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Teachers' digital competencies and their relationship with the digital divide: A systematic review in the context of upper secondary education

Competencias digitales docentes y su relación con la brecha digital: Una revisión sistemática en el contexto de la educación media superior

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TEACHERS' DIGITAL COMPETENCIES AND THEIR RELATIONSHIP WITH THE DIGITAL DIVIDE: A SYSTEMATIC REVIEW IN THE CONTEXT OF UPPER SECONDARY EDUCATION

COMPETENCIAS DIGITALES DOCENTES Y SU RELACIÓN CON LA BRECHA DIGITAL: UNA REVISIÓN SISTEMÁTICA EN EL CONTEXTO DE LA EDUCACIÓN MEDIA SUPERIOR

ABSTRACT

Digital changes in education systems have increased existing inequalities, making teacher digital competence a key factor in addressing the digital divide, particularly in upper secondary education. This systematic review analyzed recent scientific literature on teacher digital competence and its relationship to the digital divide at this educational level. A systematic review of studies published between 2021 and 2025 was conducted. The search was conducted in academic databases related to education and social sciences, selecting empirical research focused specifically on upper secondary school teachers. Of a total of 208 records identified, 10 studies met the established criteria and were included. The results showed that most teachers have basic or intermediate levels of competence and that the digital divide persists beyond access to technologies, linked to insufficient training processes, different institutional conditions, and limited pedagogical integration of digital technologies. In addition, significant gaps were identified in addressing the critical and ethical dimensions of teacher digital competence. It is argued that developing and strengthening teachers' digital competence requires contextualized and critical training approaches to help bridge the digital divide and thereby achieve a more equitable and inclusive educational practice in upper secondary education.

Keywords: data mining, language R, neurosciences, neuroscience, neuroeducation, methodology

RESUMEN

Los cambios digitales en los sistemas educativos han aumentado las desigualdades existentes, poniendo la competencia digital docente como un factor clave para afrontar la brecha digital, particularmente en la educación media superior. Esta revisión sistemática analizó la literatura científica reciente sobre la competencia digital docente y su relación con la brecha digital en este nivel educativo. Se llevó a cabo una revisión sistemática de estudios publicados entre 2021 hasta 2025. La búsqueda se realizó en bases de datos académicas relacionadas con la educación y las ciencias sociales, seleccionando investigaciones empíricas centradas específicamente en docentes de educación media superior. De un total de 208 registros identificados, 10 estudios cumplieron con los criterios establecidos y fueron incluidos. Los resultados mostraron que la mayoría de los docentes presentan niveles básicos o intermedios de la competencia y la brecha digital persiste más allá del acceso a tecnologías, vinculadas con procesos formativos insuficientes, condiciones institucionales diferentes y una integración pedagógica limitada de las tecnologías digitales. Además, se identificaron vacíos relevantes en la atención a las dimensiones críticas y éticas de la competencia digital docente. Se argumenta que desarrollar y fortalecer la competencia digital de los docentes requiere enfoques de formación contextualizados y críticos para ayudar a cerrar la brecha digital y con ello lograr una práctica educativa más equitativa e inclusiva en la educación media superior.

Palabras clave: competencia digital docente, brecha digital, educación media superior, revisión sistemática, PRISMA 2020

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1. Introduction

Digital competence is a multidimensional construct that includes pedagogical and technological knowledge, skills, and attitudes. These are aimed at fostering innovation and improving teaching-learning processes in face-to-face and virtual environments (Palacios-Rodríguez et al., 2025). On the other hand, the digital divide focuses on limitations in access and inequalities in the meaningful use and critical appropriation of technologies (Seoane, 2024).

Today, the world is dominated by rapid digitization processes and deep social inequalities. These factors are key points in the global education debate. The growth of digital learning environments shows that the availability of technological infrastructure does not guarantee innovative educational practices, and equitable education depends largely on the level of digital competence of teaching staff.

The importance of teachers' digital competence plays a strategic role in determining their potential to be innovative and capable of designing technology-mediated learning experiences, thereby reducing digital inequalities. However, some research indicates that teachers' levels of digital competence, especially in upper secondary education, tend to be at basic or intermediate levels, which limits their capacity for pedagogical innovation (Domínguez-González et al., 2025; Fernández-Batanero et al., 2022).

In this regard, it is important to strengthen technical skills and the ethical, critical, and pedagogical dimensions of technology use, particularly in contexts with structural inequalities, since the digital divide persists as a structural problem that mainly affects rural communities and vulnerable sectors. This reflects inequalities in infrastructure, teacher training, connectivity, and access to devices (Arango-Lopera et al., 2022).

Systematic review studies focused solely on teachers' digital competence (Fernández-Batanero et al., 2022) analyze teachers' digital competence from frameworks such as Technological Pedagogical Content Knowledge (TPACK), the European Framework for the Digital Competence of Educators (DigCompEdu), and the Teacher Digital Competence Questionnaire (COMDID). These studies emphasize the importance of digital competence as one of the challenges facing teachers today and report a lack of teacher training and insufficient training in information and communication technologies (ICT).

The results of the reviews indicated that teachers have low or intermediate levels of digital teaching competence. They also pointed out that training continues to focus on technical skills and that there is conceptual and pedagogical fragmentation. The most common review periods were 2008–2023. It is important to note that they increased after 2020, as the impact of remote education was addressed. According to the number of studies that integrate both variables, a significant gap in the scientific literature was revealed, especially in the context of upper secondary education.

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Therefore, there is a significant gap in research on upper secondary education, as most studies on teacher digital competence have focused more on higher education and basic education. However, research focused on upper secondary education is limited, fragmented, and scattered (Falcó Boudet, 2017; Giler-Medina, 2023). The absence of systematic reviews focused on this educational level fully justifies the relevance of the present study, as there is a need to synthesize findings and provide contextualized information to support the design of teacher training policies and programs.

The aim of this study was to review the empirical literature on teachers' digital competence and its relationship with the digital divide at the upper secondary level, using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for the period 2021-2025. This systematic review synthesized the available evidence on digital competence and its relationship with the digital divide. For this reason, it was possible to identify trends, gaps, and challenges in order to provide information to guide the design of educational policies, teacher training programs, and future lines of research at the upper secondary level.

2. Method of research

This study was developed through a systematic review of the literature using a mixed-methods approach with a convergent design, following the guidelines established by the PRISMA 2020 statement. This approach combined quantitative analysis of scientific production trends with qualitative analysis of the content of the studies. This provided a broader and deeper understanding of how teachers' digital competence may be related to the digital divide in upper secondary education.

From a quantitative perspective, descriptive variables were examined, including year of publication, country of origin, disciplinary area, study population, and methodological design. In parallel, the qualitative component focused on the interpretive analysis of the main findings, the issues reported, the methodological approaches selected, and the teaching implications. The findings from both approaches were integrated to establish relationships between the trends observed and the emerging content patterns.

The literature search was conducted between September 22 and October 15, 2025, in academic databases recognized for their relevance to educational and social sciences. For literature published in Spanish, databases such as *SciELO*, *Dialnet*, and *Redalyc* were consulted, while *Eric* and *ProQuest* were used for literature published in English. These databases were chosen for their comprehensive coverage of research on education and empirical studies related to technology. Search strategies were used for title, abstract, and keywords, and controlled terms related to the study variables using Boolean operators (AND, OR). The equations were differentiated and adapted to each database.

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("competencia digital docente" OR "habilidades digitales docentes") AND ("brecha digital" OR "equidad digital") AND ("educación media superior" OR "bachillerato" OR "preparatoria").

("teacher digital competence" OR "teacher ICT skills") AND ("digital divide" OR "digital equity") AND ("upper secondary education" OR "high school").

Filters were applied by year of publication (2021-2025), language (Spanish and English), and document type (scientific article with full text available). In addition, a complementary manual search was conducted based on a review of the references of the included studies, in order to identify possible relevant research not retrieved in the initial search. In order to ensure the relevance and quality of the studies analyzed, previously defined inclusion and exclusion criteria were established.

Research published between 2021 and 2025, written in Spanish or English, that explicitly addressed teacher digital competence, the digital divide, or the relationship between these two variables was considered. In addition, it had to focus on upper secondary school teachers (high school or upper secondary). Likewise, only studies with full texts available were considered.

On the other hand, duplicate documents, theoretical or documentary reviews without empirical results, book chapters, papers, abstracts, and conferences were excluded. Similarly, studies that did not include the educational community, documents that did not clearly describe the Method of research or instruments used, and closed-access or unavailable documents were discarded (Table 1).

In studies published in English, those referring to the terms "upper secondary education," "secondary school," or "high school" were considered eligible. The article itself (description of level, age/grade, or institutional affiliation) was verified to correspond to the educational stage prior to higher education. Studies focusing on primary or lower secondary education were explicitly excluded.

Table 1

Inclusion and exclusion criteria for upper secondary school teachers' digital competence

Inclusion criteria	Exclusion criteria
Year of publication: 2021–2025.	Year of publication: publications prior to 2021.

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Language: Spanish and English.	Language: Documents in languages other than Spanish or English.
Participants: High school teachers (*upper secondary*, *high school*).	Participants: Studies that do not include the educational community.
Topic: Studies that explicitly analyze teacher digital competence, the digital divide, or digital inclusion in education.	Research focused exclusively on students, excluding faculty.
Type of studies: Empirical research (qualitative, quantitative, or mixed).	Types of studies: Documentary, theoretical, or conceptual reviews, book chapters, papers, and abstracts.
Method: studies that clearly describe the methodological design and data collection instruments.	Duplication: articles repeated in different databases.
Access: Full text available.	Method: studies that do not clearly describe the method of research and instruments used.
	Access: Articles with restricted access or unavailable.

2.2. Quantitative analysis

The quantitative analysis identified general trends in scientific output on the subject under study. To this end, research questions were formulated to examine the temporal distribution of publications, countries of origin, disciplinary areas involved, and populations studied (Table 2). Quantitative data were systematized using frequency counts and represented in descriptive figures to facilitate understanding between the included studies.

Table 2
Quantitative analysis research questions

Topics for analysis	Research questions
Number of publications per year	How has scientific output on digital competence in teaching and the digital divide in upper secondary education evolved during the period 2021–2025?
Countries of origin	In which countries and educational contexts has research on teacher digital competence and the digital divide been conducted during the study period?

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Disciplines of knowledge that have contributed	Which academic disciplines have developed studies on digital competence in teaching and the digital divide?
Populations studied	Which populations have been most frequently investigated in the selected studies?

2.3. Qualitative analysis

At the same time, a qualitative analysis of the included studies was carried out using thematic content analysis. The unit of analysis was the fragments of the results and discussion text of each study that described: a) issues associated with teacher digital competence and/or the digital divide; b) institutional conditions; c) teacher training; d) pedagogical integration; and e) critical/ethical dimension. Initial open coding was applied to identify recurring themes, followed by axial coding to group codes into integrative categories. The final categories were defined by recurrence and conceptual consistency and were contrasted with the questions (Table 3). Given that the selection and analysis were carried out by one researcher, the absence of independent double coding is recognized as a limitation.

Table 3
Qualitative analysis research questions

Subject of analysis	Research questions
Relevant issues	What issues does the specialized literature report as relevant to digital competence in teaching at the upper secondary level?
Methods of research that addressed the problem	What methods of research have been used to study digital competence among teachers at the upper secondary level?
Instruments	What tools have been used to investigate teachers' digital competence and the digital divide at the upper secondary level?
Key findings	What research findings are considered most relevant in the study of teachers' digital competence and the digital divide?
Recommendations	What strategies for training and strengthening teachers' digital skills have been implemented at the upper secondary level?

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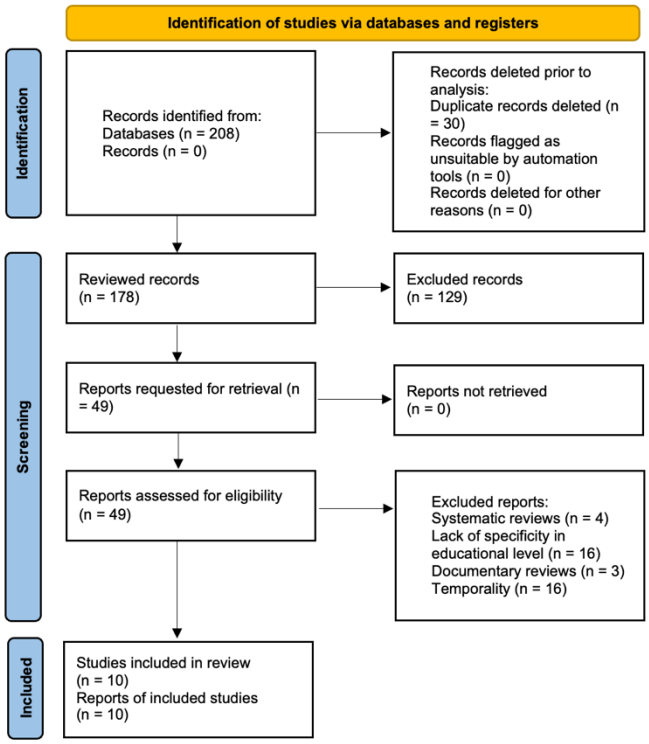
2.4. Selection process

The selection process was carried out in three stages in accordance with the PRISMA 2020 guidelines: a) elimination of duplicates; b) screening of titles and abstracts to identify thematic relevance; and c) review of full texts to verify compliance with inclusion criteria. The initial search identified 208 records. After eliminating 30 duplicates, 178 articles were retained for review of titles and abstracts. Subsequently, 49 studies were evaluated and 39 were excluded because they did not correspond to the upper secondary level, did not meet the time frame, did not present empirical evidence, or lacked methodological clarity.

Finally, 10 studies were identified as meeting all the criteria and were included in the systematic review. The entire process was presented using the PRISMA 2020 diagram. The screening and selection of studies was carried out by the author of the study, which is recognized as a methodological limitation and is taken into account in the interpretation of the results (Figure 1).

Figure 1

Flowchart of the study selection process according to PRISMA guidelines 2020



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For the initial screening and organization of the retrieved studies, a spreadsheet in Microsoft Excel was used. This allowed for the efficient systematization and refinement of the preliminary information from the identified documents. In the first phase, a rapid screening matrix was constructed that included variables such as authors, title, abstract, year of publication, language, educational level, main study variable, database, and reference, which facilitated the identification of duplicates and the initial assessment of relevance according to the established inclusion and exclusion criteria.

Subsequently, studies that met the selection criteria were transferred to a second data extraction matrix, also created in Excel. This spreadsheet contained detailed information on each document, including title, authors, year of publication, country, language, journal, study objective, type of research, sample, main variable, instruments used, main findings, relevant conclusions, keywords, final observations, complete reference, and database of origin. This ensured a systematic, orderly, and transparent analysis of the information and also facilitated the integration of the quantitative and qualitative results of the review.

2.5. Assessment of risk of bias

Methodological quality and risk of bias were assessed using the criteria of the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). This tool was designed to facilitate systematic reviews that combine content from qualitative, quantitative, and mixed studies. The MMAT allows for the evaluation of methodological quality rather than summarizing scores from the results, prioritizing an assessment of descriptive criteria of the main methodological aspects of each article.

In accordance with the instrument's guidelines, the criteria were applied differently depending on the methodological design of each article. The evaluation was performed using a matrix created in Excel, which took into account the clarity of the research objectives, the suitability of the methodological design, the applicability of the data collection instruments, the consistency between the analysis and the results, and possible sources of bias. This evaluation was used for descriptive and methodological transparency purposes, without discarding studies based on their quality, and its results are summarized in Table 4.

3. Resultados

The results of this systematic review originated from the analysis of 10 empirical studies published between 2021 and 2025, focusing on the analysis of digital teaching competence and the digital divide in upper secondary

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education settings or their international equivalent. In terms of methodological design, quantitative and correlational studies predominated, followed by qualitative and mixed-method research.

3.1. Methodological quality of the included studies

In order to assess the methodological quality of the 10 included studies, they were evaluated using MMAT (Hong et al., 2018). In this regard, the number of criteria met by each study (out of a total of five) was reported as a descriptive approximation of the methodological strength of the included evidence (Table 4).

Table 4
Studies included through the MMAT

Author(s)	Year	Design	Type of study	Criteria achieved *	Quality level
Sabroso Peña & Forteza Martínez	2025	Descriptive quantitative	Quantitative	Four out of five	Moderate methodological quality
Gutiérrez Sandoval et al.	2023	Descriptive quantitative	Quantitative	Four out of five	Moderate methodological quality
González Fernández	2021	Quantitative correlational	Quantitative	Five out of five	High methodological quality
Coloma Rodríguez et al.	2025	Mixed (*Delphi*)	Mixed	Five out of five	High methodological quality
Santander Moreno et al.	2025	Mixed	Mixed	Five out of five	High methodological quality
Photo y Mohale	2024	Qualitative (phenomenological)	Qualitative	Four out of five	Calidad metodológica moderada
Scott	2023	Qualitative	Qualitative	Four out of five	Calidad metodológica moderada

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Table 4
Studies included through the MMAT

Author(s)	Year	Design	Type of study	Criteria achieved *	Quality level
Oyebola Akinoso	2023	Quantitative correlational	Quantitative	Four out of five	Calidad metodológica moderada
Ogegbo	2023	Descriptive quantitative	Quantitative	Four out of five	Calidad metodológica moderada
Prieto-Ballester et al.	2021	Descriptive-correlational quantitative	Quantitative	Five out of five	High methodological quality

Note. The number of criteria achived was presented for descriptive purposes, without assigning overall scores or establishing formal hierarchies among studies, following the recommendations of Hong et al. (2018).

In general terms, the studies included in the systematic review presented moderate to high methodological quality. The main strengths were related to the clarity of the research objectives, the adequacy of the methodological designs, and the consistency between the analysis and the reported results. The main limitations identified in some studies were related to the incomplete description of the sample selection process, particularly in some quantitative and qualitative studies. These results were considered in the interpretation of the findings, giving greater analytical weight to those studies with greater methodological soundness.

3.2. Quantitative analysis

The quantitative analysis identified temporal, geographical, and methodological trends in the included studies. Given the small number of studies included (n=10), the figures served a descriptive and exploratory function. Therefore, the results should be interpreted with caution. In temporal terms, a higher concentration of publications was observed from 2023 onwards. This suggests a recent interest in the analysis of teachers' digital competence and its relationship with the digital divide in the post-pandemic context in upper secondary education, although the evidence should be interpreted with caution due to the limited number of studies included (Figure 2).

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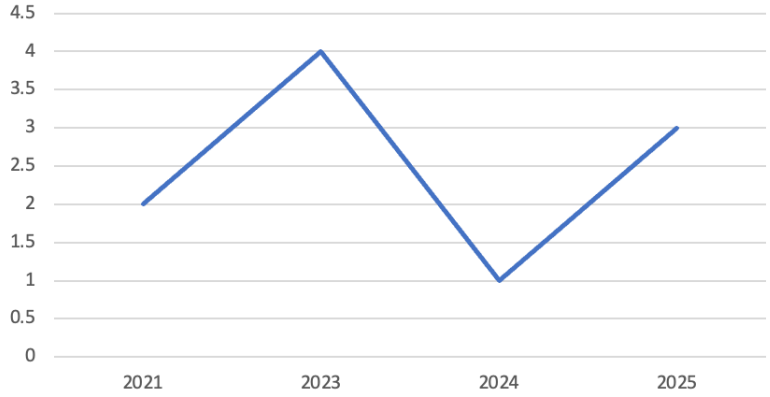
Figure 2

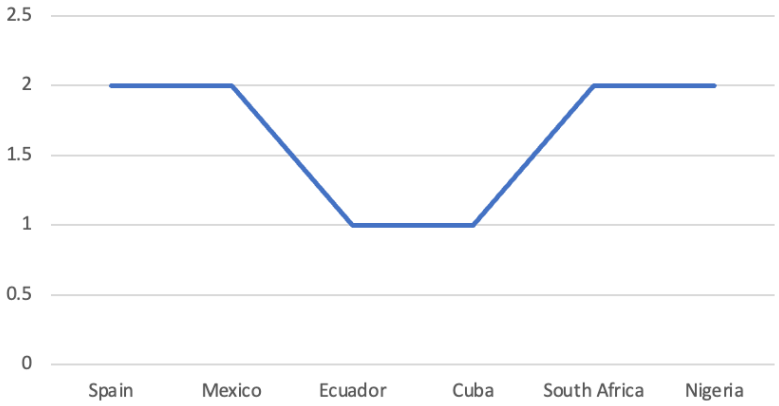
Distribution of included studies by year of publication (2021–2025)



The studies included focused on Latin American contexts, particularly Mexico and Ecuador. This reflected a greater interest in this issue in regions characterized by structural inequalities in the process and use of digital technologies. The scarcity of research from other regions highlights a gap in the international comparative literature on upper secondary education (Figura 3).

Figure 3

Distribution of included studies according to the country of the educational context analyzed



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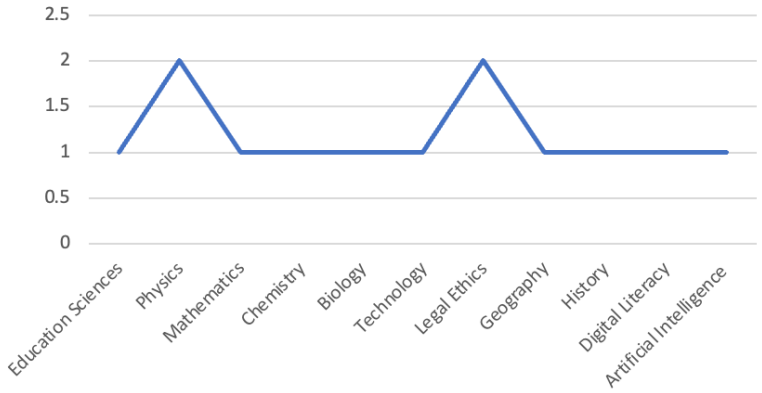
From a disciplinary perspective, the studies analyzed are predominantly from the field of education, with an emphasis on areas related to the social sciences and science and technology. This predominance revealed an approach focused on educational diagnosis, with little presence of interdisciplinary approaches (Figura 4).

Figure 4

Disciplinary areas from which studies on digital teaching competence and the digital divide in upper secondary education are addressed



With regard to the populations studied, the included studies focused on teachers working at the educational level equivalent to upper secondary education. In international studies, particularly those published in English, the term "secondary school" was used to refer to the educational stage corresponding to "upper secondary education" or "high school," in accordance with the organization of the educational system of the country of origin, consistent with the defined inclusion criteria. However, it was found that most of the research addressed teacher digital competence, while the digital divide appears less frequently as a central variable. Few studies analyze both variables in an integrated manner, which reinforces the relevance of this work.

3.3. Qualitative analysis

Qualitative analysis identified a set of relevant issues related to teachers' digital competence and the digital divide in upper secondary education. Studies consistently reported that the digital divide in terms of access and infrastructure continues to be a structural factor that conditions the development of teachers' digital competence, especially in educational contexts with limited connectivity, a shortage of devices, and insufficient technological resources (Photo & Mohale, 2024; Santander Moreno et al., 2025; Scott, 2023).

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Likewise, various studies have pointed out that the digital divide is not limited solely to access, but also to the pedagogical use of technologies, highlighting a significant gap between the availability of digital resources and their effective integration into teaching-learning processes (Gutiérrez Sandoval et al., 2023; Santander Moreno et al., 2025; Scott, 2023). In this regard, it was observed that teachers tend to use technologies in an instrumental way, without didactic planning or clear alignment with the curricular objectives of upper secondary education.

Another recurring problem in the literature was insufficient teacher training in digital competence, which has been characterized as fragmented, short-term, and focused mainly on technical aspects, without an emphasis on the development of pedagogical, critical, and ethical skills for the use of digital technologies (Coloma Rodríguez et al., 2025; Sabroso Peña & Forteza Martínez, 2025). This situation limits teachers' ability to respond to educational demands and contributes to the persistence of the digital divide in schools (Table 5).

Table 5

Relevant issues identified in documents on digital competence in teaching and the digital divide at upper secondary level

Relevant issues	Number of items	Cites
Unequal access to digital resources, infrastructure, and connectivity, which limits the effective use of digital technologies and widens the digital divide in vulnerable educational contexts.	2	Sabroso Peña & Forteza Martínez (2025); Scott (2023).
Insufficient continuing education for teachers in digital skills with a pedagogical and methodological focus, as well as a lack of systematic and sustainable institutional programs (aligned with frameworks such as DigCompEdu) that go beyond the purely technical use of ICT.	5	González Fernández (2021); Gutiérrez Sandoval et al. (2023); Sabroso Peña & Forteza Martínez (2025); Santander Moreno et al. (2025); Scott (2023).
Low or intermediate levels of digital competence among teachers, revealing weaknesses in pedagogical integration, ICT-based assessment, and student empowerment.	3	González Fernández (2021); Gutiérrez Sandoval et al. (2023); Santander Moreno et al. (2025).
Insufficient development of the critical, ethical, and civic dimensions of digital teaching competence, which limits the	3	Coloma Rodríguez et al. (2025); González Fernández (2021); Prieto-Ballester et al. (2021).

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Table 5
Relevant issues identified in documents on digital competence in teaching and the digital divide at upper secondary level

Relevant issues	Number of items	Cites
reflective and responsible pedagogical integration of digital technologies.		

Nota. In international studies, the term "secondary school" is interpreted as equivalent to upper secondary education, in accordance with the education system of the country of origin.

In terms of methodological approaches, the studies analyzed showed a predominance of descriptive and non-experimental designs, mainly aimed at diagnosing the level of teachers' digital competence and the conditions of access to and use of technologies in specific educational contexts (Oyebola Akinoso, 2023; González Fernández, 2021; Prieto-Ballester et al., 2021). This methodological predominance reflected a stage of characterization of the variable, rather than intervention or impact assessment.

The instruments used for data collection were structured questionnaires, perception surveys, self-assessment scales, and semi-structured interviews, aimed at measuring digital skills, teaching attitudes, and institutional conditions for technological integration (González Fernández, 2021; Gutiérrez Sandoval et al., 2023; Photo & Mohale, 2024; Scott, 2023). Some studies incorporated digital tools for the application of the instruments. However, their use is mainly limited to the administration of questionnaires, without extensive use of advanced analytical strategies (Table 6).

Table 6
Instruments used to investigate teachers' digital competence and the digital divide at the upper secondary level

Instruments used	Number of items	Cites
Structured questionnaire/survey.	4	González Fernández (2021); Gutiérrez Sandoval et al. (2023); Ogegbo (2023); Prieto-Ballester et al. (2021).
Teacher digital competence questionnaire based on the DigCompEdu framework.	1	Santander Moreno et al. (2025).
Qualitative techniques: semi-structured interviews and classroom observation.	2	Photo & Mohale (2024); Scott (2023).

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Table 6

Instruments used to investigate teachers' digital competence and the digital divide at the upper secondary level

Instruments used	Number of items	Cites
Mixed instruments (questionnaires combined with interviews and/or observation).	2	Coloma Rodríguez et al. (2025); Santander Moreno et al. (2025).

Note. In international studies, the term "secondary school" is interpreted as equivalent to upper secondary education, in accordance with the education system of the country of origin.

The qualitative results indicated that teachers' digital competence plays a mediating role between the structural conditions of the educational context and the opportunities for pedagogical integration of digital technologies in upper secondary education. The studies showed that, even in contexts where there is basic access to technological resources, the absence of solid digital competence among teachers limits the transformation of pedagogical practices (Gutiérrez Sandoval et al., 2023; Santander Moreno et al., 2025; Scott, 2023).

Similarly, it is recognized that the persistence of the digital divide hinders the professional development of teachers, creating a sense of inequality between educational institutions and reinforcing traditional teaching practices, especially in socially and economically vulnerable contexts (Santander Moreno et al., 2025; Scott, 2023). These relationships indicated that the digital divide and teacher digital competence do not act as separate variables, but as interrelated variables.

Finally, the studies examined highlighted a lack of attention to the critical and ethical dimensions of digital competence, focusing instead on aspects such as skills, techniques, and operations. This gap is significant because it indicates that there is still a considerable void in the literature, especially at the upper secondary level, where digital teacher training is central to improving inclusive and equitable educational practices. (Coloma Rodríguez et al., 2025; Sabroso Peña & Forteza Martínez, 2025).

3.4. Relationship between study variables

In accordance with the convergent mixed approach, the quantitative and qualitative components were analyzed simultaneously and subsequently incorporated into the interpretative stage. This integration facilitated the articulation of general trends in quantitative analysis with emerging patterns in qualitative analysis, resulting in a relational perspective of digital teaching competencies and the digital divide in upper secondary education.

The quantitative analysis revealed scientific output concentrated in Latin American contexts and a predominance of descriptive studies focused on diagnosing teachers' digital competence and the conditions for

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accessing and using technologies. Complementarily, the qualitative analysis showed that the structural limitations associated with the digital divide translate into mostly instrumental teaching practices and fragmented teacher training processes.

The integration of both components showed that teachers' digital competence acts as a mediating factor between the conditions of the educational context and the pedagogical integration of digital technologies. Taken together, the findings indicated that the digital divide and teachers' digital competence are interrelated variables, whose integrated understanding is key to explaining the difficulties of educational innovation at the upper secondary level.

4. Discussion

The objective of this systematic review was to analyze recent empirical literature on teacher digital competence and its relationship with the digital divide at the upper secondary level, in the period 2021–2025, following the guidelines of the PRISMA 2020 guide. The analysis of the 10 studies identified consistent patterns that show partial progress but also persistent challenges in the development of teachers' digital competence at this educational level. The trends coincided with those reported in previous research, which indicate that the use of technologies is often limited to administrative, communication, or content presentation functions, without systematic pedagogical integration into teaching-learning processes (Gutiérrez Sandoval et al., 2023; Sabroso Peña & Forteza Martínez, 2025; Santander Moreno et al., 2025).

From this perspective, the results confirmed that the digital divide is not limited to the availability of infrastructure or connectivity, but is also significantly manifested in teachers' ability to integrate technologies into their teaching practices. The studies reviewed showed that, even in contexts where basic access or digital resources exist, the lack of teacher training limits the educational use of these resources (Photo & Mohale, 2024; Santander Moreno et al., 2025; Scott, 2023).

A significant finding of this review was the identification of a bidirectional relationship between teachers' digital competence and the digital divide. On the other hand, unfavorable structural conditions such as connectivity, insufficient infrastructure, and limited institutional support restrict opportunities for the development of teachers' digital competence (Photo & Mohale, 2024; Scott, 2023). Furthermore, low levels of teachers' digital competence reproduce the digital divide by limiting the implementation of technology-mediated pedagogical strategies that could promote educational inclusion and equity (Gutiérrez Sandoval et al., 2023).

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In this sense, the results suggest that teachers' digital competence acts as a mediating factor between the structural conditions of the educational context and the effective integration of digital technologies in upper secondary education. This mediation was particularly observed in the pedagogical dimension of digital competence, which appears to be the weakest and, at the same time, the most decisive factor in transforming teaching practices. Studies such as those by González Fernández (2021), Prieto-Ballester et al. (2021), and Santander Moreno et al. (2025) pointed out that the absence of solid pedagogical training limits the transformation of instrumental technological use toward more innovative teaching models.

From an educational policy perspective, the results of this review highlighted the need to move from strategies focused exclusively on providing technological infrastructure to comprehensive teacher training policies. In the context of upper secondary education, it is essential to promote continuous training programs that strengthen not only technical skills, but also pedagogical, critical, and ethical competencies in the use of ICT, in accordance with the principles of a humanistic and inclusive education promoted by the *New Mexican School* (Secretaría de Educación Pública [SEP], 2019). Likewise, greater coordination is required between national policies, educational institutions, and teaching practices in order to reduce educational gaps and promote the meaningful integration of technologies into teaching and learning processes..

Similarly, the review noted limited attention to the critical and ethical dimensions of teachers' digital skills. Few studies explicitly addressed these dimensions, revealing a significant gap in the literature analyzed (Coloma Rodríguez et al., 2025; Sabroso Peña & Forteza Martínez, 2025). This gap is particularly significant at the upper secondary level, where a broad education for students requires teachers who are capable of guiding responsible, critical, and reflective use of digital technologies.

From a methodological perspective, the studies confirmed the predominance of descriptive studies, mostly relying on questionnaires and self-perception scales to measure teachers' digital competence (Oyebola Akinoso, 2023; González Fernández, 2021). While these approaches provide valuable insights, the available evidence was limited in explaining how teaching practices are modified or which training strategies effectively contribute to reducing the digital divide in real-life upper secondary education contexts.

Compared to other levels of education, such as basic education and higher education, upper secondary education presents specific challenges in relation to the development of teachers' digital competence. While strategies in basic education tend to focus on initial digital literacy and higher education offers greater institutional autonomy and access to training resources, upper secondary education continues to face limitations related to the diversity of subsystems, the heterogeneous initial training of teachers, and the limited availability of specialized training. These conditions reinforce the need to design differentiated training policies and strategies that address the particularities of this level of education.

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Overall, the discussion of the results allows us to affirm that teachers' digital competence and the digital divide should be understood as interrelated variables, influenced by structural, pedagogical, and institutional factors. The evidence analyzed suggests that strategies focused exclusively on technological access are insufficient if they are not accompanied by systematic teacher training processes that strengthen the pedagogical integration of technologies at this educational level (Santander Moreno et al., 2025).

4.1. Limitations of the study

The study has certain limitations that should be considered when interpreting the findings, including possible publication and availability bias, as only articles with accessible full text were included. Language and database bias, as the search was restricted to publications in Spanish and English. Finally, the predominance of quantitative studies, which limits the establishment of causal relationships and the analysis of longitudinal changes in teacher digital competence and the digital divide.

5. Conclusions

This systematic review analyzed recent scientific output (2021-2025) on teacher digital competence and its relationship with the digital divide in upper secondary education, integrating quantitative and qualitative evidence using a convergent mixed-methods approach. The results showed that teachers' digital competence develops unevenly and is mostly at basic or intermediate levels in most studies, which conditions the pedagogical integration of digital technologies.

It was confirmed that the digital divide continues to influence the development and application of teachers' digital competence. However, this divide is not limited to access to physical infrastructure and connectivity, but can also be attributed to insufficient teacher training and a lack of institutional support. Thus, teachers' digital competence becomes a mediating variable between the structural conditions of the education system and the integration of technologies in the classroom.

Similarly, it was found that little attention was paid to the critical and ethical aspects of teachers' digital competence, which reveals a significant gap in the literature on upper secondary education. Methodologically, descriptive designs dominated, emphasizing the need for more robust research to evaluate the impact of training strategies and institutional initiatives to bridge the digital divide.

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Finally, the findings of this research reinforced the importance of moving beyond approaches focused solely on technological access and advancing toward comprehensive strategies that combine infrastructure, teacher training, and pedagogical approaches to promote more equitable and meaningful digital integration in the upper secondary education system.

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