
Training in digital competence of teachers of primary and early childhood education in Spain. A bibliometric review of the literature

Formación en competencia digital del profesorado de educación primaria e infantil en España. Una revisión bibliométrica de la literatura

西班牙小学和幼儿教育教师的数字能力培训. 关于相关文献的文献计量学综述

Обучение цифровой компетентности учителей начального и дошкольного образования в Испании. Библиометрический обзор литературы

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Resumen

La competencia digital es esencial en la formación del profesorado en los centros educativos, sin embargo, las investigaciones muestran la forma en la que ésta sigue sin ser efectiva y de calidad. De aquí parte el propósito de esta investigación con un análisis bibliométrico descriptivo de la literatura existente sobre la formación en competencia digital del profesorado de educación primaria e infantil en España. Utilizando los metadatos de 45 publicaciones indexadas en la base de datos Scopus y apoyados en los programas Bibexcel y VosViewer. Para su análisis hemos hecho uso de diferentes técnicas bibliométricas (acoplamiento bibliográfico, co-citación y co-ocurrencia).

Los resultados muestran una tendencia al alza en lo que respecta a publicaciones sobre la temática, con una mayor repercusión en las ciencias sociales; igualmente, la co-ocurrencia muestra la forma en que las temáticas de investigación actuales versan sobre la formación del profesorado, la COVID19 o el aprendizaje online. Del mismo modo, la revisión de la literatura muestra la enorme carencia que sigue habiendo en la formación que ha recibido o está recibiendo el profesorado con respecto a la competencia digital.

Finalmente, se discuten los hallazgos y se concluye con la necesidad de seguir investigando sobre las dimensiones metodológicas, organizativas y/o normativas que influyen en el desarrollo de las competencias digitales en el profesorado.

Palabras clave: análisis bibliométrico, tecnología educativa, competencia del docente, formación universitaria.

Abstract

Digital competence is essential in teacher training in schools. However, research shows that they are not yet effective nor do they have quality.

The purpose of this research was to carry out a descriptive bibliometric analysis of the literature on the training in digital competence of teachers of primary and early childhood education in Spain using the metadata of 45 publications indexed in the Scopus database and supported by the Bibexcel and VosViewer programs. For analysis we have used different bibliometric techniques (bibliographic coupling, co-citation and co-occurrence).

The results tell us that we are in an upward trend in terms of publications on the subject, with a greater impact on the social sciences; likewise, the co-occurrence shows the way in which current research topics deal with teacher training, COVID19 or online learning. In the same way, the review of the literature shows the lack of training that teachers have received or are receiving with respect to digital competence.

Considering the results, the main conclusion refers to the need to continue researching the methodological, organizational and/or regulatory dimensions that influence the development of digital skills in teachers.

Keywords: bibliometric analysis, educational technology, teacher competence, university education.

概要

对数字能力的培养对于学校教师至关重要,但是,研究表明它仍然没有起到应有效果且质量不高。由此,本研究的目的是对有关西班牙小学和幼儿教育教师数字能力培训的现有文献进行描述性文献计量分析。使用在 Scopus 数据库中索引并由 Bibexcel 和 VosViewer 程

序支持的 45 种出版物的元数据。对于它的分析,我们使用了不同的文献计量技术(文献匹配、共引和共现)。

结果显示该主题的出版物呈上升趋势,对社会科学的影响更大;同样,这种共现现象表明了当前研究主题处理教师培训、COVID19 或在线学习的方式。同样,对文献的回顾表明了文献如何影响教师已经接受或正在接受的数字技能培训中继续存在的巨大缺陷。

最后,我们对调查结果进行了讨论。得出的结论是,需要对影响教师数字技能发展的方法、组织和/或监管方面进行进一步研究。

关键词:文献计量分析,教育技术,教师能力,大学教育。

Аннотация

Цифровая компетентность необходима для подготовки учителей в школах, однако исследования показывают, что она все еще не является эффективной и качественной. Цель данного исследования - провести описательный библиометрический анализ существующей литературы по обучению цифровой компетентности учителей начальной школы и младших классов в Испании. Использованы метаданные 45 публикаций, индексируемых в базе данных Scopus и поддерживаемых программами Bibexcel и VosViewer. Для его анализа мы использовали различные библиометрические методы (библиографическая связь, совместное цитирование и совпадение). Результаты показывают тенденцию к росту числа публикаций по данной теме, причем большее влияние оказывается на социальные науки; аналогичным образом, совместное цитирование показывает, что текущие темы исследований касаются подготовки учителей, COVID19 или онлайн-обучения. Аналогичным образом, обзор литературы показывает, что она указывает на огромный пробел в подготовке, которую получили или получают учителя в отношении цифровых компетенций. В заключение мы обсуждаем полученные результаты и делаем вывод о необходимости дальнейших исследований методологических, организационных и/или нормативных аспектов, которые влияют на развитие цифровых компетенций у учителей.

Ключевые слова: библиометрический анализ, образовательные технологии, компетентность преподавателя, университетское образование.

Introduction

The promulgation of the Organic Law of Universities 6/2001 of December 21 responds to a process of convergence towards a community model of higher education with the purpose of improving the skills development of students (Rodrigo & Almirón, 2013). In this context in which competence development is promoted, different international documents (COM, 2003; eEurope, 2002) stated two decades ago the importance of developing digital competence in teachers in training so that they would use innovative pedagogies in the classroom.

As Cózar and Roblizo (2014) state, digital competence is an important competence in the training of 21st century teachers. Despite its importance, however, the authors remind us that the new European Education system has eliminated the subject "New technologies applied to education". This situation has caused the development of ICT as a transversal competence.

This is a controversial issue, especially when different studies (Gallego et al., 2010; Prendes et al., 2010; Tello & Aguaded, 2009) point to the need to improve the training of new teachers in the use of ICT applied to education, that is, to develop digital competence in Education students. In this regard, the Ministry of Education, Culture and Sports of Spain (2015) defines digital competence as:

Digital competence implies the creative, critical and safe use of ICT to achieve objectives related to work, employability, learning, the use of free time, inclusion and participation in society. This competence supposes the adaptation to the changes that new technologies introduce in literacy, reading and writing, skills that allow one to be competent in digital environments (Order ECD/65/2015)

Digital competence is defined as the set of technological, communicative, media and informational tools, knowledge and attitudes as the result of a complex and multiple literacy process (Gisbert et al., 2016). The acquisition of digital competence requires the development of five dimensions —information, communication, content creation, security and problem solving— (Ferrari, 2013; INTEF, 2017) and going through a phase of digital literacy, another of deepening in knowledge and another of knowledge creation (UNESCO, 2011).

The Ministry of Education and Vocational Training of Spain (MEFP, 2022) has agreed at the sectoral conference on education that digital competence must be accredited before 2024 by all educational administrations as one of the key elements in the transformation of the Spanish educational system.

With the Resolution of May 4, 2022 of the General Directorate for Territorial Evaluation and Cooperation, the Spanish government has acquired a commitment with the European Commission in relation to the use of digital technologies, which considers that:

[...] in the educational context, its presence must be considered. On the one hand, as a competence, together with literacy and calculation, it forms part of the basic literacy of all citizens in the compulsory educational stages and adult education, and it is an essential element of academic and professional training in the post-compulsory teachings. On the other hand, teachers and students must use them as tools to develop any other type of learning (BOE, May 4, 2022).

The development of digital competence in teachers requires a training framework that contributes to the development of what is called digital teaching competence (CDD), that is, that teachers acquire a series of skills, attitudes and technological knowledge so that their students can acquire knowledge and skills that will enable them to be active participants in the digital world (Hall et al., 2014).

Considering the importance that the development of digital skills has in the training of new teachers, we approached this research with the purpose of analyzing from a bibliometric perspective the scientific production and the most relevant studies that have been developed on the subject in our country.

Methods

This research is part of what is known as a systematic review of the literature (RSL) (Cuevas et al., 2022; Gabarda et al., 2022) with bibliometric contributions (Lechuga et

al., 2021; Meneses & Becerra, 2020; Novo & Fuentes, 2022). We focus on the quantitative analysis of bibliometric data on a specific topic (Gil et al., 2020), providing information on production by country, citations, authors, etc. In this case, we focused on the digital competence of teachers in training of primary and early childhood education in Spain.

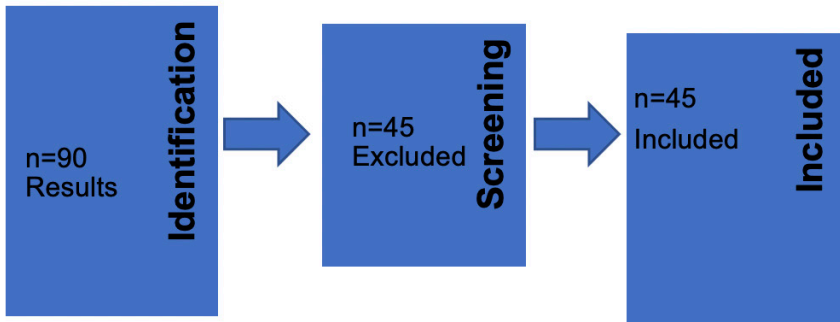
The research revolves around a central question 1) What do the main investigations show on Digital Competence in teachers in training and active teachers of primary and early childhood education in Spain?, and in particular, we have the purpose of finding out 2) What bibliometric characteristics do these studies present?, and 3) What future challenges are posed in teacher training on this topic? Like other investigations such as that of Colomo et al. (2022), we have used the Scopus database. As Marín-Suelves and Ramón-Llin (2021) and Torralbas et al. (2021) state, this database has a greater temporal coverage, number of documents, etc.

The research has been developed in three phases, [F1] generation of the search equation, [F2] choice of documents, and [F3] analysis of the results. The descriptors and booleans used were TITLE-ABS-KEY "digital competences" OR "digital Skills" OR "TIC" AND "Teacher training" AND "children's school" OR "primary school" OR "elementary School" and 90 results have been found as of September 20, 2022.

Following the indications of the PRISMA declaration (Page et al., 2021; RSF, 2019) (See Figure 1), the results have been refined based on the proposed objective and, therefore, only the articles associated with Spain [Country/Territory] (n=45) and ignoring the rest of the documents found in other countries and other types of documents [5 conference paper; 1 Book chapter; 1 conference review].

Figure 1

Bibliometric analysis flowchart



Due to the small number of articles, we decided not to select a specific time spectrum; therefore, the publication of the first article on this subject [year 2012] has been considered as a starting point. 45 articles have been selected: 32 correspond to the field of Social Sciences, 8 to Psychology, 2 to Arts and Humanities and 1 to Computer Sciences. In addition, 25 of them are written in English and 20 in Spanish.

Regarding the articles published according to the theme per year, and as we present in Table 1, we can see an upward trend in which a large part of the total research accumulates in the last three years (53.2% of the total production).

Table 1*Number of publications per year*

Year	Number of publications	Percentage
2022	10	22.2%
2021	7	15.5%
2020	7	15.5%
2019	3	6.6%
2018	4	8.8%
2017	8	17.7%
2016	3	6.6%
2015	0	0%
2014	1	2.2%
2013	1	2.2%
2012	1	2.2%
Total	45	100%

In the first phase we have used different bibliometric techniques: a) analysis of scientific production (year, periodicity, country, etc.), b) co-occurrence analysis (most used keywords, relationships between keywords and research lines and research topics) considering the social, intellectual and conceptual structure (Aria & Cucurullo, 2017; Colomo et al. 2022), c) co-citation (how the articles cite each other, and finally, d) the bibliographic coupling (similarities between the references shared by the selected articles).

The Bibexcel and Vosviewer software have been used to analyze the selected documents, in this sense, Vosviewer is one of the best computer applications for developing works and presentations of bibliometric nodes.

In the second part of the research, supported by the variables that we reflect in Table 2, we present a systematic review of the literature (Cuevas et al., 2022; Santana & Perez, 2020).

Table 2*Analysis variables and inclusion and exclusion criteria*

Variable	Inclusion criteria	Exclusion criteria
Year of publication	All registered articles	None
Área de Indexación	>50 publications and matching topics	None

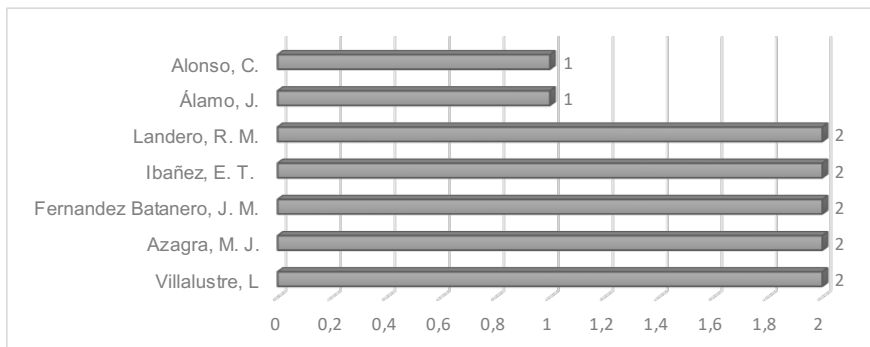
Variable	Inclusion criteria	Exclusion criteria
País	Spain	Other countries
Tipo documento	Articles published in scopus	Contributions to conferences, book chapters, abstract or without full access.
Publicaciones con más citas	10 most cited	Publications with less than 5 citations

Results

In order to respond to the proposed purposes, we want to present the most relevant results below. Considering the academic production by authors, we find authors such as Fernández Batanero, Lourdes Villalustre, Azagra, Ibañez and Landero with two publications on the topic of study and followed by Judit Álamo del Claret —Las Palmas School— and Alonso (n=1) (Figure 2).

Figure 2

Publications by author



As can be observed, in terms of universities, there are a total of five universities (Oviedo, Salamanca, Valencia, Alicante and Sevilla) that are positioned at the top of the list in Spain in terms of production (n=3) (V. Figure 3).

Figure 3

Production by Spanish universities

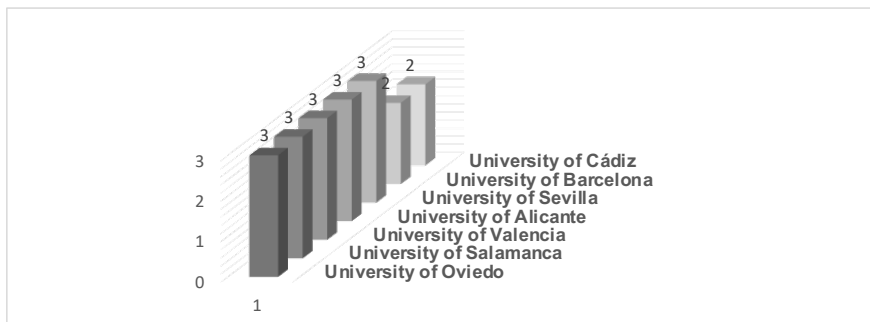
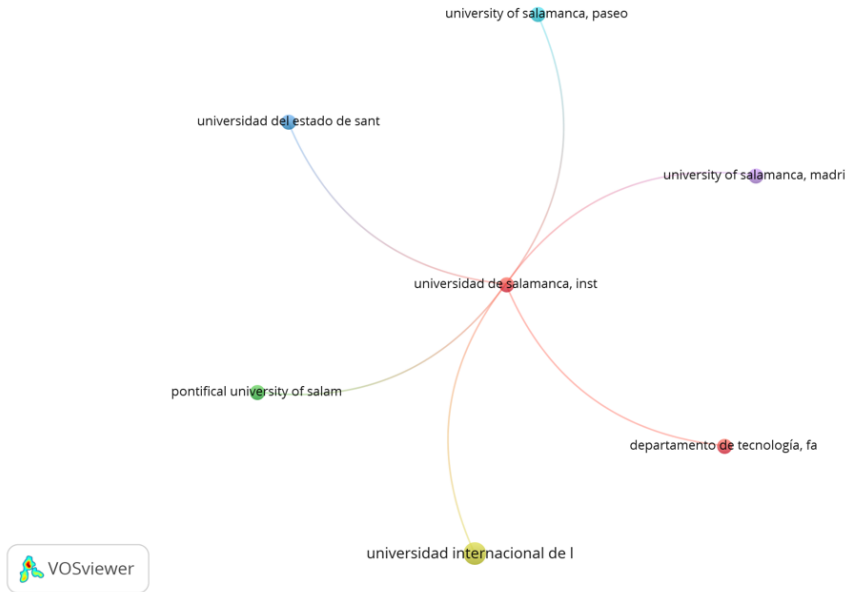


Figure 4 shows a weak link in relation to the inter-university scientific citation index with respect to the topic of study. In this sense, it is observed how the papers published by the University of Salamanca are the most cited by other universities.

Figure 4

Citation map by universities



By analyzing the journals that have published the largest number of articles on the topic of study in the Scopus database (See Table 3), it can be seen how the journals *Cultura y Educación* (n=2), *Education Sciences* (n=2), *Education Journal of Teacher Education* (n=2), *Ocnos* (n=2) and *Sustainability Switzerland* (n=2) are the ones with the largest number of articles, however, we identified a trend of very few publications. In terms of impact factor (JIF), it is significant to check how the five journals occupy the first quartile (Q1) in the Scopus database.

Table 3

International-national journal publications

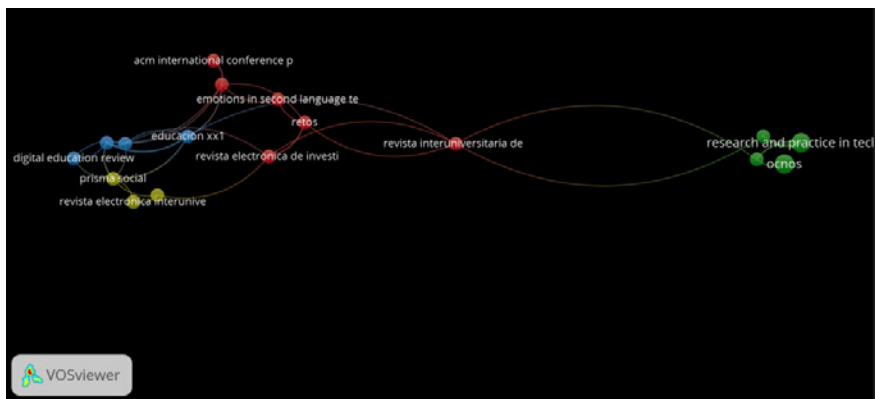
Journals	Number of documents	Year
Cultura y Educación	1	2017
	1	2018
Education Science	1	2022
	1	2021
Educaccao e Pesquisa	2	2022

Journals	Number of documents	Year
Education Journal of Teacher Education	1	2017
	1	2020
Ocnos	2	2016
Sustainability Switzerland	1	2020
	1	2021

The bibliographic coupling analysis is high among all the journals, showing 17 items and four differentiated coupling groups or clusters, which represents little dispersion as well as interconnections between the journals. In this sense, we highlight journals such as Educatio XXI [59 citations 9 Total Link Strength] or RIE [54 citations and 8 Total Link Strength] as the most cited.

Figure 5

Bibliographic coupling links with other sources



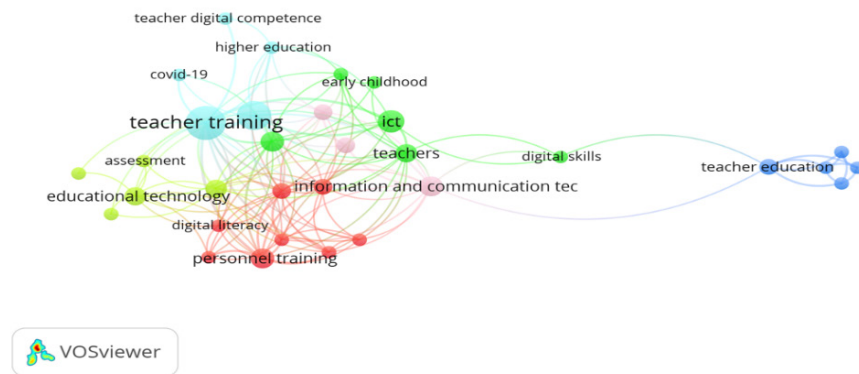
These results are directly connected to Bradford's Law of Dispersion (1934), whereby a certain amount of scientific research on a very specific topic tends to focus on a limited selection of journals without any dispersion.

Conceptual structure: co-occurrence analysis

The keywords used in the research articles determine the topics and contents of the research (Ramos-Meza, 2021), therefore, analyzing the co-occurrence network of the keywords they use provides us with essential information on related topics [conceptual link] and topics used in the study of digital competence in teacher training in primary and early childhood education in Spain (Figure 6).

Figure 6

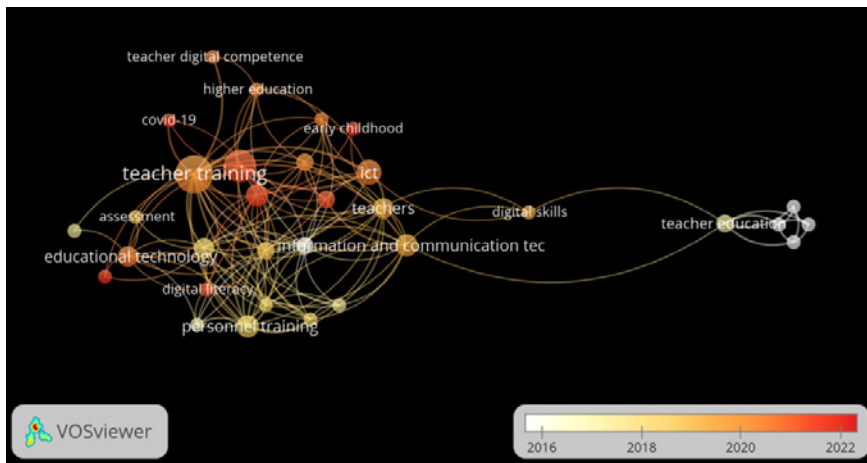
Co-occurrence of keywords with respect to the subject of study



The indicator of co-occurrence in the overlay of thematic visualization by years (Figure 7), shows how three temporal blocks have been marked. In the 2016-2018 time spectrum, the main topics are related to *Communication competence, Linguistic competence or Information and communication technologies*. Regarding the 2018-2020 time spectrum, we can see that the topics focus on terms such as *Teachers, Digital Skills, Higher Education, Teachers training*. Finally, the block of articles published between 2020 and 2022 considers topics that revolve around concepts such as *Digital Competence, COVID19, Online learning or Digital Literacy*, among others.

Figure 7

Co-occurrence of keywords by temporary blocks



After analyzing 31 articles, 170 keywords were suggested, and 32 of them were suggested more than twice. Therefore, if we consider the way in which these are correlated with each other, it can be seen how they are grouped around six differentiated clusters that are related to 15 descriptors (Table 4).

Table 4*Main elements in Thematic Clusters ordered by strength*

Cluster	ID	Keywords	Occurrence	Strength
C5	252	Teacher training	14	38
C5	329	Digital Competence	10	23
C3	321	Education	3	22
C1	462	Personell training	5	22
C2	465	Teacher	4	19
C1	21	Teaching	3	18
C4	117	Digital Competences	4	16
C6	150	Information and Communication technologies	5	16
C2	239	Primary Education	5	16
C1	177	Digital Literacies	2	15
C2	178	ICT	6	15
C6	179	Early Childhood Education	3	12
C4	360	Educational Technologies	4	12
C1	440	Students	2	12
C2	331	Technology	2	10

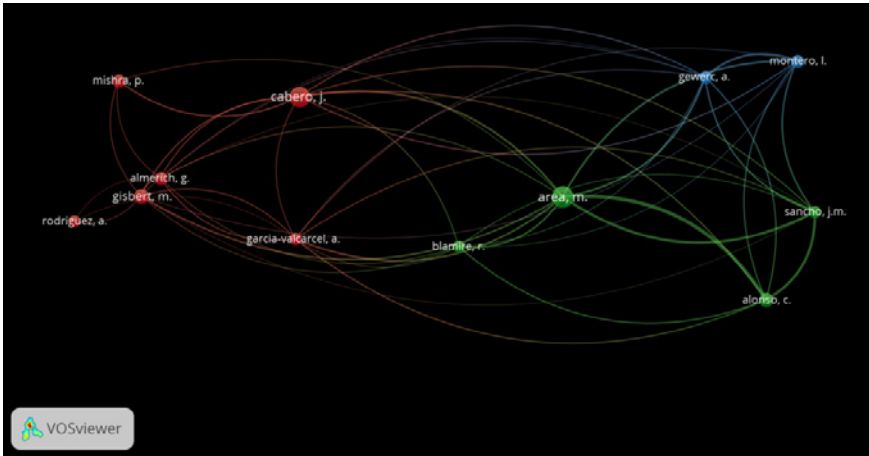
This information allows us to understand how research on Digital Competence in teachers in training has been taking shape. In this sense, the fact that there are six clusters shows us the way in which there is a great diversity of research topics that are not related to each other and that are configured as another research domain.

Intellectual structure: co-citation analysis

Intellectual analysis is considered as a complement to co-occurrence analysis (Colomo et al., 2022), and allows us to analyze what the author citation levels are when two or more documents are cited together. As can be seen from Figure 8 and using the “minimum 7 citations” criterion, we observe that three differentiated clusters are created. The first of them, with 13 elements, includes authors who stand out for their high co-citation index (Cabero, 18 citations and 348 total link strength; Gisbert, 10 citations and 127 total link strength; Almerich, 13 citations and 18 total link strength). In the second cluster we find 12 authors among whom Manuel Area appears as the most cited author [23 citations and 216 Total Link Strength]. In the third, we found 11 authors among whom Adriana Gewerc Barujel from the University of Santiago de Compostela stands out [9 citations and 88 Total Link Strength].

Figura 8

Analysis of co-citation by authors



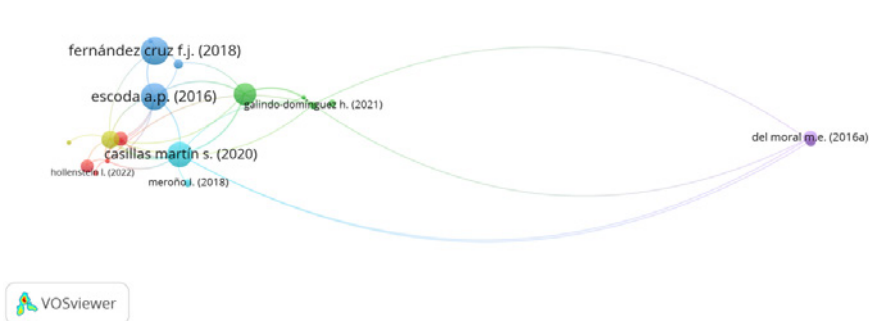
As previously indicated, there are three differentiated co-citation clusters. This data informs us of the way in which the theme tends to be concentrated in a rather limited set of authors who cite each other. As we have commented, there is a cluster with five authors that indicates the dispersion in terms of the basic references used in each research article in the sample.

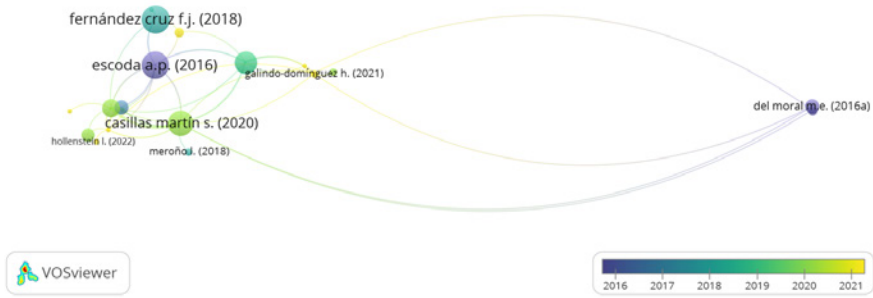
Social Structure: Analysis of bibliographic coupling

The bibliographic linkage analysis offers us a measure of similarity when two or more papers refer to a common work (Colomo et al., 2022). In this sense, the inclusion criterion used has been two documents and five citations. As shown in Figure 9, there are 4 coupling clusters. In the first cluster we find authors such as Fernández Cruz et al. (2018) with 59 citations and 12 total link strength. In the second place we find Escoda and Rodríguez with their 2016 article which has 54 citations and 10 total link strength. In the third of the clusters (C2) appears Casillas et al. (2020) with 50 citations and 21 total link strength and in the fourth (C3) we find Girón-Escudero et al. (2019) with 38 citations and 11 total link strength. Finally, we find Del Moral et al. (2016a) with 16 citations and 34 total link strength.

Figure 9

Bibliographic coupling by articles





The bibliographic link between the works is quite limited, only 6 of the 30 investigations are linked to each other. This represents the little similarity between the cited documents and the authors. In other words, the analyses show a high dispersion in relation to the bibliographic references that the authors have used in the analyzed investigations.

To develop the second part of the research, identifying and content variables have been considered (Cuevas et al., 2022; Gabarda et al., 2022), in the same way, the relevance of the articles has been considered [cited by (highest)] and the main author (h-index) (Table 5).

Table 5
Analysis variables

Dimensions	Content variables
Year	Sample
Country	Purposes
Authorship	Results
Language	
Total citations	
Citations per year	
<i>The first author h-index [productivity and citation impact]</i>	

Table 6
Literature review in Spain

Year	2010
Title	Competencias para el uso de TIC de los futuros maestros
Authors	Paz Prendes, M ^a ., Castañeda, L. y Gutiérrez, I.
Language	Spanish

Year	2010
Sample	482 students of Primary Education (34%) of Foreign Languages (16%), Special Education (24%) and Music Education (26%)
Purposes	Find out what are the training competences of the teaching students of the University of Murcia.
Results	Future teachers did not show problems with the use and configuration and installation of ICTs and the analyses show low scores in the automation, creation, editing and evaluation mechanisms.
Citations	62
Average number of citations per year	4.7
The first author h-index	42

Year	2018
Title	El proceso de integración y uso pedagógico de las TIC en los centros educativos madrileños
Authors	Fernández Cruz, F.J., Fernández Díaz, M.J., Rodríguez Mantilla, J.M.
Language	Spanish
Sample	1433 teachers of Primary and Secondary Education in Madrid.
Purposes	Analyze the characteristics of the Primary and Secondary schools of the Community of Madrid in relation to the ICT Competence profiles of teachers
Results	The use of ICTs in educational centers depends on teacher training, competency profiles and available resources.
Citations	59
Average number of citations per year	11.8
The first author h-index	6

Year	2016
Title	Evaluación de las competencias digitales autopercibidas del profesorado de Educación Primaria en Castilla y León
Authors	Pérez Escoda y Rodríguez Conde
Language	Spanish
Sample	63 Primary Education teachers in Castilla y León from 9 rural and urban centers in 8 provinces

Year	2016
Purposes	1) Identify the basic components of digital competence. 2) Develop the descriptors for a common conceptual framework. 3) Propose a plan for the implementation and review of the conceptual framework, as well as propose the descriptors of said competence at all levels (initial, intermediate and advanced).
Results	The results show that there are few teachers with a sufficient level of digital skills to innovate in the classroom and that the training of Primary Education teachers in Castilla y Leon in digital skills is a necessity.
Citations	54
Average number of citations per year	9
The first author h-index	11

Year	2020
Title	Digital competence of early childhood education teachers: attitude, knowledge and use of ICT
Authors	Casillas Martín, S., Cabezas González, M. y García Peñalvo, F. J
Language	English
Sample	308 primary school teaching students.
Purposes	Evaluate the way in which students self-assess their digital competence.
Results	The students self-assess their attitude towards ICT as favorable, although they consider that their management is moderate and their knowledge is limited.
Citations	50
Average number of citations per year	16.6
The first author h-index	8

Year	2019
Title	Análisis de la autopercepción sobre el nivel de competencia digital docente en la formación inicial de maestros/as.
Authors	Girón- Escudero, Cózar-Gutiérrez, R. & González-Calero Somoza, J.A.
Language	Spanish
Sample	117 students of the 4th year of the Teacher Degrees in Early Childhood Education and Primary Education of the Faculty of Education of Albacete

Year	2019
Purposes	Analyze the digital teaching competence in the students of the Early Childhood and Primary Education Degree using the model of the "Common Framework of Digital Teaching Competence" of the INTEF (2017).
Results	Students show a basic level of digital competence at the end of their studies characterized by simple tasks (search for tutorials for the creation of digital content, store files, include some hyperlink). Likewise, they only know the basic technical characteristics of digital devices and the tools with which they carry out their work in the classroom.
Citations	38
Average number of citations per year	9.5
The first author h-index	10

Year	2020
Title	The Challenge of Initial Training for Early Childhood Teachers. A Cross Sectional Study of Their Digital Competences
Authors	Romero-Tena, R., Barragán-Sánchez, R., Llorente-Cejudo, C., Palacios-Rodríguez, A.
Language	English
Sample	535 students in the 4th year of the Degree in Early Childhood Education at the University of Seville.
Purposes	Assess the degree and type of self-perceived digital competence before and after taking the subject "Information and communication technologies applied to early childhood education"
Results	Students have a medium-high perception of their digital skills in all the areas included in the study, although the areas of communication and collaboration ($\bar{x} = 6.04$; $\sigma = 7.62$) and critical thinking ($\bar{x} = 6.22$; $\sigma = 1.79$) received the lowest scores.
Citations	25
Average number of citations per year	8.3
The first author h-index	7

Year	2016
Title	Relatos digitales: activando las competencias comunicativa, narrativa y digital en la formación inicial del profesorado
Authors	Del-Moral, M ^a E., Villalustre, L. y Neira, M ^a R.
Language	Spanish

Year	2016
Sample	143 students of the Primary Education Teaching Degree at the University of Oviedo (2012-2013).
Purposes	Evaluate the level of communicative, narrative and digital competence linked to the design of stories in digital environments.
Results	The students in training have great skills with technology and the use of computer applications (88.8%), audiovisual projects (48.8%) and with the creative process (84.4%).
Citations	16
Average number of citations per year	2.2
The first author h-index	8

Year	2021
Title	The ethical dimension of digital competence in teacher training
Authors	Novella-Garcia, C. y Cloquell-Lozano, A.
Language	English
Sample	118 study plans from Spanish universities
Purposes	Find out how digital competence is approached in teacher training in different Spanish universities.
Results	Digital competence is implanted in most of the study plans of Spanish universities. However, it does so from an instrumental perspective. Only 26.1% of all teaching guides incorporate the ethical dimension in subjects related to the use and learning of ICT.
Citations	7
Average number of citations per year	3.5
The first author h-index	2

Year	2021
Title	Digital competence in the training of pre-service teachers: Perceptions of students in the degrees of early childhood education and primary education.
Authors	Galindo, H. y Bezanilla, M. J.
Language	English
Sample	200 students of Primary Education (154) and Early Childhood Education (46).
Purposes	Evaluate the digital competence profile of early childhood and primary education teachers in training.

Year	2021
Results	The results show that future teachers have a medium level of digital competence and have some difficulties with the dimension related to content creation. Likewise, the results show how over the years, and sometimes throughout the courses, the dimensions of teacher digital competence improve significantly.
Citations	5
Average number of citations per year	2.5
The first author h-index	5
Year	2018
Title	Primary school student and teacher perceptions of competency-based learning
Authors	Meroño, L., Calderón, A., Arias-Estero, J. L. y Méndez-Giménez, A.
Language	English
Sample	8,513 primary school students from 58 schools and 1,010 primary school teachers from 110 schools.
Purposes	Analyze the perception of primary school students and teachers about learning based on student competencies.
Results	The perception of the students was higher [especially from 3rd grade on] than that of the teachers, except in the case of digital competence. In the teaching staff, a high correlation is detected between the perceptions about the acquisition of the students' competences.
Citations	5
Average number of citations per year	1
The first author h-index	7

As we have presented in the previous table, the research refers to the training of teachers in digital skills [in training or active]. We understand that, as Carrera and Coidur (2012) point out, knowing the perception that teachers have about their digital skills is a highly researched topic. In this sense, the results are contradictory, since, on the one hand, we find studies such as those by Paz Prendes et al. (2010) or Fernández Cruz et al. (2018), which show that the level of ICT skills of teachers in training of Primary and Early Childhood Education is very low, and on the other hand, research such as that of Galindo and Bezanilla (2021) and Del Moral et al. (2016), indicate that the level of teachers in training is medium or high compared to other skills, respectively.

Undoubtedly, we find an important dimension in the training of students. In this regard, the study by Meroño et al. (2018) shows that teachers in training perceive digital

competence as a key element in their professional development, they consider that they have no problems introducing and working with ICTs in the classroom (Prendes et al., 2010) and they perceive themselves qualified by training to do so (Romero Tena et al., 2020).

Discussion and conclusions

Considering the scientific research focused on the training in digital competence in teachers and the results obtained, we can affirm that we find ourselves with an incipient topic of study and, still, little researched in Spain. In this regard, and if we consider the journals indexed in the scopus database, since it is a recent topic, we do not find a large scientific production and the few that exist are concentrated in a small group of journals.

This reality is perceived when we analyze the number of articles found, the authors, the number of journals, the universities and the inter-university scientific production that have been published on the subject. Undoubtedly, this is a worrying situation, even more so when various authors (Paredes et al., 2015; Sancho-Gil et al., 2015) point out that the ICT training received by undergraduate students in teacher training programs does not meet the requirements and does not contribute to the digital literacy of teachers in training (Guzmán-Simón et al., 2017). We find two dimensions that challenge us as teachers and researchers to broaden the spectrum of research on digital competence and training of Education students. In this sense, it stands out that scientific production has increased significantly over the last 3 years: between 2012 and 2019 46.6% (n= 21) were published and during the last three years production has increased more than in the total of previous years [2020/2022 53.3% (n=24)]. That's a reality that reflects the importance and interest that the subject is acquiring.

It should also be noted that all the journals that deal to a greater extent with the studied topic are positioned in the first quartile (Q1). This fact informs us of two aspects, on the one hand, that we are dealing with "impact" journals that are interested in publishing articles on digital competence and the training of new teachers, and on the other hand, that these researches meet a series of characteristics and quality criteria.

Although terms such as "digital competence", "teachers in training" or "primary school" have been used in the search for the articles, the analyses show us that over six years (2016-2022), the concepts or keywords that have been incorporated into the research have varied depending on the educational and/or social situation and the terms that have been appearing. In this regard, and as indicated by Gisbert et al. (2016), the emergence of terms such as "digital competence", "digital literacy", "digital skills" or "21st skills", among others, contribute to the term digital competence becoming more complex and, therefore, they must use other terms to describe or define the research topics that revolve around the works that have the study of digital competence in students of the Education degree as their central axis. In this sense, we must consider that both the title and the keywords used are those that will facilitate the delimitation and description of the research (Murillo et al., 2017), and as demonstrated in this study, the terms "teachers in training" and "digital competence" are the ones that have a significantly greater concurrence. This data informs us that both concepts have a semantic and investigative load per se, and for this reason, they appear recurrently in many analyzed articles.

In relation to the citation of the articles, a relevant aspect is that there are only few citations and they are concentrated in a limited number of authors who self-cite each other. This data is one more sign that there is little research on the subject, and therefore, the authors have to rely on the few papers that are published in journals that occupy impact indexes.

As previously indicated, a systematic review of the literature has been carried out considering dimensions such as the relevance of the articles (total citations) and the main author (h-index). Among the selected articles, six of them address the level of digital competence of students in training, three of them the perceptions of active teachers and one of them analyzes the study plans of Spanish universities. Another significant aspect is that all the articles have samples that range between 63 and 9,500 participants and with the exception of two of them that use digital narratives and rubrics and analysis of dimensions, respectively, all of them use questionnaires that are appropriate as a research instrument. to the focus of intended study.

Considering the analyzed information and the results of the bibliometric analysis and the literature review, we conclude by indicating some issues that allow us to understand them as possible challenges:

- Although there is little scientific production on the development of digital skills in Education students, research has been increasing in recent years and existing publications have significant population samples, rigorous analyses and are published in journals with a high index of impact. All these aspects have contributed to the construction of a solid scientific corpus and the dissemination of the research that is being developed.
- Considering what authors such as Paredes et al. (2015) or Sancho-Gil et al. (2015) indicate about the little training in digital competence of teachers in training, research is needed on the methodological, organizational, and regulatory dimensions that limit the development of this competence in students (Casillas Martín et al., 2020).
- Finally, on the one hand, it should be noted that this study is a starting point that shows how little research has been carried out about the topic, and on the other hand, we would like to indicate that one of the limitations is that we have only considered the articles published in the Scopus database, since this decision has allowed us to ensure that the selected articles meet scientific quality criteria (Torralbas et al., 2021) and not make the mistake of analyzing duplicate articles (Colomo et al., 2022). At the same time, we find the real challenge in continuing to maintain this research environment which we entered three years ago and in ensuring that the scientific evidence has an impact on more and better trained teachers in digital skills.

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