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Corresponding author's address:

^{1,3} Departamento de Pedagogía.
Facultad de Ciencias de la
Educación y Psicología. Universidad
Rovira i Virgili. Carretera de Valls, s/n
43007 - Tarragona (Spain)

² Departamento de Pedagogía y
Didáctica de las Ciencias Sociales, la
Lengua y la Literatura. Universidad
Jaume I. Av. Vicente Sos Baynat,
12006 Castellón de la Plana (Spain)

E-mail / ORCID

jonathan.borden@urv.cat

 <https://orcid.org/0000-0003-0389-6087>

blores@uji.es

 <https://orcid.org/0000-0001-8487-5960>

mireia.usart@urv.cat

 <https://orcid.org/0000-0003-4372-9312>

ARTICLE / ARTÍCULO

Professional Training and Digital Competence in Teaching: A Systematic Review of the Literature

Formación Profesional y Competencia Digital Docente: una revisión sistemática de la literatura

Yonathan Humberto Borden Lanza¹, Beatriz Lores Gomez² & Mireia Usart Rodríguez³

Abstract: This research aims to analyse the scientific evidence regarding the levels of Digital Competence (DC) among Vocational Education and Training (VET) teachers in Spain. To achieve this, a systematic review of the literature is presented as a research design, following the PRISMA-P Statement. The databases consulted were Dialnet, Scopus, and Web of Science, covering the search period from 2014 to 2022. Following the filtering process, 12 studies were selected for further analysis. The results indicate that in the past decade, there has been a notable increase in research aimed at recognising and examining the levels of Digital Competence in Teaching (DCT), as well as its impact on teaching-learning processes. However, there exists a scarcity of published scientific output. It has been concluded that teachers, in general, and Vocational Training teachers, in particular, perceive themselves to be at a low level of development in digital teaching competence. It is essential to implement research instruments that assist them in: (1) identifying their actual level of Digital Teaching Competence, and (2) providing training proposals that enhance the areas constituting Digital Teaching Competence and shape their attitudes towards the use of Digital Technologies.

Keywords: Vocational Education and Training (VET), Educational Technology, Digital Competence of Educators, Systematic review.

Resumen: El propósito de esta investigación es analizar la evidencia científica sobre los niveles de Competencia Digital (CD) que poseen los docentes de Formación Profesional (FP) en España. Para ello se presenta como diseño de investigación una revisión sistemática de la literatura, sustentada en la Declaración PRISMA-P. Las bases de datos consultadas han sido Dialnet, Scopus y Web of Science, y el periodo de búsqueda comprende los años 2014-2022. Tras el proceso de filtrado se han seleccionado 12 estudios. Los resultados demuestran que en la última década ha habido un importante incremento en investigaciones orientadas a reconocer y examinar los niveles de Competencia Digital Docente (CDD), así como su impacto en los procesos de enseñanza-aprendizaje. Sin embargo, existe un número escaso de producciones científicas que se encuentren publicadas. Se ha concluido que el profesorado en general y de Formación Profesional en particular, se percibe a sí mismo en un nivel bajo de desarrollo de la Competencia Digital Docente y es necesario aplicar instrumentos de investigación que les ayuden a: (1) identificar su nivel real de Competencia Digital Docente y, (2) proporcionar propuestas formativas que mejoren las áreas que constituyen la Competencia Digital Docente y determinar sus actitudes hacia el uso de las Tecnologías Digitales.

Palabras clave: Formación Profesional, Tecnología Educativa, Competencia Digital Docente, Revisión Sistemática de la Literatura.

1. Introduction

The consistent integration and quotidian utilisation of Digital Technologies (DT) within educational contexts do not inherently ensure their advantageous outcomes or pedagogical efficacy (Antonietti et al., 2022; Lázaro-Cantabrana et al., 2019). The academic discourse presents a spectrum of viewpoints concerning the evolution of technological infrastructure within educational institutions, frequently juxtaposing this evolution with the pragmatic implementation of such frameworks. Notably, Esteve-Mon et al. (2016) elucidate how the cultivation of Teaching Digital Competence (TDC) bolsters the utilisation of technology-enhanced learning environments. Furthermore, Verdú-Pina et al. (2023) emphasise the critical importance of advancing technopedagogical and methodological paradigms related to digital technology (DT) within classrooms that are oriented towards technology integration. These findings collectively underscore the prevailing emphasis within the literature on the imperative of ongoing professional development for educators.

Enterprises and governments are increasingly focused on facilitating the integration and sustainability of DT within educational processes to enhance the labour market by producing highly qualified personnel (Otero Gutiérrez et al., 2018). In the Spanish context, a crucial strategy for addressing workforce improvement is the coaching of Vocational Education and Training (VET) students. VET is defined as the "set of training processes aimed at preparing individuals for the workforce and ensuring their qualifications" (Campos-Bermejo & Morales-Lozano, 2022, p. 88). Numerous modifications have been implemented to align VET with the needs of the productive sector. Given its nature, VET serves as the most relevant educational level for building the foundation of professional citizenship. However, data indicate that significant progress is still needed to accomplish this goal (Jalil, 2018).

In recent years, educational policymakers have initiated a paradigm shift aimed at reconfiguring VET classrooms into environments where the utilisation of DT is fundamentally integrated. The primary objective of this transformation is to equip VET students with a nuanced understanding of market dynamics, thereby enhancing their capacity to devise and implement innovative projects and proposals for organisational improvement (Ministerio de Educación y Formación Profesional, 2020). Achieving this ambitious vision requires VET educators not only to recognise and articulate their roles as digitally competent stakeholders but also to engage in the practical application of appropriate pedagogical methodologies and the seamless integration of digital technologies into the educational framework (Campos-Bermejo & Morales-Lozano, 2022).

1.1. Vocational Education and Training and Teaching Digital Competence.

Vocational Education and Training (VET) serves as a pivotal mechanism for facilitating the transition toward a society capable of autonomously navigating complex technical environments. It establishes a critical connection between theoretical instruction and practical application within the professional sphere (Borden et al., 2023). Furthermore, VET institutions emulate the operational dynamics of corporate entities by incorporating DT into their pedagogical frameworks (Schwendimann et al., 2015; Redecker, 2017). For instance, educators within VET programs strive to adapt their technical and pedagogical knowledge to ensure that students not only comprehend

the theoretical underpinnings of their education but also effectively apply that knowledge in practical skills in real-world contexts (Cattaneo and Aprea, 2018).

In the scholarly discussion surrounding TDC, Lázaro Cantabrana et al. (2019) explain that a foundational principle involves integrating DT after acquiring a comprehensive repertoire of competencies, abilities, and skills. The extent of TDC attainment is theorised to significantly influence educators' methodologies in engaging with environmental phenomena and scientific concepts, fostering approaches that are both diverse and innovative (Lund et al., 2014). Furthermore, individual educators may enhance their capability to evaluate the intricate interrelations between content, pedagogy, and technology, particularly after completing a reflective understanding of their personal TDC levels (Instefjord & Munthe, 2017).

1.2. Applied Technology Classroom Concept in Vocational Education and Training.

In 2012, a notable emergence of environments characterised by a high presence of DT occurred, exemplified by the establishment of Future Labs and Entrepreneurship Classrooms throughout Europe, including Spain (INTEF, 2017). This was a strategic response to the evolving landscape of VET. Subsequently, in 2020, the Applied Technology Classroom (ATC) was introduced as a key initiative aimed at modernising VET for a new era and responding to the COVID-19 economic crisis. These cutting-edge technological spaces have been meticulously designed to equip the emerging workforce in Spain with essential skills, thereby fostering a culture centred on digitalisation, innovation, and entrepreneurship (San-Martin et al. 2020). As the educational system progressively integrates these advancements, it better prepares students to thrive in an increasingly competitive and dynamic job market (Moreno-Guerrero et al., 2021).

The primary objective of ATC initiatives is to transform VET, enhancing digital competencies and reinforcing core elements such as collaboration, active participation, innovative pedagogical techniques, and practical application (Eizagirre Sagardia et al., 2017). This advancement presents a significant opportunity for VET centres to effectively redesign their digital projects, enabling the creation of specialised ecosystems that harness the potential of digital technologies. Ultimately, such transformations are expected to enrich the learning experiences and outcomes for students, equipping them with the necessary skills to navigate the challenges of the modern workforce. (Ministerio de Educación y Formación Profesional, 2020).

1.3. Pedagogical Emphasis on Digital Technologies in VET Centres.

The concept of Digital Technology (DT) in educational settings, as articulated by Loogma et al. (2012), serves as a comprehensive construct of digital literacy that underpins various dimensions of the teaching and learning process. This multifaceted approach provides essential support, reinforcement, and enhancements to educational efficacy. The authors further assert that the integration of DT is pivotal not only in bolstering employability but also in fostering active citizenship, promoting social mobility, and conferring competitive advantages at the national level. However, it is imperative to recognise that the prevalent interpretation of DT within educational environments often manifests as a reductive assemblage of technological tools

confined to specific physical spaces. This limited perspective ultimately undermines the foundational intent of technological environments, which were initially conceived to facilitate continuous access to a diverse array of resources through the strategic implementation of digital technologies (Brown & Long, 2014).

To advance the establishment of ATC within VET centres, the focus must extend beyond infrastructural considerations and equipment procurement. It should concentrate on implementing pedagogical methodologies that effectively facilitate the acquisition of complex technical competencies. As Tena and Carrera (2020) elucidate, these innovative educational environments should equip students with the necessary tools "to enhance their digital competencies and cultivate their social skills" (p. 466). From an instructional standpoint, the integration of technology within ATC is suggested to have a profoundly positive influence on students' engagement in active exploratory learning, due to the synergistic alignment between technological resources and the selected pedagogical frameworks (King et al., 2015).

The relationship between TDC and VET is a complex one that deserves further exploration, as existing literature often overlooks significant evidence that could enhance our understanding of this interplay. To address this deficiency, the primary objective of this article is to analyse the scientific evidence regarding the levels of TDC possessed by VET teachers and their engagement with ATC spaces in Spain. To facilitate this analysis, several key research questions have been established:

- What scientific evidence does exist about VET teachers' Digital Competence?
- Related to Digital Competence, what training needs do VET teachers have?
- Regarding VET Learning regulated by the inclusion of DT, what modality (In-person, hybrid, distance) and what type of methodologies are more efficient for VET student learning?
- Concerning DC, what role should the VET teacher play in the management of an ATC?

Through the rigorous examination of these pivotal inquiries, the article aims to provide substantive insights into the integration of technology within vocational education, as well as the ongoing professional development of educators in this field.

2. Methodology

A systematic literature review (SLR) was conducted to thoroughly examine the existing scientific evidence regarding the levels of DC exhibited by VET instructors, as well as the application of technological frameworks within the Spanish context. The execution of a systematic literature review required adherence to a pre-established search protocol, which encompasses stringent inclusion and exclusion criteria to ensure methodological rigour. This research endeavour was grounded in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocol (PRISMA-P) guidelines, as outlined by Moher et al. (2015) and Shamseer et al. (2015). The PRISMA-P guidelines were instrumental in articulating the processes of identification, screening, eligibility assessment, and criteria for inclusion (refer to Figure 1) of the pertinent

publications. These processes subsequently informed the development of the results, discourse, and conclusions articulated within this systematic literature review.

3. Study search strategy

The following outlines the sequence of terms utilised in the search conducted in key high-quality database sources pertinent to this research topic: Dialnet, Scopus, and Web of Science (refer to Table 1). The search incorporated terms related to vocational education and training (VET) as well as the Digital Competence of teachers, employing the Boolean operators “AND” (formación AND profesional) and (vocational AND training) and “OR” (competencia digital OR literacy). The search was filtered by language, specifically in English and Spanish. Given the limited number of publications on VET and TDC, some terms were not indexed in Scopus and Web of Science. For instance, the phrase “digital competence” was excluded, and the time range and geographic focus varied.

Table 1. Terms used for the bibliographic search, according to databases.

Database	Search	Period
Dialnet	(Formación Profesional Dual) (formación profesional) AND (competencia digital OR literacy) Languages: English and Spanish	2014- 2022
Scopus	(formación AND profesional) AND (vocational AND training) refinado: 2016-2022, vocational Training, Languages: English and Spanish	
Web of science	vocational training (Topic) and Open Access and 2022 or 2021 or 2020 or 2019 or 2018 (años de publicación) and SPAIN (país/regiones)	

3.1. Inclusion and Exclusion Criteria

Table 2 outlines the inclusion and exclusion criteria applied throughout the phases of the systematic literature review (SLR), including identification, screening, eligibility assessment, and final inclusion. This review focuses on literature published between January 2014 and December 2022, a period marked by significant developments in vocational education and training, as well as in the pedagogy of DC. Prior to this timeframe, research in these areas was notably scarce, highlighting a significant gap in scholarly discourse.

The criteria presented in Table 2 serve to ensure that the literature selected for review is both relevant and of high scholarly quality, facilitating a thorough examination of pedagogical advancements and emerging frameworks. This systematic approach aims to contribute to a deeper understanding of current practices in Digital Competence within vocational education, contextualising these developments within the broader landscape of educational research and policy, considering the rapid technological advancements.

Table 2. Inclusion and exclusion criteria used for the systematic literature review

Inclusion Criteria	Exclusion Criteria
IC1: Publications that show qualitative and quantitative results on the levels of Digital Competence (DC) of teachers and students of Vocational Education and Training (VET) were considered, as well as the pedagogical usage they make of the Applied Technology Classrooms (ATC) and/or methodologies related to DT and digitization of VET centers.	EC1: The publication was considered out of context. Publications that are not aimed at Vocational Education and Training and Digital Competence are not included, and future VET teachers are not considered.
IC2: International, European, and studies in Spain that evaluate the DC level of VET teachers and other experiences of using applied technology classrooms, entrepreneurship or also known as Future Classrooms Labs.	EC2: Publications that are not carried out at the VET educational level, whether traditional or dual, have been excluded.
IC3: Descriptive, experimental studies, case studies, triangulation of qualitative and quantitative data or bibliometric studies.	EC3: Studies with deficits in the presentation of the study methodology or lack of information on the study design have been excluded.
IC4: Studies written in English and Spanish published in the period of 2014 to 2022, only in scientific journals.	EC4: Studies published before 2014.
IC5: Complete scientific articles with open access were considered.	CE5: Those articles that were not available in the databases have not been included.

3.2. Conducting the review

As articulated in the introductory section, the research endeavour was formally initiated after a comprehensive consensus among the authors regarding several foundational elements. Specifically, the authors delineated (1) the core research questions, which served as the guiding framework for extracting pertinent answers from a meticulous analysis of the selected publications, (2) the systematic search strategies employed in strict adherence to the PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols) statement, thereby ensuring methodological rigor and transparency throughout the research process, and (3) the explicit criteria established for the inclusion and exclusion of publications, which were pivotal in curating a relevant and high-quality body of literature for review.

Figure 1 graphically represents the various phases as outlined in the PRISMA-P declaration, thereby providing a visual representation of the structured approach employed in this systematic review. This methodological framework not only strengthened the integrity of the research but also facilitated a comprehensive synthesis of existing knowledge within the identified domain of inquiry.

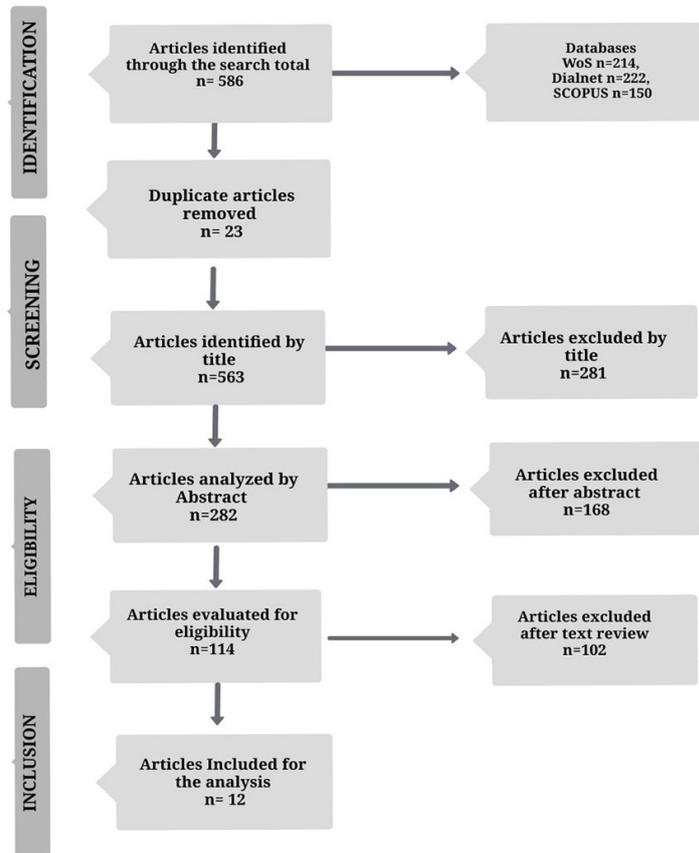


Figure 1. Description of the Systematic Literature Review procedure, based on the PRISMA Protocol.

3.3. Identification phase

In December 2022, a comprehensive literature review was conducted, resulting in the retrieval of a total of 586 scholarly publications from various academic databases, specifically Dialnet (46%), Scopus (23%), and Web of Science (31%). The selection criteria for these publications directed the inclusion of both qualitative and quantitative findings regarding the levels of DC among Vocational Education and Training (VET) teachers and students. Additionally, the review encompassed publications that explored the pedagogical applications of Applied Technology Classrooms, thereby fostering a richer understanding of teaching methodologies within this context.

To systematically organise and facilitate further analysis, relevant references and information from the retrieved publications were catalogued in a Microsoft Excel spreadsheet. This technical framework included critical data such as the title, abstract, authorship, year of publication, specific objectives, and delineated learning outcomes for each study. Through this rigorous process, 23 duplicates were systematically identified and removed, resulting in a refined selection of 563 publications deemed relevant for subsequent phases of review and analysis. This meticulous approach

underscores the commitment to ensuring a comprehensive and academically rigorous foundation for the following examination of DC within the VET sector.

3.4. Screening phase

During this phase of the systematic review process, an assessment of the literature was conducted, focusing on the titles of the publications to determine their relevance to the established exclusion criteria. Initially, a comprehensive database search yielded a substantial number of publications. However, upon scrutiny by the researchers, it became apparent that a significant portion did not meet the stringent criteria set forth for inclusion in the study. As a result of this rigorous filtering process, a total of 281 publications were systematically excluded because they failed to satisfy one or more of the predetermined exclusion criteria. These criteria were designed to ensure that only the most relevant and high-quality studies would be considered for further analysis.

Following this thorough evaluation, 282 publications emerged as suitable candidates for progression to the next phase of the review. This selection marks a critical step in the research process, as the chosen publications will undergo a more in-depth examination to assess their methodologies, findings, and contributions to the field. This phase ensures that the foundation of the subsequent analysis is built upon a solid framework of relevant and credible literature.

3.5. Eligibility phase

During the eligibility phase, a comprehensive analysis was conducted of the 282 submitted abstracts. This critical evaluation led to the exclusion of 168 abstracts, based on stringent adherence to predefined inclusion and exclusion criteria. The primary rationale for exclusion centred around the absence of pertinent discussions regarding the DC of Vocational Education and Training (VET) teachers (denoted as EC1). Additionally, many abstracts failed to provide substantial insights into the utilisation or application of methodologies associated with digital technologies (DT) or the integration of digitisation within VET classroom settings (IC1). Following this rigorous screening process, a total of 114 publications were meticulously selected for the final phase of the review, ensuring a robust and focused examination of the relevant literature in this vital area of educational research.

3.6. Inclusion phase

Throughout the inclusion phase, a comprehensive examination was conducted on a total of 114 publications. Pre-established inclusion and exclusion criteria were meticulously reviewed in each publication to ensure the integrity and relevance of selected studies. Out of the 114 publications, 102 were excluded based on their failure to meet specific inclusion criteria, which were systematically categorised as follows: Inclusion Criterion 1 (IC1) accounted for 42 exclusions, Inclusion Criterion 2 (IC2) led to 10 exclusions, Inclusion Criterion 3 (IC3) resulted in 12 exclusions, Inclusion Criterion 4 (IC4) prompted 8 exclusions, and Inclusion Criterion 5 (IC5) culminated in 30 exclusions.

Ultimately, a selection of 12 publications was identified and incorporated into a rigorous and methodologically sound analysis. This selection process was meticulously designed to enhance the clarity, consistency, and reliability of the research objectives. The chosen publications aim to provide scientific insights and

substantive answers to the core research questions, thereby contributing to the advancement of knowledge within the relevant field.

4. Results

4.1. Characteristics of the included articles

The selected publications, which adhered strictly to the predefined inclusion criteria, comprise a total of 12 studies, as detailed in Table 1. These works represent a diverse range of research methodologies, reflecting a comprehensive approach to the investigated phenomena. Specifically, the body of literature includes four quantitative studies that employ statistical analyses to derive significant findings; three descriptive-correlational-predictive studies that elucidate relationships among variables and forecast outcomes; one quasi-experimental study that offers insights into causal inferences within a controlled setting; one bibliometric analysis that systematically evaluates the impact and contributions of literature in the field; and finally, three qualitative studies which provide depth and context through rich, narrative data. This variation in research design, illustrated in Figure 2, underscores the multifaceted nature of the inquiry and the breadth of perspectives represented in the literature.

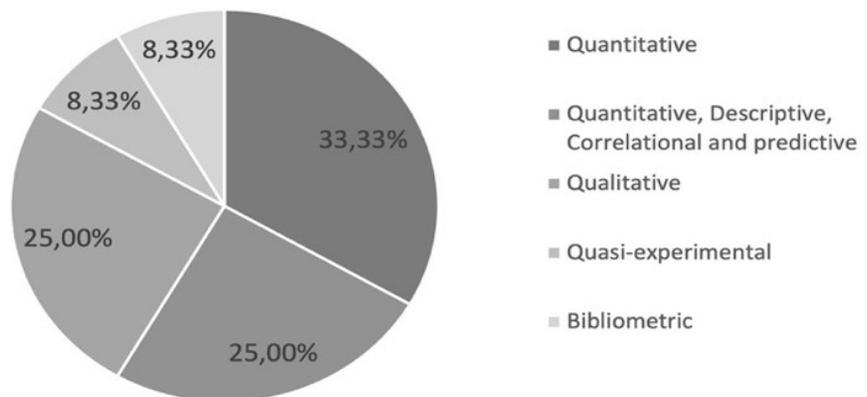


Figure 2. Study Types included for the SLR.

The studies included in this systematic literature review (SLR) share a common thematic focus on examining TDC within the VET context. Moreover, these studies explore the innovative development of educational environments and learning spaces where Digital Technologies (DT) are actively integrated and utilised as pedagogical tools. The synthesis of findings across these investigations underscores the multifaceted role of DT in enhancing instructional methodologies, fostering skill acquisition, and ultimately transforming the educational landscape within vocational training programmes. A comprehensive overview of these studies is presented in Table 3, highlighting the distinct objectives and contributions of each research endeavour to the broader discourse on TDC in vocational education and training (VET). Through this

aggregation of literature, the review aims to explain the pathways through which DT not only facilitates learning but also propels systemic changes within vocational educational frameworks.

Table 3. Description of included articles for the SLR

Reference	Type of study	Objective	Main results
Sánchez-Prieto et al., 2021	Quantitative	Find out if the inadequate DTC development also occurs in the Dual VET.	With a sample of 1,568 VET teachers, the results show that due to a low level of digital skills, it is improbable to find the factors that influence various DC components, such as the teacher's previous knowledge, where the educational center is located, or the professional family to which it belongs.
Casal Otero et al., 2021	Quantitative	To know the DTC levels of VET teachers in Galicia, their attitudes towards DT and the influence of the gender variable in this competence.	The results describe that the sample of 249 teachers has an integrator and expert DTC level, attitudes towards DT are favourable and the gender variable is a significant factor in the DC levels in VET teachers.
Sánchez Prieto et al., 2020	Quantitative	To determine if the low DC level is influenced by the gender of the teacher.	The sample of this study was 1568 teachers, the results show that there are no significant differences between teachers in the application of skills. It also shows that the gender gap exists in other contexts.
Moreno Guerrero et al., 2020a	Quantitative	To know the level of influence that context, culture, and economic factors have on the use of DT devices, especially computers, tablets, and smartphones.	With a sample of 251 students from different vocational education and training families, this study concluded that the context variable does not represent an influence on the frequency of use of the devices analysed or on the training of the students.
López Belmonte et al., 2020	Quantitative Descriptive, correlational, and predictive	To consider how VET teachers make transformative proposals with DT tools such as Augmented Reality and know which are the DTC areas with the highest incidence as a decisive factor for the DT use.	The results obtained from a sample of 627 VET teachers show that the unsatisfactory training of teachers in knowledge about AR does not allow them to develop activities with a high educational content. This scant VET teachers training has an impact on the DTC level. According to the study, VET teachers self-perceived themselves at a medium level of the DTC.

Reference	Type of study	Objective	Main results
Moreno-Guerrero et al., 2021	Quantitative Descriptive, correlational, and predictive	To evaluate and analyse how the DC of VET teachers interferes when dealing with teaching processes throughout virtuality.	With a sample of 627 VET teachers, the results of this study reveal the scarcities in the different DTC areas. According to the authors, the results reflect how these scarcities directly affect the teaching processes throughout virtuality. The findings of this research also reveal that two of the DTC areas (Areas 1 and 2) restrict VET teachers' usage of the online learning model.
López-Belmonte et al., 2020	Quantitative Descriptive, correlational, and predictive	To know VET teachers DTC average in the application and development of the Blended Learning method.	According to the findings obtained after the participation of 627 VET teachers, it was possible to identify that the lack of VET teachers DTC development limits the development of models such as Blended Learning, and that the DTC is a key stone for the development or application of models like this or similar ones.
Hinojo-Lucena et al., 2020	Quasi-experimental	Find out the degree of effectiveness of the B-learning modality at the Vocational Education and Training educational level, with emphasis on an applied sciences module.	With a sample of 147 VET students, this study models how students who have developed tasks through the Blended Learning modality have obtained improvements in all dimensions of the study.
Moreno Guerrero, Antonio José (2019)	Bibliometric	To know the publications that develop the B-learning modality in Vocational Education and Training, the data was obtained from the high-quality Web of Science database.	The results show that there is an increasing interest in scientific production on this subject, this conclusion could be obtained after a finding of 63 publications included for the analysis.
Lorente García, Rocío (2014)	Qualitative	To analyse the perception of teachers about the improvements that must be made to the VET to meet the demands of the labour market.	With the participation of 50 teachers, it was possible to extract their perception based on the necessary and pertinent improvements to the VET educational system. As a result, it was possible to assess the need to improve the technification of the VET processes but focused on the attention of a constantly changing labour market.

Reference	Type of study	Objective	Main results
García-de-Paz & Santana Bonilla, 2021	Qualitative	To inquire from the perspective of VET teachers, the virtual training, and transformative processes, embraced after the COVID-19 pandemic arrival.	Interviews were conducted with a sample of 8 members of the teaching management staff of a Vocational Education and Training centre with an emphasis on Electricity and Electronics. The findings suggest three elements that helped the transition from face-to-face to virtual education; the basic digital services for communication and teaching that the centre has, the organizational structure of the centre based on a shared leadership model with an autonomous team and the participation of the family as a fundamental pillar from the perspective of teachers.
Suárez Guerrero et al., 2021	Qualitative	To relate pedagogy, resources, evaluation as an essential mean in the VET teachers DTC acquaintance.	Based on a sample of 11 teachers from the Autonomous Community of Valencia. Several conclusions were obtained, highlighting among the main ones, the wisdom of teachers about some of the technological resources and the adaptability to the teaching practice. However, the study also valued that teachers do not use technological tools in the evaluation processes.

The analysis reveals a significant increase in the volume of scholarly literature dedicated to exploring and analysing the impacts of TDC on pedagogical methodologies and educational frameworks over the past eight years. This trend is further corroborated by an examination of its association with VET and the broader scope of lifelong learning initiatives (refer to Figure 3) (Aguilar de la Rosa, 2022). Despite this positive trajectory, it is essential to highlight the prevailing deficiency of publications indexed in high-quality, peer-reviewed databases. Such a shortfall hampers the potential for comprehensive and rigorous scientific inquiries into this critical domain, thereby limiting the depth of understanding and the advancement of knowledge about TDC's multifaceted influences in educational contexts.

4.2. Relation between the SLR findings and other studies discussing TDC

Several of the included studies explore concepts based on the perceptions and discourses of VET teachers regarding the current state of vocational education and its significance in society. Conversely, other studies focus on a labour market characterised by pressing demands and a strong emphasis on developing workers' digital competencies (Lorente García, 2014). These publications identify teachers as a crucial source of knowledge, vital for shaping a country's future workforce. The data suggest that VET teachers must effectively differentiate between the content taught in the classroom and that which is applied and tested in real-world practice (Aguilar González, 2015; Barrientos et al., 2019). Homs Ferret (2016) argues that, given the continuous expansion and influence of new digital technologies, the role of VET teachers has evolved beyond that of a passive participant in their learners' knowledge

development. For instance, concerning learning acquisition, teachers are now expected to act as mediators between what occurs in educational settings and what is required in the workplace.

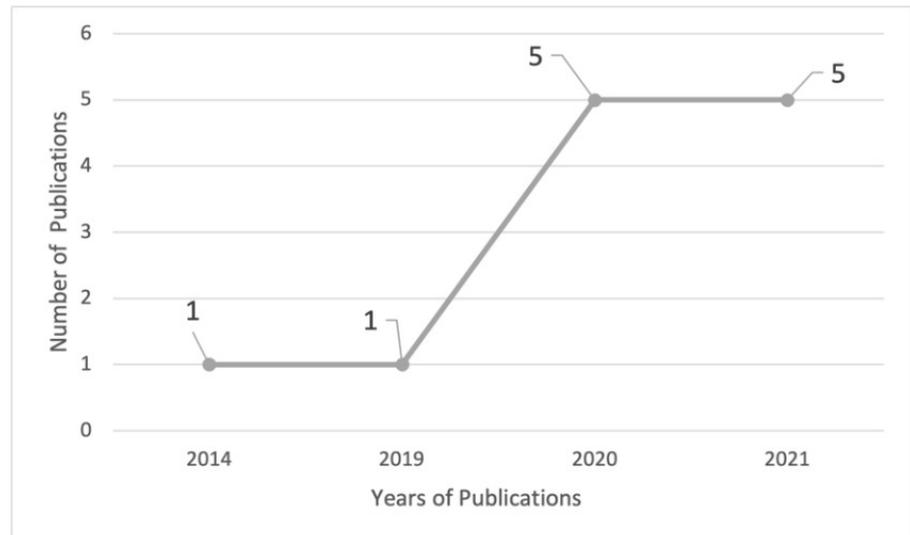


Figure 3. Description by year of the included publications for the SLR

In their study, García-de-Paz and Santana Bonilla (2021) investigate how teachers assess their DC and its impact on the development of students' digital skills. They emphasise that the integration of digital technologies (DT) profoundly influences teaching methodologies and learning processes, which are crucial for achieving optimal levels of TDC. The works of Cabanillas-García et al. (2019), López Belmonte et al. (2020a), and Moreno Guerrero et al. (2020a; 2021), along with Suárez Guerrero et al. (2021), support the argument that effective digital integration is essential for fostering digital competencies in both educators and students, thereby enhancing educational outcomes in contemporary contexts.

Casal Otero et al. (2021) conducted a comprehensive investigation into the concept of TDC, positioning it as a pivotal element in enhancing pedagogical practices within VET. Their analysis highlights the importance of both didactic methodologies and the attitudinal dispositions necessary for the effective integration of Digital Technology (DT) within educational contexts. Concurrently, the works of Sánchez Prieto et al. (2020) and Sánchez-Prieto et al. (2021) delineate the gender disparity among VET educators as a salient factor influencing the sustainable development of TDC. In contemporary discourse, the gender gap emerges as a critical theme impacting TDC advancement across various strata of Vocational Education and Training (Mosteiro García & Porto Castro, 2016; Sanmartín López et al., 2016; Villar-Aguilés & Obiol-Francés, 2020) and extends its implications across diverse educational tiers (Hidalgo Ariza et al., 2020; Niño-Cortés et al., 2022; Usart-Rodríguez et al., 2021).

The existing literature critiques the efficacy of TDC within VET centres (García-Valcárcel et al., 2017; Lázaro Cantabrana & Gisbert Cervera, 2015), thereby underscoring the need to recalibrate training paradigms for future VET educators. This imperative is

substantiated by extensive discourse in various studies involving both undergraduate and master's degree candidates that advocate for further scholarly exploration into the acquisition of Digital Competence (DC) as an essential cross-curricular competence (Casal Otero et al., 2022; Cisneros-Barahona et al., 2022; Esteve-Mon & Gisbert, 2013). Such investigations are crucial for refining pedagogical strategies and ensuring the alignment of educational outcomes with contemporary technological needs.

Numerous scholars, including Hinojo-Lucena et al. (2020), López-Belmonte et al. (2020b), and Moreno Guerrero (2019), have conducted thorough examinations regarding the impact of TDC on the evolution of pedagogical methodologies, particularly blended learning. These studies provide a comprehensive overview of how vocational education and training (VET) instructors self-assess their competencies when employing strategies designed to enhance the educational experience of VET students. Key variables identified within this body of research—such as the specific domains of TDC, spatial reconfiguration, and gender considerations—shed light on the factors influencing the self-perceived levels of TDC among VET educators. In this context, Moreno-Guerrero et al. (2020b) undertake an in-depth analysis of TDC domains alongside information literacy and its constituent dimensions. Concurrently, Gómez-García et al. (2022) elucidate the principles of spatial redesign and transformation within educational institutions as informed by the “Future Classroom Lab project,” emphasising how such spatial innovations enhance collaborative endeavours between students and educators.

5. Conclusions

In this segment, a systematic organisation and comprehensive analysis of each research question is presented, grounded in the findings derived from the publications included in the systematic literature review (SLR).

5.1. What scientific evidence exists about VET teachers' Digital Competence?

The current landscape of VET highlights a significant deficiency in high-quality evidence regarding the DC of VET teachers. This concern has prompted increased scrutiny and emphasis from scholars in the field. Moreno-Guerrero et al. (2020a) assert that the inadequate training of educators in the pedagogical application of digital technologies (DT) can largely be attributed to an overemphasis on the instrumentalisation of Digital Competence. Their findings suggest that educators who recognise their DC levels are more likely to enhance educational quality and implement methodologies that are aligned with the ongoing digital transformation.

Further supporting this perspective, García-Valcárcel et al. (2017) contend that the effective pedagogical implementation of emerging digital technologies—such as augmented and virtual reality—necessitates a robust development of DC among educators. This sentiment is echoed by Suárez Guerrero et al. (2021), who argue that DC for VET teachers should not merely be an ancillary skill but rather a cross-curricular priority integral to the qualification process of VET students.

Moreover, Cabanillas-García et al. (2019) elaborate on the critical role that DC plays in facilitating effective teaching and learning processes across various modalities. They posit that digital technologies can serve as essential tools for instructional

delivery within the VET framework. Collectively, these insights underscore the imperative for educational institutions to prioritise the development of DC among vocational education and training (VET) teachers to foster a more effective and relevant educational experience for their students.

5.2. Concerning Digital Competence, what training needs do VET teachers have?

The integration of DT within educational environments is experiencing a significant rise across various levels of the educational system. According to the comprehensive analysis conducted by Moreno-Guerrero et al. (2021), this trend underscores the need for educators to develop a nuanced understanding of digital transformation. As classrooms increasingly reflect the demands and expectations of a technologically know-how student body, it becomes essential for teachers to not only familiarise themselves with these tools but also to harness them effectively in their pedagogical practices. This journey entails developing a robust DC that empowers educators to adeptly manage various technological resources and create innovative teaching methodologies that seamlessly incorporate these tools.

Furthermore, López Belmonte et al. (2020b) highlight that the rapid progression of technological innovation has brought to the forefront certain limitations that educators, as users of DT, demonstrate. These deficiencies are not merely technical but extend to a broader self-perception regarding their TDC. As teachers grapple with the demands of integrating technology into their pedagogical frameworks, their often low self-assessment of their abilities can inhibit effective implementation. This situation underscores the pressing need for targeted professional development initiatives that enhance teachers' confidence and competence in utilising digital technologies within the classroom context. The evolving landscape of education requires a paradigm shift in how teachers perceive and implement their roles in integrating digital technologies. By addressing both the knowledge requirements and the psychological barriers surrounding TDC, the educational system can move toward a more integrated and effective use of technology that enriches students' learning experiences.

5.3. Regarding VET Learning regulated by the inclusion of DT, what modality (In-person, hybrid, distance) and what type of methodologies are more efficient for VET student learning?

Blended learning, often referred to as hybrid learning, has garnered significant acceptance in the realm of vocational education and training (VET) due to its potential to enhance instructional effectiveness. López-Belmonte et al. (2020b) elucidate that the integration of blended learning merges traditional pedagogical methods with innovative technological tools, thereby allowing educators to refine their instructional strategies. However, the authors caution that the full realisation of blended learning's benefits may be hindered by certain limitations in its implementation, suggesting that these shortcomings deserve careful consideration to optimise the teaching and learning experience.

Furthermore, Sánchez Prieto et al. (2020) emphasise the critical linkage between the methodologies associated with digital technologies (DT) and their didactic applications. The authors argue that the effective integration of these technologies is vital for professional development within the educational sector. García-de-Paz and Santana-Bonilla (2021) elaborate on this context by addressing the

transformative impact of the COVID-19 pandemic, which necessitated a rapid transition from traditional face-to-face instruction to remote or virtual learning environments due to the unprecedented lockdown measures.

This shift has presented educators with a dual-faceted challenge. On the one hand, some perceive this transition as an invaluable opportunity to modernise their pedagogical approaches and enhance the quality of the teaching-learning process. Such educators are inclined to embrace innovation and seek ways to leverage technology to foster more engaging and compelling learning experiences. Conversely, some resist these changes, viewing them as disruptive to their established teaching practices and routines. This dichotomy highlights the ongoing tension within the educational community regarding the adoption of new methodologies. It underscores the imperative for professional development and support systems to facilitate effective transition and foster a culture of adaptability in VET settings.

5.4. Concerning Digital Competence, what role should the VET teacher play in managing an applied technology classroom?

The contemporary educational landscape, as elucidated by Sánchez-Prieto et al. (2021), underscores the multifaceted role of the teacher when guiding students through learning processes within applied technology environments. In this context, the educator emerges as a tutor, moderator, and counsellor, essential for facilitating effective pedagogical interactions. This evolution reflects a significant shift in classroom dynamics, as articulated by Gómez-García et al. (2022). Today's educational spaces have transcended traditional paradigms characterised by static and unengaging methodologies. Instead, they now embody a more dynamic and interactive essence that fosters collaborative technological engagement among teachers and students alike.

The contributions of Hinojo-Lucena et al. (2020) and Moreno-Guerrero et al. (2020b) further illuminate the integral role of digital technology in educational settings. These scholars argue that technology acts as a pivotal support system in the teaching and learning processes, particularly in equipping students to meet the demands of a rapidly evolving labour market. As such, the integration of digital tools not only enhances the learning experience but also provides students with essential resources, motivation, and growth opportunities. This, in turn, cultivates critical skills and promotes greater autonomy in educational pathways.

The intersection of modern educational practices and digital technology heralds a transformative approach to teaching and learning. By embracing collaborative methodologies and situating technology as a supportive ally, educators can better prepare students to navigate the complexities of the contemporary workforce while fostering an engaging and responsive learning environment.

5.5. Conclusive Insights Derived from the Systematic Literature Review

This systematic literature review analyses the empirical evidence regarding the levels of DC among VET educators and their interactions with applied technological environments within the Spanish context. In strict adherence to the PRISMA-P guidelines, rigorous inclusion criteria have been established, ensuring that the

methodological approach yields reliable and valid responses to the research questions posed.

The outcomes of this review reveal a troubling dearth of scholarly contributions that thoroughly investigate the Technological Digital Competence (TDC) of VET instructors, particularly within esteemed and high-quality academic databases. This notable gap in the literature highlights a significant limitation in the existing body of knowledge, underscoring the need for bibliographic studies to illuminate key aspects of TDC. Consequently, the findings emphasise the need for expanded research initiatives that can comprehensively address the digital pedagogical readiness of VET teachers, thereby fostering a deeper understanding of the competencies required in an increasingly digital educational landscape.

The analysis conducted on the studies included in this investigation highlighted the critical significance of developing TDC among VET educators. This topic emerges as a pivotal concern not only for educational policymakers tasked with shaping effective curricula and professional development programs but also for employers who rely on the VET system to produce highly competent graduates equipped to meet the demands of the contemporary workforce.

The inquiry yielded compelling evidence of a persistent trend: VET educators frequently exhibit a low self-assessment of their DC. This phenomenon can be comprehensively attributed to two primary factors. Firstly, the existing training frameworks regarding the components of TDC often prove inadequate, failing to equip educators with the necessary skills and confidence to integrate technological tools into their pedagogical practices effectively. Secondly, prevailing attitudes towards digital transformation play a crucial role, as these attitudes significantly influence educators' engagement with technological resources and their application within educational settings. Such dynamics underscore the urgent need for strategic interventions that enhance the digital competencies of VET educators, thereby fostering a more robust and effective vocational education ecosystem. This study represents a pivotal contribution to the academic discourse surrounding VET educators and their digital competencies. By implementing a structured scientific protocol in our analysis, we affirm the validity of our findings.

Moreover, this study offers a systematic examination of TDC levels among VET teachers, with our conclusions emphasising the pressing need for the development of research instruments that enable educators to assess their actual TDC level accurately. The implications of this research extend beyond academia, serving as a valuable resource for all stakeholders involved in the VET sector, facilitating optimised resource allocation, and enhancing awareness of digital competencies.

5.6. Limitations of the study

Throughout this study, several significant limitations have been encountered that warrant discussion. Foremost among these was the limited number of publications focusing on the pedagogical applications of digital technologies within Vocational Education and Training (VET) settings. This scarcity of relevant literature highlights a notable gap in the research landscape, complicating efforts to draw comprehensive conclusions about the integration of digital tools in educational practices. Additionally, issues have arisen with the methodological rigour and clarity of the existing studies.

Many of the publications reviewed lacked coherent frameworks or robust methodological structures, raising concerns about the reliability and generalisability of their findings. Such deficiencies prompt questions about the validity of the conclusions drawn and underscore an urgent need for more systematic and transparent research approaches in this domain. Moreover, the constraints imposed by the study's timeline limited the ability to conduct a thorough review. This factor emphasises the necessity for ongoing grants that can adapt to the rapidly evolving technological landscape and its implications for VET.

5.7. Implications for Future Research Endeavours

This study highlights the necessity for a broader framework to understand TDC in VET. By utilising various high-quality databases, including ERIC, researchers can obtain comprehensive insights into the integration of digital skills within vocational curricula. An interdisciplinary approach, drawing from educational technology, pedagogy, psychology, and workforce development, facilitates the identification of best practices in teaching and informs policy formulation.

Using diverse methodologies, researchers can uncover the barriers and facilitators that affect the implementation of digital competency frameworks. This general perspective is vital for developing targeted, evidence-based pedagogical strategies for vocational learners. Ultimately, this inclusive approach enhances academic discourse on DC and supports the creation of policies that prepare students for success in a digital workforce.

6. References

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