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LITERATURE REVIEW

Digital Competence of Special Education Teachers: Impact, Challenges and Opportunities†

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Abstract

The digital training of teachers in general, and especially special education teachers, has become a key axis for transforming the education system in favour of quality education, equality and equity. This study provides a systematic review of the literature in four databases (Scopus, ERIC, Dialnet and Web of Science) on the level of digital competence of special education teachers during the period 2010–2021. A total of 25 studies were analysed. The results were organised according to the description of the studies (year of publication, country of production, methodological approach) and the conceptual analysis of the network, which allowed us to assess the impact, challenges and opportunities of the digital competence of special education teachers. The main results of the review show digital competence as a pending subject for special education teachers. In this sense, this review includes suggestions that can be carried out when developing training actions to improve the level of digital competence of special education teachers. This training is crucial for the learning and academic success of students with special educational needs.

Keywords: digital competence; teacher education; special education; systematic review

In recent decades, our society has witnessed a spectacular transformation in terms of scientific developments and social changes. The impact on society and on education is increasingly visible, and we are in a permanent state of transformation and improvement due to the dizzying proliferation of information and communication technologies (ICT; De Moya Martínez & Cózar Gutiérrez, 2013).

ICT is a revolutionary and impactful phenomenon, encompassing both the technical and the social, and permeating all human activities — work, education, academia, leisure and consumption (Roblizo & Cózar, 2015). The incorporation of these tools in society, and in the field of education, has meant that the use of these technologies in the classroom has gone from being a possibility to becoming a necessity and a basic working tool for teachers and students, allowing the emergence of access to new spaces and effective and adaptable learning environments. Moreover, in addition to facilitating an innovative and creative approach, ICT also contributes to the elimination of barriers that impede the access of all people to education, especially for students with special educational needs (Starcic, 2010).

Thus, technologies have great potential to achieve the inclusion of students with special educational needs in society and in schools. However, the incorporation of ICT to address the educational needs of these students has, to date, been inadequate (Florian, 2003).

This focus on equality and equity is evident in all international initiatives over the last few decades, such as the UNESCO-WeiDong Group Funds-in-Trust Project 'Leveraging ICT to Achieve Education 2030' (UNESCO, 2017), which, over 4 years, will help participating member states to harness the

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potential of ICT to achieve Sustainable Development Goal (SGD) 4 by 2030. On 13 December 2006, the United Nations General Assembly adopted the international Convention on the Rights of Persons With Disabilities, which states that ratifying states should undertake or promote research and development on, and the availability and use of, accessible ICTs for persons with disabilities, including specific technical devices designed to improve the daily lives of persons with disabilities (United Nations, 2006). We therefore define ICT as the set of tools, resources and devices that enable access to information and communication and support student learning (Cabero-Almenara & Ruiz-Palmero, 2018). In addition, they increase students' motivation and interest, thus favouring their learning (Sevillano & Rodríguez, 2013). The use of these tools can make access to information difficult in the case of students with special educational needs, which is where the field of assistive technologies or adaptive technologies develops. Assistive technologies are resources to overcome access barriers to digital technologies and have a positive impact on improving the quality of life of students with special educational needs (Zappalá et al., 2011).

The implementation of these tools has magnificent advantages, but the process of integrating them into education requires teachers trained in digital competencies — that is, having the skills, attitudes and knowledge required to promote true learning in a context enriched by technology (Esteve-Mon et al., 2016). To do so, teachers must be able to use technology to enhance and transform classroom practices, remove barriers, design unique educational contexts and enrich students' development and identity (Hall et al., 2014). Digital training of teachers, and especially special education teachers, becomes a key axis for transforming the education system in favour of quality education, equality and equity.

In this context, it seems pertinent to carry out a study that analyses in depth different variables, both bibliometric and thematic, to provide researchers and those interested in digital competencies for teachers who support people with special educational needs with an updated overview of the scientific impact of these variables and perspectives of study, which allow difficulties and weaknesses to be detected and new challenges to be projected. In addition, we also consider such a study necessary for the following reasons: (a) Our study contributes to increasing the field of knowledge in relation to ICT and special education, and (b) the information obtained contributes to a better understanding of the knowledge structure of the scientific domain of ICT and the field of special education by analysing research articles published in high-impact journals. In this way, by identifying the lines of research and their interconnections, based on the information contained in the databases analysed, the understanding of this knowledge structure will be favoured. And, finally, knowledge of the scientific production analysed will provide insight into the development and evolution of ICT in the field of special education, making an effective contribution to reducing the possible digital divide due to special educational needs. Therefore, the aim of this study is to review, analyse and classify the existing scientific literature related to the level of digital competence of special education teachers. To do so, a systematic literature review was conducted to investigate research trends and identify emerging themes.

Research on Teachers' Digital Competence and Special Education

In the pedagogical field, learning with ICT to support people with special educational needs has been the subject of research for several decades, with a slight increase in recent years. In the case of Europe, the initial results of the project 'European Research Agendas for Disability Equality', which encourages the participation of civil society organisations to engage in research with academic institutions, where technology plays a predominant role, were published in 2010 (Priestley et al., 2010). In this paper, the authors focused on ICT as a support for learning in different domains (ICT access, teaching and learning methods, development and testing of ICT solutions, reviews, evaluations, articles on inclusion, social and behavioural development, documents, use of ICT as mediators to interact, digital games, etc.).

There have also been literature reviews (Fitzgerald et al., 2008; Liu et al., 2013; Perelmutter et al., 2017; Starcic & Bagon, 2014) that highlight, for the most part, the scarcity of research related to ICT as

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Table 1. Research Questions and Coding Criteria

Research questions	Coding criteria
RQ1. What is the general state of research in relation to the digital competence of special education teachers?	Year, country of publication, population
RQ2. Are special education teachers trained in digital competences?	Methodology, instruments, results of the studies
RQ3. What factors affect the success of digital training for special education teachers?	Results of the studies
RQ4. What is the conceptual network around the research on special education teachers' digital competence?	Word frequency and co-occurrence of keywords

support for learners with special educational needs. Researchers also note that the potential of ICT-supported learning for the inclusion of people with special educational needs has not been sufficiently explored.

Another area of action focusing on ICT as support for people with special educational needs has revolved around the professional development of teachers to prepare them for ICT use and educational inclusion — that is, to provide them with skills and competencies for their own professional learning and teaching. As such, studies have been carried out that report on the development of competencies in both initial (Starcic, 2010) and ongoing training (Fernández-Batanero et al., 2019) to design learning environments that respond to individual needs. Developing digital competence in the education system requires the correct integration of the use of technologies in the classroom and that teachers have the necessary training in this competence. The latter is probably the most important factor for the development of digital culture in the classroom and the alignment of the education system with the new 'network society' (Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado, 2017).

In the Spanish context, Muñoz Pérez and Cubo Delgado (2019) evaluated the digital competence of special education teachers towards technologies, concluding that it is the teacher of students with hearing impairment who has greater digital competence and is more competent in using technological tools and resources to manage and communicate personal and/or professional information. For their part, López Núñez et al. (2020) carried out a theoretical review on the digital competence of teachers to address the learning difficulties of students. This work highlights the scarce production of specific research related to teachers, despite the increase in the number of works on this topic in recent years.

Method

A systematic literature review methodology was used in accordance with the criteria and recommendations of the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) to systematically identify relevant studies in the literature (Moher et al., 2009). Thus, the systematic review process applied to this study consists of the following phases: (1) research questions, (2), data sources and search strategies, (3) eligibility criteria, (4) study selection and (5) data coding and synthesis. Each phase will be discussed in turn.

Phase 1. Research Questions

The review focused on three themes: digital competence of teachers, special education and ICT. To respond to the objective of the study, research questions (RQ), listed in Table 1, were established, which set the scope of the research and helped the research team to maintain clear boundaries during the implementation of the study.

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Table 2. Inclusion and Exclusion Criteria

	Included	Excluded
Population	Special education teachers or future special education teachers	Articles focusing on students or families
Phenomenon of interest	It should involve the analysis of the digital competence of special education teachers	Articles that do not assess digital teacher training
Context	Focused on the field of special education	Articles that address another educational field
Study design	Articles indexed in peer-reviewed scientific journals, of a quantitative, qualitative, or mixed nature, published between 2010 and 2021	Publications such as books, book chapters, conference proceedings, essays or review articles

Phase 2. Data Sources and Search Strategies

A systematic search of the literature published between 2010 and 2021 was carried out. To extract the most recent data, the search was limited to the last 12 years. The data for this paper were obtained from a search of different electronic databases: Scopus, ERIC, Dialnet and Web of Science. These databases are considered valuable for academics looking for current evidence on their research topic, which is why they were used in our study.

The search descriptors, extracted from the ERIC thesaurus, were 'special education', 'special education teacher', 'teacher digital competence', 'teacher training', 'technology', 'ICT', 'disability', and 'special needs student', and appeared in the title, abstract and/or keyword sections of the publications. Boolean operators (AND/OR) were used to ensure a rigorous search, and descriptors were combined using the advanced search option (Finfgeld-Connett & Johnson, 2013). No restrictions were applied according to the language of publication. The initial search, conducted by the first author, was supplemented by hand searching the reference lists of the studies (Horsley et al., 2011). The searches were completed on 24 November 2021.

Phase 3. Eligibility Criteria

To narrow down and discriminate the scientific output of interest, the resource used to establish both inclusion and exclusion criteria was the PICoS strategy (Pertegal-Vega et al., 2019). This tool is characterised by establishing eligibility criteria based on four variables: population, phenomenon of interest, context and study design. The inclusion and exclusion criteria are described in Table 2.

To avoid bias, all inclusion and exclusion criteria, search strategies, procedures for coding the information contained in the studies and the type of analysis applied to this information have been made explicit. In this way, the transparency of the review is guaranteed.

Phase 4. Study Selection

The study selection process was conducted, following the guidelines of the PRISMA Statement, through four rounds (Moher et al., 2009): (a) identification of relevant literature for the study, (b) screening of the literature applying the eligibility criteria, (c) studies assessed for eligibility and (d) inclusion of articles for this systematic review.

Figure 1 shows the flowchart of the search and selection process to ensure transparency and clarity. In the first round, a total of 114 records were identified through searching for descriptors in the title, abstract and keywords fields in the different databases. In addition, the reference lists of the studies were manually reviewed, and seven studies were selected. Among these records, 39 duplicate records were excluded. In the second round, after removing the duplicates, the remaining 82 studies were screened by both investigators using the inclusion criteria described in Table 2. Following the review,

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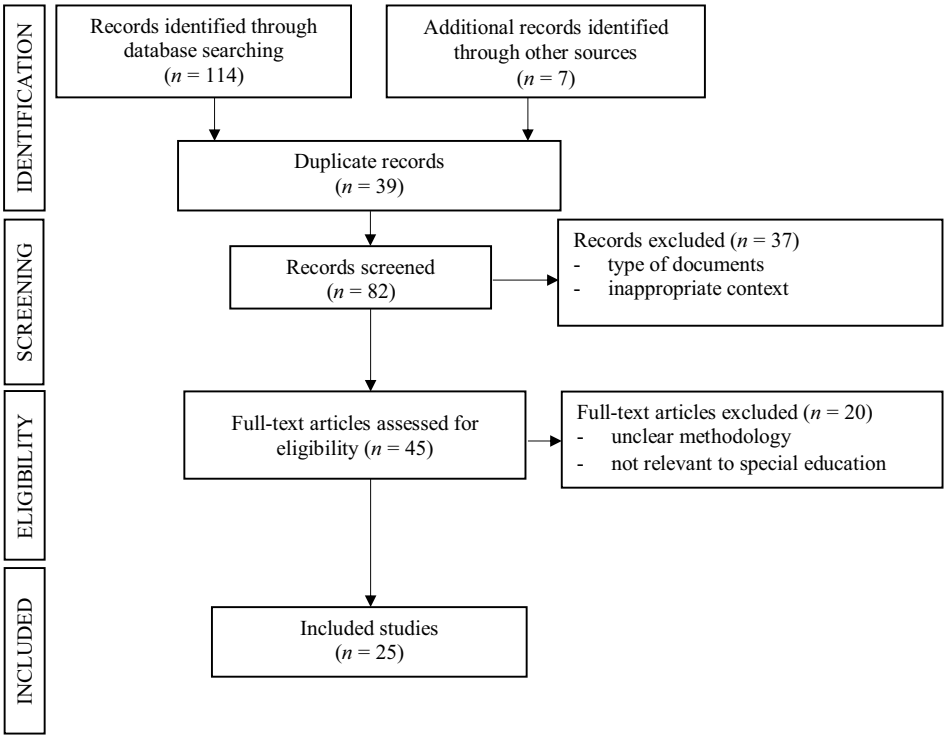

Figure 1. Flowchart of the Literature Selection Process.

37 studies were excluded. In the third round, the 45 full-text articles were assessed independently by both authors to decide on their inclusion in our study. To address the specific research questions, all articles that did not describe the methodological process and outcomes related to teachers' digital competencies were excluded. As a result of this assessment, in the last round, a total of 25 studies were included in this systematic review.

To obtain an in-depth assessment of the validity and quality of all included studies, the study selection procedure was carried out by double screening using inclusion and exclusion criteria. Studies were included if the authors scored each of the categories as 'adequate'. The initial concordance, when cross-checking the results of both authors, was 96%. Disagreements were resolved by discussion and consensus between the two researchers until a 100% agreement was reached.

Phase 5. Data Coding and Synthesis

For screening and eligibility assessment, both authors independently assessed the relevance of the selected studies by a close reading of the full text and systematisation of the main contributions according to title, abstract and keywords.

An Excel spreadsheet was used for the process of data extraction and synthesis of relevant information from the included studies. The categories were defined as follows: author(s), year, methodology, instrument, population and country (Table 3), the impact of ICT on students (Appendix A; see supplementary material), and predictors of digital competence (Appendix B; see supplementary material). Table 3 shows the studies analysed organised by year of publication and ordered alphabetically by the first author's surname.

In addition, VOSviewer software was used as an analysis tool for mapping research trends based on bibliometrics (Knoke & Yang, 2007). The VOSviewer tool, developed by Nees Jan van Eck and Ludo

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Table 3. Characteristics of the Studies Analysed

Author(s)	Year	Methodology	Instrument	Population	Country
Almeida et al.	2016	Quantitative	Q	SEN teachers	USA
Alotaibi & Almalki	2016	Mixed	DA, Q	SEN teachers	Saudi Arabia
Altinay Aksal & Altinay Gazi	2015	Qualitative	I, DA	Headmasters of the special education schools	Cyprus
Artemova et al.	2021	Mixed	O, Q, DA	Future SEN teachers	Russia
Bari et al.	2013	Quantitative	Q	SEN teachers	Malaysia
Compagno et al.	2016	Mixed	Q, FG, P	SEN teachers	Italy
Echevarría Sáenz	2014	Quantitative	Q	SEN teachers	Costa Rica
Eligi & Mwantimwa	2017	Mixed	Q, DA	Future SEN teachers	Tanzania
Fernández Batanero	2018	Quantitative	Q	SEN teachers	Spain
Galiano-Barrocal et al.	2015	Quantitative	Q	SEN teachers	Spain
García García & López Azuaga	2012	Mixed	Q, FG, DA, O, I	SEN teachers	Spain
Gonçalves & Ferreira	2021	Qualitative	O	SEN teachers	Brazil
Jee & Kwak	2019	Qualitative	I, DA	SEN teachers	Korea
Lee et al.	2011	Quantitative	Q	SEN teachers	USA
Loiselle & Chouinard	2012	Quantitative	Q	SEN teachers	USA
Magyar et al.	2020	Quantitative	Q	SEN teachers	Hungary
Muñoz Pérez & Cubo Delgado	2019	Quantitative	Q	SEN teachers	Spain
Ozdamli	2017	Mixed	Q, I	Future SEN teachers	Cyprus
Palominos Bastias & Marcelo García	2021	Mixed	Q, I, FG, O	Future SEN teachers	Chile
Ribeiro & Moreira	2010	Quantitative	Q	Future SEN teachers	Portugal
Siyam	2019	Quantitative	Q	SEN teachers	United Arab Emirates
Tello Díaz-Maroto & Cascales Martínez	2015	Quantitative	Q	SEN teachers	Spain
Vico Linde	2019	Mixed	Q, O	SEN teachers	Spain
Vladimirovna Arhipova & Sergeevna Sergeeva	2015	Quantitative	Q	SEN teachers	Russia
Yeni & Gecu-Parmaksiz	2016	Quantitative	Q	Future SEN teachers	Netherlands

Note. Q = questionnaire; SEN = special education needs; DA = documental analysis; I = interview; O = observation; FG = focus group; P = portfolio.

Waltman at the Centre for Science and Technology Studies at Leiden University (the Netherlands), is a free program that allows the construction and visualisation of bibliometric networks (van Eck & Waltman, 2010).

These networks can be constructed through the VOS (visualisation of similarities) mapping technique by analysing co-occurrence or joint occurrences based on keywords extracted from the scientific articles to be analysed. For the visualisation of the networks in VOSviewer, the following stages were developed: retrieval of records from the databases, normalisation of the thesaurus (i.e., the development of a thesaurus for the normalisation of keywords recorded differently or the translation into English of

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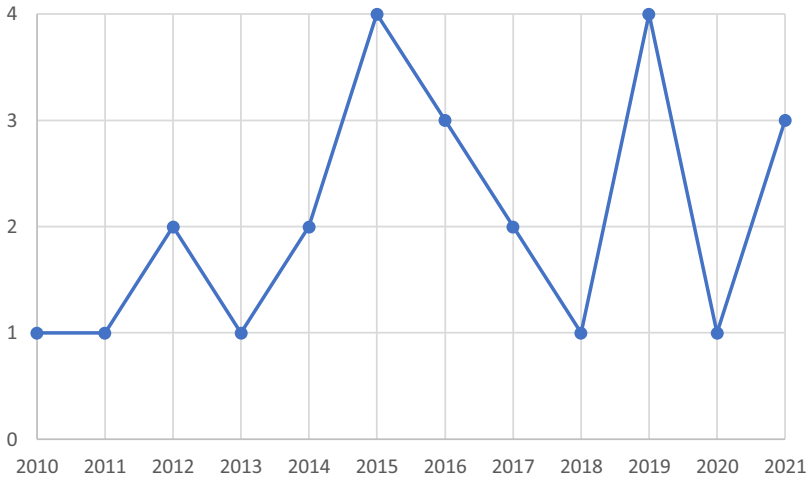

Figure 2. Number of Articles Published Per Year.

terms extracted in other languages), importation into VOSviewer and generation of the bibliometric network.

The use of bibliometric maps in the literature makes it possible to identify research themes and trends (van Eck & Waltman, 2010) represented through groupings or clusters, which are a set of related keywords. The linkage or relationship between two elements is called a 'link' and is represented by lines. In general, the closer together the two items are, the stronger their relationship. These constitute a network of co-occurrences of keywords that allow the identification of research trends by area (Yoo et al., 2019).

Results

In this review, we identified 25 studies that focused on the impact of special needs teachers' digital competence. The analysis procedure was applied to these studies to answer the research questions posed earlier. This section details the results of our analysis in two phases. First, we describe the findings related to the description of the general characteristics of the analysed research and, second, the main results of the conceptual network analysis.

Characteristics of the Studies Analysed

Most of the articles in our review were published during or after 2015 (Figure 2). Productivity increased over the period 2011–2021. This increase in literature is especially evident between 2015 and 2019, when the production of scientific literature in this regard doubled.

To determine the geographical distribution of studies related to the digital competence of special education teachers, the nationality of the first author of each article in the sample was selected, which allowed us to observe the interest aroused by this topic from a global perspective. Spain is the country with the highest number of scientific productions related to special education teacher training and technologies, with six articles out of the 25 that make up the sample. In second place is the United States with three articles. Next, two studies are attributed to Cyprus and Russia, respectively. Finally, Brazil, Chile, Costa Rica, Hungary, Italy, Korea, Malaysia, Netherlands, Portugal, Saudi Arabia, Tanzania and United Arab Emirates complete the geographical distribution, with one article from each country.

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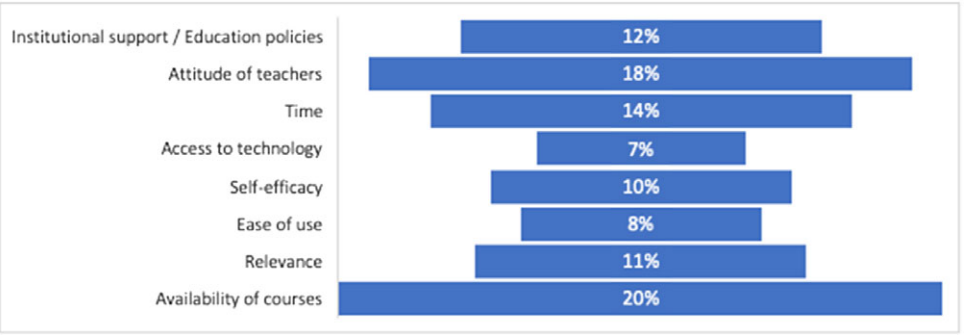

Figure 3. Factors Impacting Special Education Teachers' Acquisition of Digital Competences.

By analysing the studies, it has been possible to determine the research methodologies employed. Thus, the quantitative approach (56%) is the most frequently used. In second place is the mixed approach (32%), followed by qualitative research (12%).

The research instruments that have been mainly used to examine the level of digital competence of special education teachers have also been observed. Regarding quantitative techniques, 52.38% of the studies employed questionnaires. Of those studies whose authors used qualitative techniques, documentary analysis (14.28%), interviews (11.9%) and observation (11.9%) stand out, and, to a lesser extent, discussion groups (7.14%) and the portfolio (2.38%).

The analysed articles (100%) point in their results to low levels of digital competence among special education teachers. The studies clearly show the need for digital training of special needs teachers. In this review, we also collected data describing the factors affecting the acquisition of these competencies based on the results of the studies analysed (Figure 3). First, the studies highlight the shortage of training courses available for special education teachers related to technologies (20%). Also affecting the acquisition of competencies are teachers' attitudes towards the use of technology (18%), followed by the lack of time for training (14%). Teachers consider the lack of institutional support and educational policies (12%) to be another barrier to their training. Other aspects worth mentioning include job relevance (11%), defined as teachers' perceptions of the extent to which they consider technologies relevant to their teaching practice, and self-efficacy (10%), understood as teachers' confidence in their ability to apply these tools in their teaching practice. Finally, mention should be made of the ease of use (8%) and access to these resources (7%).

To determine the impact of using ICT to support students with special educational needs, the perceptions of special education teachers were collected in the studies analysed in this review. The teachers highlight that their use of ICT favours the academic performance of these students (32%), while at the same time boosting students' motivation for learning (20%). It should also be noted that the teachers point out that the implementation of ICT in the classroom improves social interaction (16%) and student participation (12%). Finally, they say that ICT is a good tool for supporting students' communication (8%), as well as improving their confidence and self-esteem (4%). Thus, teachers consider ICT to be an essential resource for students with special educational needs.

Conceptual Network Analysis

Using the VOSviewer software, a series of clusters (groupings) was identified that allowed us to interpret current research trends in this field (Figure 4). These clusters were obtained from the most frequently used (co-occurrence) and interrelated keywords in the research.

Each node in the network represents a keyword, the size of the node indicates the occurrence of the keyword (i.e., the larger the node, the greater the number of times the keyword occurs), and the link

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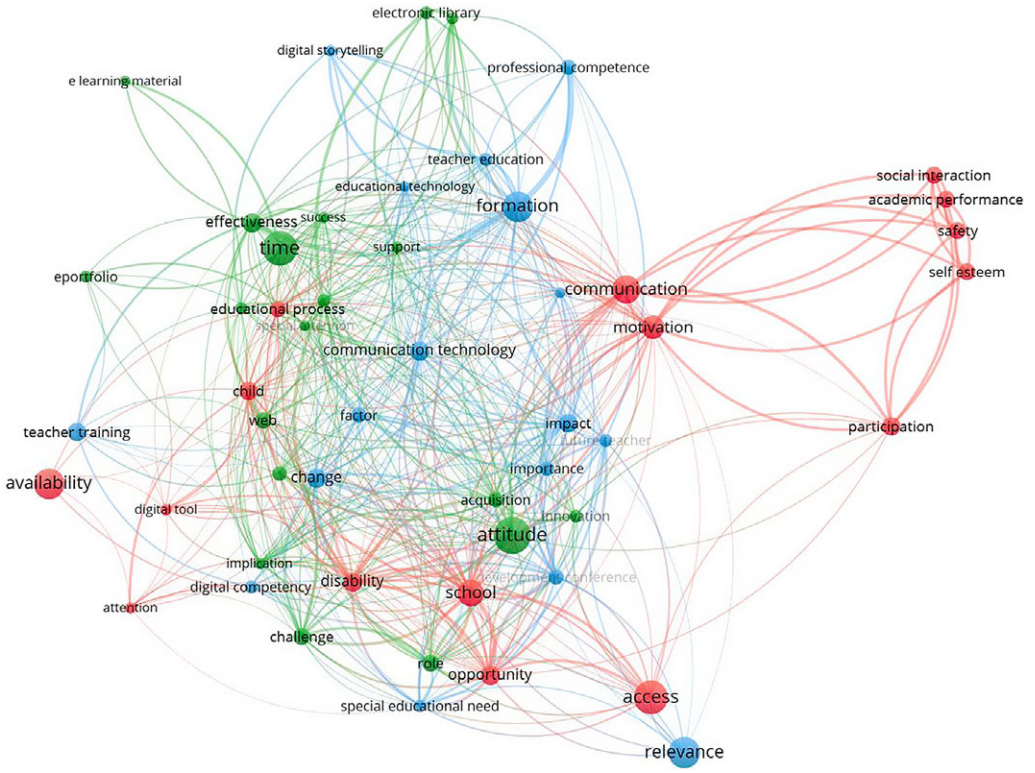

Figure 4. Co-occurrence Map by Keywords.

between the nodes represents the co-occurrence between keywords (i.e., the thicker the link between the nodes, the stronger the relationship between keywords; Tao et al., 2020; Xu et al., 2021). Each colour represents a thematic cluster, where nodes and links in that cluster can be used to explain the coverage of that topic (Donthu et al., 2021).

The blue cluster encompasses aspects related to the level of digital competence training, highlighting words such as formation, professional competence, or teacher education. The red cluster, from a more generic perspective, concretises the impact of teachers' digital competence in the field of special education on students with special educational needs, pointing to keywords such as motivation, communication, and participation. And the green cluster is related to the challenges of digital competence of special needs teachers, pointing to keywords such as attitude, time, or effectiveness.

Discussion

Through the systematic literature review process, it has been possible to ascertain the impact of the digital competence of special education teachers. In this way, we have answered the four research questions.

RQ1. What is the General State of Research in Relation to the Digital Competence of Special Education Teachers?

A systematic review allows us to know what the current state of research is on the topic under investigation. In this review, we found only 25 articles eligible for analysis. Given the low production of research on the digital competence of special education teachers, researchers are encouraged to

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strengthen this line, not only to show and analyse their level of digital competence but also to make progress in the development of digital teacher training plans, which is so necessary at this time.

From the results obtained in this study, when determining the geographical distribution of the studies reviewed, it is clear that this topic has generated worldwide interest. However, when looking at the scientific production by year of publication over the last 12 years, we can see that it is still very limited. Even though production increased between 2015 and 2019, today there is stagnation (and we can even speak of regression) with respect to research on special education and ICT. This stagnation is mainly due to the noncompliance with international inclusive proposals that have not evolved as expected (Iglesias & Martín, 2020). It is worth mentioning that the COVID-19 pandemic may have influenced these data at the global level in recent years (2020).

Thus, we can determine that, although the impact of technology is a relevant topic in the literature and for the education systems of different countries worldwide, its research in the field of special education is still partial, which is consistent with previous studies (Altinay Aksal & Altinay Gazi, 2015).

RQ2. Are Special Education Teachers Trained in Digital Competences?

The studies that describe, examine or evaluate the use of ICT by special education teachers mainly employ a quantitative methodology, with the questionnaire as the main research instrument, which is consistent with previous studies (Starcic & Bagon, 2014). This is followed by studies with a mixed methods research design, in which both qualitative and quantitative research approaches have been applied (García García & López Azuaga, 2012). To a lesser extent, some studies employ a qualitative methodology, using documentary analysis, interviews and observation as the main research instruments. In addition to determining the relevant strategies in research processes in the field of ICT and special education teacher training, this analysis allows us to determine the level of digital training of special education teachers through the results of the studies.

The results presented in the articles clearly show the need to improve ICT training for special education teachers, which leads to reflection on the low levels of preparation of these education professionals. As Cabero Almenara (2007) points out, ICT by itself does not bring about change, but rather requires the development of certain skills, such as digital skills, on the part of teachers to be able to offer a quality educational response to the diversity of pupils. In this sense, the results of the review show that the digital competence of special education teachers is a pending subject.

RQ3. What Factors Affect the Success of Digital Training for Special Education Teachers?

The results of our analysis suggest that the digital competencies of special education teachers are low. Researchers find that special education teachers perceive themselves to be poorly trained to use ICT effectively in special education classrooms (Lee et al., 2011). Increasing the level of digital training of special education teachers will lead to the modernisation of the education system, increasing its quality (Vladimirovna Arhipova & Sergeevna Sergeeva, 2015). Lack of training may influence the use of these technologies, as studies show that teachers make sporadic use of these technologies because they feel insecure due to their poor training (Lee et al., 2011; Loiselle & Chouinard, 2012).

Despite the insufficient level of mastery of computer technologies, special education teachers have shown a positive attitude towards the use of these tools in the teaching–learning process (Ozdamli, 2017; Siyam, 2019; Vico Linde, 2019; Yeni & Gecu-Parmaksiz, 2016). Their use has had a positive impact on students with special educational needs, which is consistent with the research of Bari, Yasin, and Ramli (2013). These results are encouraging, as teachers with a positive attitude towards ICT use are more likely to persist in their efforts to train in digital competences. This suggests the need to rethink the digital training of special education teachers (Palomino Bastias & Marcelo García, 2021).

The analysis of the results of the study made it possible to identify the factors that make it difficult for special education teachers to be trained in digital competences. On the one hand, the scarce availability of courses and training activities related to this subject is highlighted, and, on the other hand, a

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lack of time for teacher preparation and training. Scarce training opportunities are sometimes justified, for example, in Spain, by the fact that there is a limit to the number of places offered in some courses (Fernández-Batanero et al., 2019). This hinders their training in ICT, highlighting that most teachers have not taken any courses related to the use of technologies for special education students (Artemova et al., 2021; Echeverría Sáenz, 2014; Magyar et al., 2020). Although studies are conducted in different countries, the lack of ICT-trained teachers for persons with special educational needs is a common challenge for all due to the reduction of measures and resources in the inclusive education process. This aspect underlines the need for educational institutions to develop and demand more training related to ICT and learners with special educational needs (courses, workshops, working groups, conferences, learning communities, etc.; Loiselle & Chouinard, 2012). This training should be closely linked to a quality educational response to learners with special educational needs. However, the data reveal that institutional support is insufficient (Alotaibi & Almalki, 2016; Ozdamli, 2017), as institutions do not facilitate the creation of these courses or access to these tools. This is due to a weak legal and policy framework for the defence of the rights of persons with special educational needs, which hinders progress towards a more inclusive society. The failure to address inclusion in all education policies means that resources are insufficient, both for teachers and for the installation of accessible physical and technological infrastructure (Samaniego et al., 2012).

Like Eligi and Mwantimwa (2017), we perceive that initial training in digital competencies for future special education teachers is still lacking, so we consider it necessary that university curriculums include content on the use of ICT for diversity. All teachers should be aware of how any student, regardless of their special educational needs, can access ICT (Fernández Batanero, 2018; Muñoz Pérez & Cubo Delgado, 2019). Today, in an era of inclusion, all teachers need training on how technologies can enhance the learning capabilities of these students (Gonçalves & Ferreira, 2021).

RQ4. What is the Conceptual Network Around the Research on Special Education Teachers' Digital Competence?

Analysing the conceptual network, we have been able to identify a series of clusters generated by the co-occurrence of the keywords of the studies through VOSviewer, which has allowed us to focus on those areas of special relevance in the research. Thus, the main areas in this field are the level of digital competencies of special education teachers, the impact of their training on the academic life of students and the challenges of ICT training for special education teachers.

Thus, we can establish that the digital literacy of teachers influences the quality and success of the education of students with special educational needs (Compagno et al., 2016; Jee & Kwak, 2019; Ribeiro & Moreira, 2010), as well as the daily life of these students (Yeni & Gecu-Parmaksiz, 2016); therefore, special education teachers require these competences. The appropriate use of these tools favours aspects such as academic performance, communication, participation or motivation of these students; however, there is a risk of causing the opposite effect if they are used incorrectly. Thus, the role and digital competence of special education teachers in charge of educating students with special educational needs in a digital society are highlighted.

Conclusions

Through the systematic review process, it has been possible to ascertain the impact of the digital competence of special education teachers by answering the four research questions around which this study has been developed. The most relevant data provided by this review indicate, on the one hand, the low level of digital competencies of special education teachers and, on the other hand, the main factors that affect the digital training of these teachers. Thus, among the conclusions, we can highlight the following:

- Special education teachers have low levels of digital literacy.
- The teacher's level of digital competence influences the use of ICT in special education classrooms.

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- The studies reviewed predominantly use a quantitative methodology to assess the level of digital competence of special education teachers, where the questionnaire is the main research instrument.
- Factors affecting the digital competence of special needs teachers include the limited supply of training programs and activities, the lack of institutional support, the shortage of teachers' time for training and the lack of access to these resources.
- Special education teachers have a positive attitude towards the use of ICT because these tools favour aspects such as academic performance, communication, participation and student motivation.

Implications for Practice

The findings of this review have many implications for practice and future research. First, they underscore the need to train special education teachers in digital competencies. Second, teacher digital competence can have a positive impact on teachers' perceptions of technology resources and the subsequent use of these resources in their teaching practice. Third, digital competence training should be included in the initial training programs of special education teachers to raise awareness of the importance of ICT use in special education classrooms. Institutions should take responsibility and provide new courses for the training of their teachers.

Redirecting the digital training of special education teachers can be the driving force for progress towards a more inclusive education (Galiano-Barrocal et al., 2015; García García & López Azuaga, 2012). Based on the findings of this study and previous research related to special education teacher training in digital competence (Almeida et al., 2016), we offer some suggestions that should be considered when improving special education teacher training:

- Digital training should focus not only on the use of technology but also on the ability to impact the learning of students with special educational needs.
- During their training, both initial and in-service teachers should be exposed to a wide variety of technological resources and tools.
- Teachers must be continuously trained in digital competences due to the rapid evolution of tools.

In summary, we can establish that ICT opens new ways of learning, but for their correct and effective use, teachers must first be updated on the appropriate use of ICT (Tello Díaz-Maroto & Cascales Martínez, 2015). Educational implications aim to go beyond the improvement of teacher training — that is, to pursue an increase in the academic success of students with special educational needs.

Limitations of the Review and Future Research

This paper has several strengths that help to pave the way for research into the impact of special education teachers' digital competence. However, as with all research, this review has limitations. Among the limitations of the present review are the limited number of studies found ($n = 25$), which may be due to the application of eligibility criteria, as well as the limitation of the selected databases, although these are relevant in the academic world. Another limitation is that this review does not differentiate the type of ICT used for learners with special educational needs. And, finally, there is the absence of meta-analysis, so the limitation of the review is the subjectivity of the authors in determining both the studies selected and the relative importance with which the results are assessed.

Therefore, in future studies, it would be desirable to study this field with a broader scope and include other publications in other databases with less scientific recognition, but which address the level of digital competence of special education teachers. Likewise, given that this study focuses on the use of ICT for pupils with special educational needs in general, we think that a future line of research could

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be conducted to carry out a more detailed study related to ICT and a specific disability. This research will allow the educational community to move towards the development of a quality school education, where educational research allows us to find the educational response to the use of ICT for the diversity of students (Fernández Batanero, 2008).

Supplementary material. To view supplementary material referred to in this article, please visit https://doi.org/10.1017/jsi.2022.8

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