ. Ці теми в основному зосереджені на «цифровій компетентності учителів», «дослідженнях вищої освіти», програмах підготовки учителів та «ІКТ в освіті». На основі отриманих результатів було запропоновано деякі рекомендації, які сприятимуть дослідникам у сфері ІКТ в освіті у визначені їх подальших напрямів досліджень.

Ключові слова: цифрова компетентність; учителі; ЦКУ; підготовка учителів; наукове картографування; бібліометричний аналіз.

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