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Scientific articles

Evolución de la producción académica en Web of Science sobre Competencias Digitales Docentes 2020-2023

Evolution of academic production in Web of Science on Teaching Digital Competences 2020-2023

Evolução da produção acadêmica na Web of Science sobre Competências de Ensino Digital 2020-2023

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Resumen

Actualmente, los cambios derivados del avance tecnológico y la emergencia del COVID-19 han impulsado a la comunidad educativa a adoptar herramientas digitales. En este contexto, los docentes desempeñan un papel central en la integración de estas tecnologías, y han sido ampliamente estudiados en la literatura académica, debido a su influencia significativa en los procesos de enseñanza. El objetivo consiste en examinar la producción académica sobre competencias digitales docentes publicada en inglés durante el período 2020-2023 en la base de datos *Web of Science* mediante un análisis bibliométrico, para identificar la evolución y las temáticas emergentes. Para alcanzar el objetivo del estudio, se llevó a cabo una revisión sistemática de la literatura, posteriormente, se aplicaron criterios de inclusión y exclusión para la selección de los documentos, se realizó un análisis descriptivo de la producción científica y, finalmente, se examinó una muestra integrada por 232 artículos científicos.

A partir del análisis de los resultados, se identificó que el año 2023 concentró la mayor producción científica, mientras que España destacó como el país con el mayor número de artículos. Se identifican como autores con mayor influencia en la producción Julio Cabero Almanera y Antonio Palacios Rodríguez, en cuanto al predominio de las revistas *Sustainability, Education Sciences y Education and Information Technologies* mantienen presencia dominante. El análisis de coocurrencia de palabras en los títulos y resúmenes revela una red compleja conformada por cuatro grupos interconectados, que abordan distintos elementos clave que influyen en la investigación de las competencias digitales docentes. La principal limitación del estudio radica en que únicamente se consideraron documentos publicados en inglés y correspondiente al periodo comprendido entre 2020 y 2023.

Palabras clave: Competencias digitales docentes, Tecnologías de la Información y la Comunicación, COVID-19.

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Abstract

Currently, changes driven by technological advances and the emergence of COVID-19 have prompted the educational community to adopt digital tools. In this context, teachers play a central role in the integration of these technologies and have been widely examined in the academic literature due to their significant influence on teaching and learning processes. The aim of this study is to examine the academic production on teachers' digital competencies published in English between 2020 and 2023 in the Web of Science database through a bibliometric analysis, in order to identify research trends and emerging themes. To achieve this objective, a systematic literature review was conducted; subsequently, inclusion and exclusion criteria were applied for document selection, a descriptive analysis of scientific production was performed, and finally, a sample consisting of 232 scientific articles was analyzed.

The results indicate that 2023 accounted for the highest volume of scientific output, while Spain emerged as the country with the greatest number of publications. Julio Cabero Almanera and Antonio Palacios Rodríguez were identified as the most influential authors in the field. Regarding journals, Sustainability, Education Sciences, and Education and Information Technologies showed a dominant presence. The co-occurrence analysis of words in titles and abstracts reveals a complex network composed of four interconnected clusters addressing key elements that influence research on teachers' digital competencies. The main limitation of the study lies in the exclusive consideration of documents published in English and within the period from 2020 to 2023.

Keywords: Digital teaching competence, Information and Communications Technology, COVID-19.

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Resumo

Atualmente, as mudanças decorrentes dos avanços tecnológicos e da pandemia de COVID-19 impulsionaram a comunidade educacional a adotar ferramentas digitais. Nesse contexto, os professores desempenham um papel central na integração dessas tecnologias e têm sido amplamente estudados na literatura acadêmica devido à sua significativa influência nos processos de ensino. O objetivo deste estudo é examinar a produção acadêmica sobre competências de ensino digital publicada em inglês durante o período de 2020 a 2023 na base de dados Web of Science, utilizando análise bibliométrica para identificar tendências e temas emergentes. Para atingir esse objetivo, foi realizada uma revisão sistemática da literatura. Posteriormente, foram aplicados critérios de inclusão e exclusão para selecionar os documentos, foi realizada uma análise descritiva da produção científica e, finalmente, uma amostra de 232 artigos científicos foi examinada.

A partir da análise dos resultados, identificou-se que 2023 apresentou a maior concentração de produção científica, sendo a Espanha o país com o maior número de artigos. Julio Cabero Almanera e Antonio Palacios Rodríguez são identificados como os autores mais influentes na pesquisa, enquanto os periódicos Sustainability, Education Sciences e Education and Information Technologies mantêm uma presença dominante. A análise da coocorrência de palavras em títulos e resumos revela uma rede complexa composta por quatro grupos interconectados, abordando vários elementos-chave que influenciam a pesquisa sobre as competências digitais dos professores. A principal limitação do estudo é que ele considerou apenas documentos publicados em inglês entre 2020 e 2023.

Palavras-chave: Competências digitais dos professores, Tecnologias da Informação e Comunicação, COVID-19.

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Introduction

In recent years, the educational environment has undergone significant transformations that have altered teaching and learning methods, with a particular focus on the roles of teachers and students, who are directly affected by these changes. Educational institutions are gradually being renewed due to the omnipresence of digital technology, posing new challenges to 21st-century education in order to train competent and critical citizens in the digital society (Area & Adell, 2021) .

The emergence of the COVID-19 pandemic has been one of the main drivers of changes in educational models towards a technological orientation, causing the greatest educational disruption in history, affecting approximately 1.6 billion students in more than 190 countries; consequently, this situation stimulated innovation and the development of distance education solutions (United Nations, 2020)

Furthermore, rapid technological advances have generated the need to adopt teaching models centered on Information and Communication Technologies (ICT), given that various investigations have supported the effectiveness of these approaches for student learning and facilitating the teaching work (Mejía, 2020; Rumiche and Solís, 2021) .

This study has a significant impact by broadening our understanding of the current scientific literature on articles dedicated to teachers' digital competencies. This will benefit diverse sectors such as education, science, the economy, and society in general, as all of them are directly or indirectly related to the quality of education. A better understanding of research trends can lead to a significant improvement in the quality of teaching and learning; therefore, the need arises to analyze the literature in response to the question: What is the scientific output of articles published in English after the emergence of COVID-19 between 2020 and 2023, using the *Web of Science database?*

In order to address the question mentioned above, this study aims to examine the academic production on digital teaching competencies published in English during the period between 2020 and 2023 in the *Web of* Science database. *Science* (WOS) was analyzed using bibliometrics to identify trends and emerging themes. To achieve this objective, a descriptive analysis was conducted by year, country, journal, and author. Two separate networks were also explored: the research co-authorship network and the network of word co-occurrences in titles and abstracts. This allowed for the identification of literary trends in this area, as well as the main lines of research addressed by leading authors. This paper consists of this introduction, followed by the literature review, the methodology, the results, the discussion, and the conclusion.

Literature review

Teachers can improve student learning when they master the use of digital tools and integrate ICT into the curriculum. Schools employ a range of technologies to generate, communicate, transmit, store, and manage information. These tools are increasingly indispensable for teaching and learning, supporting strategies such as the flipped classroom and the use of interactive whiteboards instead of traditional blackboards (United Nations Educational, Scientific and Cultural Organization, 2023).

In the educational field, teachers occupy a central position in the effectiveness of the teaching-learning process, and their performance is influenced by a series of factors. In this context, digital teaching competencies (DTCs) have gained relevance due to the need for educators to possess the necessary knowledge and skills in the use of technological tools in their work, which contributes to their professional development and allows them to innovate and create in response to the needs of students (Candia, 2023; Clara, 2024; Vidal-Villarruel and Maguiña-Vizcarra, 2022) .

Several authors have addressed CDD from different perspectives, one of the most complete and integrative in the words of Verdú-Pina et al. (2023).

> "DDC is a complex professional competence that brings together a set of knowledge, skills and attitudes that the teacher must possess and mobilize, simultaneously, to use digital technologies in their professional practice. DDC is made up of knowledge related to didactic, methodological, space and resource management, communicative, ethical aspects and their own professional development" (p. 9).

On the other hand, the The National Institute of Educational Technologies and Teacher Training [INTEF] (2022) defines them as:

> "The integration of knowledge, skills, abilities and attitudes that must be simultaneously put into play to perform their functions by implementing digital technologies and to solve the problems and unforeseen events that may arise in a specific unique situation as education professionals" (p. 12).

The growing interest in digital skills within the education, social, and government sectors has led some institutions to create assessment frameworks that facilitate the quantification of these skills in diverse contexts. This development responds to the need to identify and improve the digital preparedness of teaching professionals.

The Digital Competence Framework for Citizens, or DigComp, is a framework for understanding the key issues encompassed by digital competence. Its aim is to enhance the population's digital skills, enabling the government to develop activities focused on employment, education, training, and lifelong learning. DigComp employs a unified language that can be used consistently across all processes, including goal setting, policy development, and planning. The competence areas it covers include information and data retrieval and management, communication and collaboration, digital content creation, security, and problem-solving. (Vuorikari et al., 2022)

Furthermore, the Digital Teaching Competence Framework (MRCDD) serves as a model for evaluating and improving educators' digital skills. Its objective is to explain the digital skills required of all teachers, regardless of subject, educational level, or teaching style, as outlined in the Organic Law on Education. This framework is divided into six areas (professional engagement, digital content, teaching and learning, assessment and feedback, student empowerment, and development of students' digital competence) and twenty-three skills, each with a complete explanation, as well as a list of performance statements and level indicators for each step of teacher professional development (INTEF, 2022) .

In recent years, teachers' digital competence has been the subject of research worldwide, attracting the interest of numerous researchers. While various applied studies have been carried out, such as those by Fernández-Morante et al., 2023; Torres-Flórez and Diaz-Betancour, 2021; Velásquez-Castro et al., 2023 , and validations of instruments and frameworks of

For example, in the studies of Builes et al., 2022; Cabero-Almenara et al., 2021; Gutiérrez-Castillo et al., 2023 , there is a scarcity of studies that focus on analyzing the scientific production related to digital teaching competencies.

Regarding previous research that has focused on investigating teachers' digital competencies from different perspectives using bibliometric analysis as a methodology, there is the study conducted by Toribio-López (2023). Its objective was to understand the current state of research on COVID-19 and digital competence through a bibliometric analysis of 308 research articles from Scopus. The results showed a significant increase in the number of publications in 2021 compared to 2020, specifically in the journal *Sustainability*. Spain and the University of Seville are leading the way in this field, with a strong presence of co-authorships from within the country. A trend towards collaborative research is evident,

particularly in Spanish-speaking countries, focusing on digital competence for the effective implementation of *e-learning*.

Cisneros-Barahona et al. (2023) conducted a bibliometric analysis of the literature on university faculty digital competence. The article aimed to analyze the scientific output on university professors' digital competence using the Web of Science (WoS) database. A sustained growth was observed since 2019. Most publications are indexed in Scopus and WoS . A small group of authors contributes significantly, with a correlation between author nationality and the affiliations of their works. A significant presence of Spanish authors and an extensive international collaboration network, particularly in Latin America, were noted.

Similarly, Paredes-Marín (2024) conducted a bibliometric analysis of documents indexed in Scopus between 2003 and 2023, focusing on digital skills and teacher performance in public schools. The results show that 93% of the works were scientific articles, with 38% in the social sciences, accounting for 20.5% of scientific productivity. Spain ranked first, while the quantity and thematic diversity of the literature on digital competencies and teacher effectiveness in public schools has expanded, addressing conceptual demands and promoting new technological applications.

Although numerous studies have been conducted using bibliometric analyses, most reviews limit their results according to their exclusion criteria. Therefore, there is currently no bibliometric analysis that examines the entire universe of scientific articles published in English from the beginning of the COVID-19 pandemic to the present in the database. WOS.

Method

The methodology used in this work was a descriptive bibliometric analysis. Sánchez-Carrasco (2023) defines it as:

> "A bibliometric analysis … is a method dedicated to the search and analysis of patterns in large volumes of scientific literature published on a specific topic … it is useful for making sense of large volumes of unstructured data in a rigorous way, and can provide an overview, identify gaps in knowledge, generate new ideas for research and position contributions within a field" (p. 162).

This premise justifies the relevance of carrying out a descriptive bibliometric analysis in order to achieve the objectives established in this study, as well as to address the question raised in this document.

Procedure

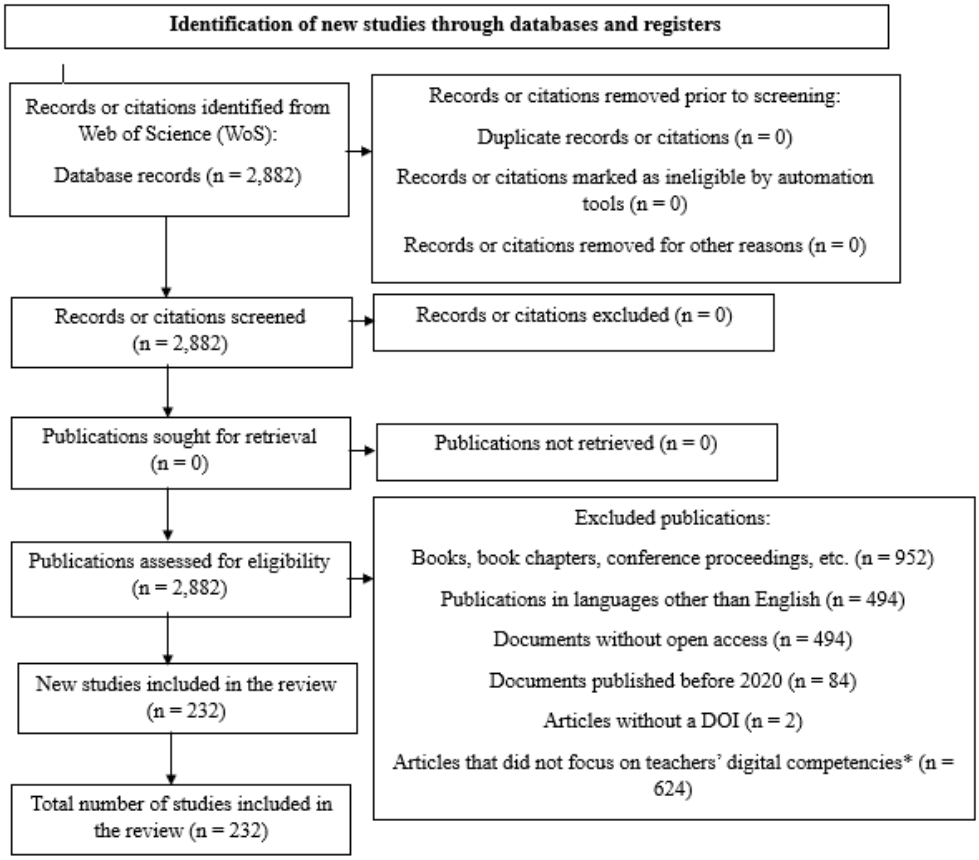
Documents extracted from the prestigious Web of Science (WOS) database were used to conduct the descriptive bibliometric analysis. The search for scientific articles was performed by entering the term " *teacher digital competence* " and selecting "all fields" as the primary search criterion in the WOS document search engine. The preliminary search yielded 2,882 documents. After applying the exclusion and inclusion criteria shown in Table 1, a total of 232 open-access scientific articles published between 2020 and 2023 were obtained. These articles, written in English, used "teacher digital competence" as their primary variable, were indexed using *Digital Objects. Assigned* DOI. The dataset examined in this study consists of bibliometric information from these 232 academic publications. The PRISMA flowchart, which proved useful in identifying and selecting the articles chosen for this study, is shown in Figure 1.

Table 1. Criteria used for the inclusion and exclusion of articles

Inclusion	Exclusion
Main variable: digital teaching competence	Not having digital teaching competence as the main variable
Studies published in the years 2020, 2021, 2022 and 2023	Studies published before 2020 and after 2023
Published scientific articles	Documents not considered (books, book chapters, conference papers, etc.).
English language	Language other than English
Open access	Access closed
Presence of DOI	Absence of DOI

Source: Own elaboration

Figure 1. PRISMA flowchart for identification and selection of studies included in the bibliometric analysis



Source: Own elaboration adapted from (Page et al., 2021)

Data analysis

VOSviewer were used to perform the data analysis. In the first phase, a bibliometric analysis was conducted using Excel to examine the data obtained from the WoS database, which allowed for the identification of research trends, including the distribution of publications by year, country, journal, and author.

In the second stage, the most cited and relevant authors in the field of digital teaching competencies were identified, and their relationships were visualized using co-authorship networks with the VOSviewer software. A semantic network was also constructed based on the co-occurrence of terms extracted from the titles and abstracts of the documents, allowing for the identification of the most influential terms in the research. This approach contributed to providing a representation of the current state of the art and the main lines of research.

Results

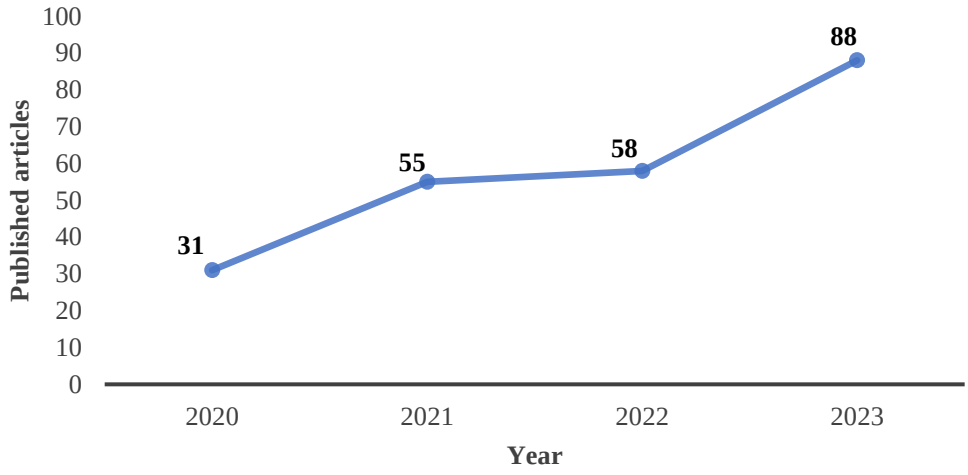
Publishing patterns over the years

This research conducted a comprehensive analysis of scientific publications between 2020 and 2023. The temporal distribution of these articles showed an upward trend throughout the period studied.

In 2020, 31 articles published in WoS on CDD were identified. In 2021, the number increased to 55 articles, representing a 77% increase compared to 2020. In 2022, 58 articles were recorded, equivalent to a 5% increase compared to 2021. Finally, in 2023, 88 publications were observed, implying a 52% increase compared to 2022.

This upward trend in publication suggests increased interest in research, with the COVID-19 pandemic being a possible driving factor. In this context, the researchers primarily examined the various scenarios triggered by this global problem in the educational field and how educators had adapted to the necessary changes, including the need to master ICTs. The distribution of output by year is shown in Figure 2.

Figure 2. Distribution of production by year



Source: Own elaboration

Geographical distribution of publications

WoS database was used, which showed 51 countries that have published at least one article in English regarding digital skills from 2020 to 2023.

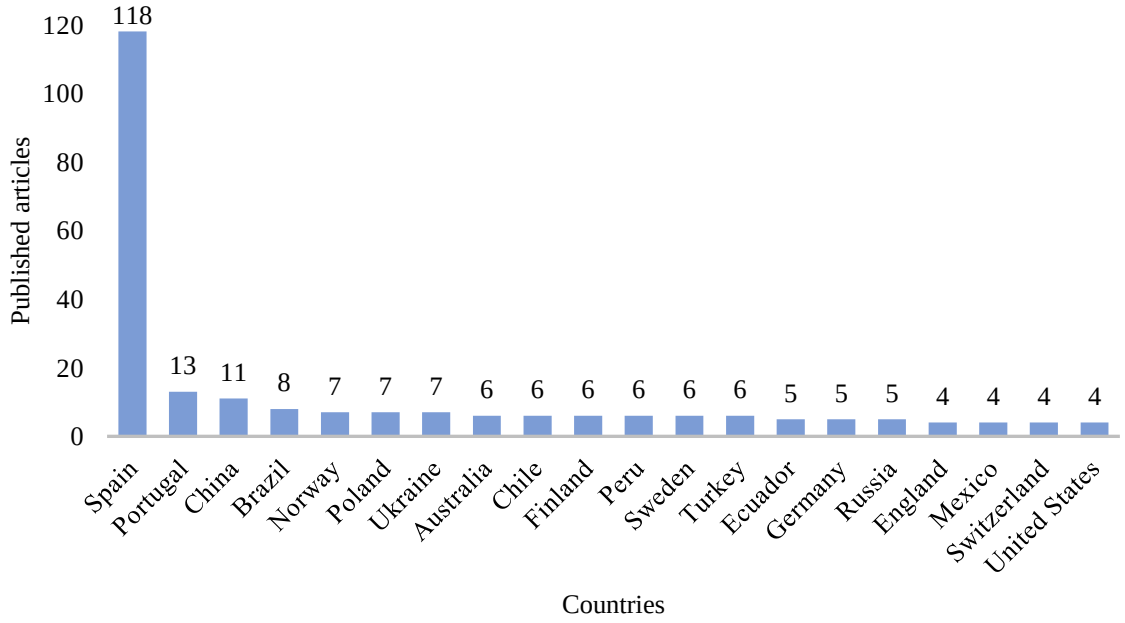
The leading country in document production in this field is Spain, with a total of 118 articles. Portugal follows with 13 publications, and China ranks third with 11 articles. While there is no direct correlation between these countries to determine their leadership in the number of published documents, several factors can be identified that have contributed to the development of research in the field of digital classifications in these countries.

Spain has been a leader in the study of digital learning outcomes since its inception, which could be related to the existence of frameworks specifically developed in this field, such as the one created by the National Institute of Educational Technologies and Teacher Training (INTEF). Furthermore, in recent years there has been an increase in research in this area in Spain, within a context marked by educational transformations at a global level.

In the case of China, the results show an increase in the number of publications related to digital communication technologies, especially from the period associated with the COVID-19 pandemic. This pattern could be related to the need to ensure educational continuity through the use of digital technologies during lockdowns.

In Latin America, the leading countries in publishing scientific articles on CDD are Chile and Peru, with six publications each, representing 2.59%; followed by Ecuador, with five publications (2.16%); and Mexico, with four publications (1.72%). The distribution of publications by country is shown in Figure 3.

Figure 3. Distribution of production by country

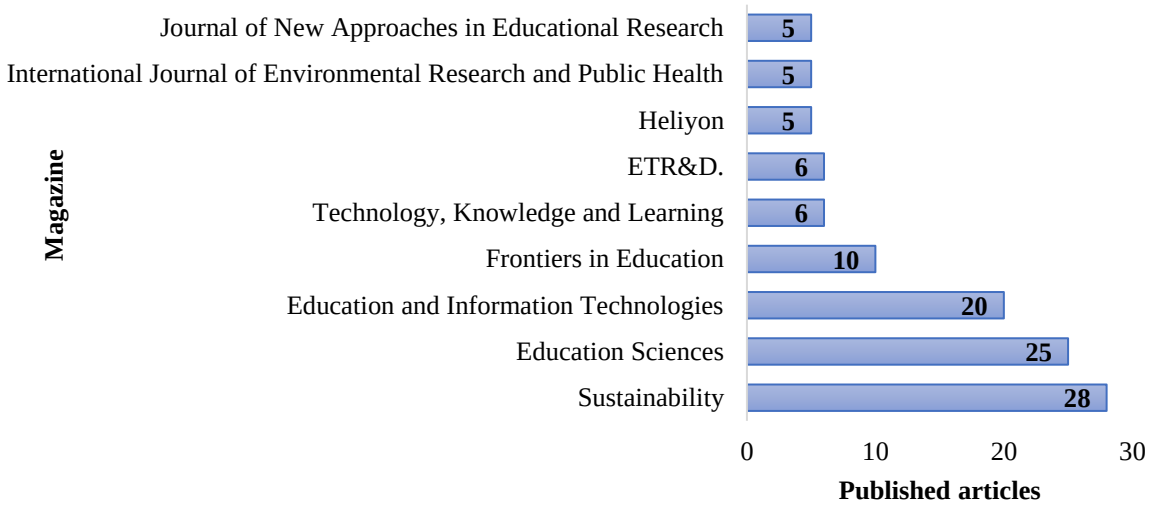


Source: Own elaboration

Distribution of publications by journal

Bibliometric analyses were performed on the journals that published the 232 scientific articles examined. *Sustainability* had the highest number of publications, with 28 articles (12%), followed by Education. Sciences contributed 25 articles (11%), and *Education and Information Technologies* contributed 20 publications (9%). Frontiers in Education contributed 10 articles (4%). *Technology, Knowledge and Learning* and ETRyD each registered six publications (3%), while *Heliyon*, *International Journal of Environmental Research and Public Health* and *Journal of New Approaches in Educational Research* They each contributed five articles (2%). This analysis reveals the distribution of scientific production across different specialized journals, highlighting its importance and contribution to the field of digital teaching competencies. The distribution of publications by journal is shown in Figure 4.

Figure 4. Distribution of production by journals



Source: Own elaboration

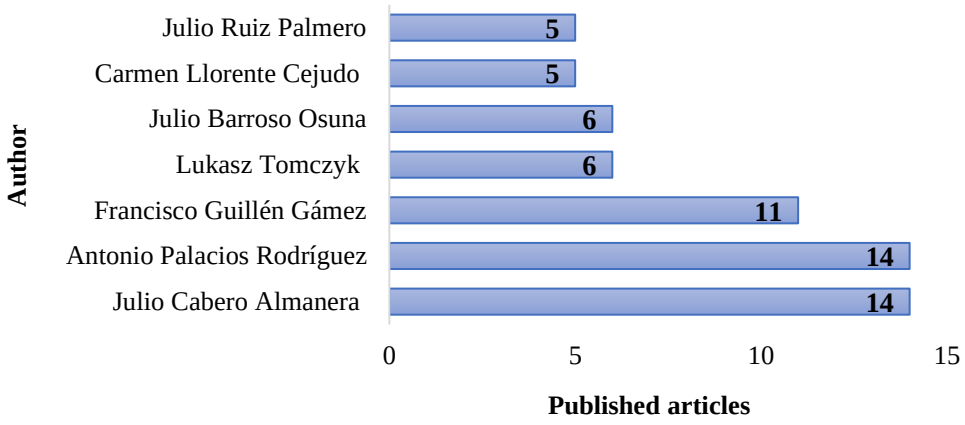
Main authors of literature

A total of 674 authors collaborated on the articles submitted for analysis. Among them, Julio Cabero Almanera and Antonio Palacios Rodríguez stand out, having each contributed a total of 14 publications.

In second place is Francisco Guillén Gámez, with 11 articles. Next are Lukasz Tomczyk and Julio Barroso Osuna, with six publications each, while Carmen Llorente Cejudo and Julio Ruiz Palmero have contributed five articles each.

This detail demonstrates the diversity and scope of collaborative research in the analyzed field of study, highlighting the significant contribution of these leading researchers. This observation underscores the remarkable contribution of the Spanish academic community in this specific field of research. The distribution of publications by author is shown in Figure 5.

Figure 5. Distribution of production by authors



Source: Own elaboration

Co-authorship network

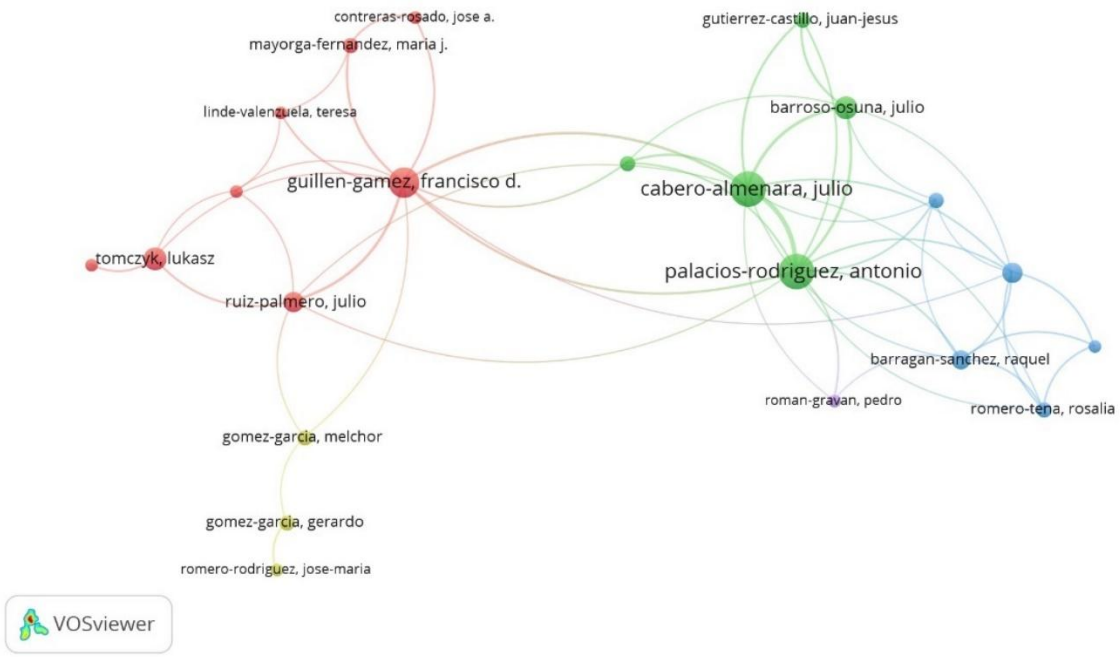
Three primary clusters were found in the networks created through co-authorship. The first was led by Julio Cabero Almenara and Antonio Palacios Rodríguez. The second was led by Francisco Guillén Gámez, and the third was primarily represented by Carmen Llorente Cejudo. Julio Cabero Almenara is the main co-author of scientific articles on CDD, with a link intensity of 34 authors.

In addition to applied research aimed at identifying factors associated with the success or failure of online educational practices, Cabero's studies focus primarily on validating tools and frameworks for measuring teachers' digital competencies and their application in different educational contexts. Antonio Palacios Rodríguez, for his part, demonstrates a high level of collaboration, with links to 33 authors, which indicates a thematic affinity and a shared line of research with Cabero. This relationship reflects sustained scientific cooperation in the joint development of publications on digital competence.

Francisco Guillén Gámez has 24 connections with various authors, standing out for his dedication to creating research that analyzes the CDD (Digital Classification of Learning) from multiple perspectives, such as geography, gender, study time, and prior preparation, among others. Furthermore, he has established links that demonstrate the relevance of the CDD, such as its impact on the success of academic studies or on the use of technological tools.

In the case of Carmen Llorente Cejudo, she has participated in the validation and testing of tools designed to measure digital competence. She has also investigated the effect of various variables, such as age, gender, and experience, on digital competence. Furthermore, she has analyzed how the COVID-19 pandemic has influenced students' perceptions of their teachers' digital competence. The authors' relationship is represented in Figure 6.

Figure 6. Co-authorship on CDD



Source: Own elaboration

Word co-occurrences in title and summary

An analysis was conducted of the most frequently used words in the titles and abstracts of the articles included in this review, as well as their relationships. This network consists of four interrelated clusters and describes the key actors, variables, motivations, and elements that have influenced the various studies analyzed.

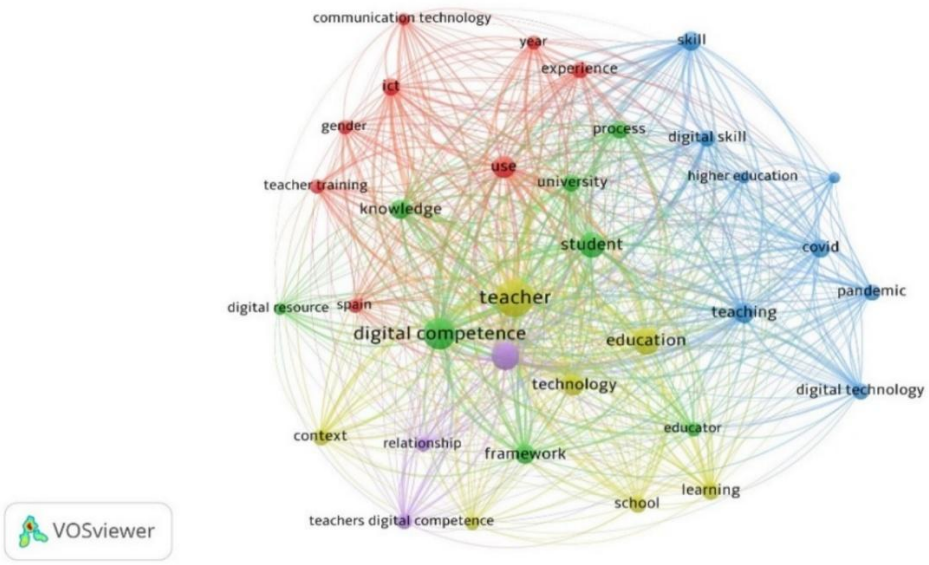
The first set is located in the center and is shown in green. This examines the main actors and elements addressed in the various articles, including digital skills, teachers, students, universities, as well as frameworks and processes.

The second cluster is located on the left and is represented in red. It contains variables that influence the studied results, of a personal and sociodemographic nature, such as gender, country, teaching experience, year, teacher status, and the teacher's access to ICT resources.

The third cluster, represented in blue, shows the reasons that have driven the study of the CDD, highlighting the pandemic caused by COVID-19, the need for the use of digital technologies, the evolution of teaching and the analysis of the digital skills of educators.

The last group is similar to the first and is located in the center, represented in yellow. It includes the actors and elements examined, such as teachers, education, learning, school, technology, and context. The association between the most frequent words in the title and the abstract is shown in Figure 7.

Figure 7. Co-occurrences of words in titles and abstracts on CDD



Source: Own elaboration

Discussion

Several previous studies using bibliometric analyses have shown a marked increase in the publication of articles focused on CDD after the emergence of the COVID-19 pandemic (Aydin and Yildirim, 2022; De La Cruz et al., 2023; Toribio-López, 2023). However, other studies have detected a significant decrease in article production in recent years (Cisneros-Barahona et al., 2023; Paredes-Marín, 2024) , in contrast, these latter studies opted to use the Scopus thesaurus as a database, which could have influenced the differences observed in productivity with the present study.

According to various bibliometric analyses carried out to date, Spain is the undisputed leader in terms of the contribution of countries to the production of scientific articles (Aydin and Yildirim, 2022; Laje, 2020; Toribio-López, 2023).

Spain stands out in scientific research in the field of disability and is consolidating its commitment to knowledge creation in this area. Furthermore, this leadership in scientific output reflects the reach of research activity carried out by Spanish institutions and the presence of Spanish researchers internationally.

On the other hand, in the specialized literature, Julio Cabero Almenara is recognized as one of the most prominent authors in recent years, both for his volume of work and for his relevance in the field of digital teaching competencies (De La Cruz et al., 2023; Toribio-López, 2023). His extensive research indicates a continuous commitment to advancing knowledge in this field, and his influence on other research suggests the relevance and scope of his work.

Regarding the semantic networks revealed by the co-occurrence of keywords, similarities with previous research are noteworthy. These studies have identified various variables explored in this research, such as the pandemic, frameworks, ICTs, and skills. Furthermore, elements that influence the results, such as teacher experience and training, are repeated (De La Cruz et al., 2023; Toribio-López, 2023).

It is important to note that this study has several limitations, which could affect the coverage and representativeness of the overall literature. In particular, the period analyzed, the language of the publications, and the database used may restrict the scope of the study. These limitations could lead to differences in the generalizability of the results in future bibliometric analyses. However, it is crucial to emphasize that they do not compromise the internal validity of the methodological procedure employed. Despite these limitations, the results obtained provide useful and significant information on the topic of study.

Conclusions

This study concludes that the productivity of the corpus of English-language scientific literature on digital teaching competencies has experienced sustained growth since the emergence of the COVID-19 pandemic. Between 2020 and 2021, an increase was observed, followed by more moderate growth in 2022 and a rebound in 2023. This phenomenon suggests a steadily increasing interest in research on this topic, which could be related to the need to adapt to the educational changes brought about by the pandemic.

Furthermore, it was demonstrated that Spain has the highest number of publications on CDD, and is also the country of origin of the leading researchers in this field. Researchers Julio Cabero Almanera and Antonio Palacios Rodríguez stand out for their significant number of publications, as do Francisco Guillén Gámez, Julio Barroso Osuna, Carmen Llorente Cejudo, and Julio Ruiz Palmero, who have also made substantial contributions. This finding underscores Spain's prominence in CDD research and development.

Bibliometric analyses of the journals that published the 232 scientific articles reveal a distribution of scientific output. *Sustainability stands out* as the most prominent journal, closely followed by *Education. Sciences* and *Education and Information Technologies.* This distribution underlines the importance of these journals in the research and development of digital teaching competencies in the academic field.

The authors' co-authorship networks reveal three main areas of focus. The first, led by Julio Cabero Almenara and Antonio Palacios Rodríguez, demonstrates a strong research partnership and a line of inquiry centered on validating instruments and frameworks for assessing teachers' digital competencies, along with applied research that identifies the critical factors influencing the success or failure of online learning initiatives. In the second area, Francisco Guillén Gámez emphasizes the different perspectives on digital teaching competencies. In the third area, Carmen Llorente-Cejudo has focused on analyzing the effects of various factors, such as COVID-19, on students' perceptions of their teachers' digital competencies and on validating instruments for measuring digital teaching competencies.

The variables analyzed in these core areas include the validation of instruments, assessment frameworks for digital learning outcomes, critical factors for the success or failure of online learning initiatives, effects of COVID-19, student perception of teachers' digital learning outcomes, and the validation of instruments to measure digital learning outcomes.

The analysis of word co-occurrences in the title and abstract reveals a complex network of four interconnected groups, encompassing a wide range of actors, factors, motivations, and components influential in the field of teacher digital competence research. Teachers and students are the key actors in the first set of analyses. The second examines individual and sociodemographic factors, such as gender, country, teaching experience, and access to technology, that affect outcomes.

The main drivers of the research are mentioned in the third group, with particular emphasis on COVID-19, the need to use digital technology, the evolution of education, and the assessment of educators' digital skills. The final group emphasizes the key components, including educators, students, technology, and context. These findings illustrate the complexity and diversity of factors and elements that comprise research on teachers' digital skills.

Future lines of research

For future lines of research, it is proposed to conduct bibliometric analyses, such as co-authorship analysis, keyword co-occurrence analysis, and citation analysis, using various databases such as Scopus , Redalyc, or SciELO, and to extend the analysis period to previous years. Similarly, documents published in languages other than English, which have seen a surge in the field of DDC in recent years, such as Spanish or Mandarin, could be included.

These additions would improve comparability between sources, broaden regional coverage, and reduce language bias, thus contributing to a more comprehensive and varied exploration of the digital skills literature landscape.

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