

Teachers' digital competencies for mediation in hybrid learning environments

Competencia digital docente para la mediación en ambientes virtuales mixtos

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Beatriz Zempoalteca Durán*
Juan González Martínez**
Teresa Guzmán Flores***

ABSTRACT

Keywords

Teacher qualifications;
hybrid learning; ICT;
teacher training; virtual
learning

As a result of the confinement due to the global pandemic of covid-19, teachers and students found themselves in the inevitable situation of suddenly moving from the traditional face-to-face model to virtual environments, with the demand for new digital skills and computer resources. The purpose of this scientific article was to describe the digital teaching competence, the main problems that the educational community faced to join virtual environments, as well as the proposals that originated to perform expeditiously in this new modality. The research was based on a systematic review of scientific articles on digital teaching competence in virtual environments in the context of the pandemic, in the Scopus database, with the support of Redalyc, Scielo, Dialnet, Elsevier and Google Scholar. The results show that the digital teaching competence still does not present an optimal level, so the most recurring solution proposal is the training and development of the digital teaching competence. Since to date the direction followed by the actors involved in virtual learning is uncertain, this investigation culminates by proposing an alternative solution.

RESUMEN

Palabras clave

Competencias del
docente; aprendizaje
semipresencial; TIC;
formación de docentes;
competencias digitales

Derivado del confinamiento por la pandemia mundial de la covid-19, docentes y estudiantes se vieron en la inevitable situación de migrar repentinamente del modelo presencial tradicional hacia los ambientes virtuales, con la exigencia de nuevas competencias y recursos informáticos. En este artículo se planteó el objetivo de describir el desarrollo de la competencia digital docente, los problemas principales que se enfrentaron en la comunidad educativa para incorporarse a los ambientes virtuales, así como las propuestas para desempeñarse de forma expedita en esta modalidad. La investigación se sustentó en una revisión sistemática de artículos científicos referentes a la competencia digital docente en ambientes virtuales de aprendizaje, debido al efecto de la pandemia, en la base de datos Scopus y con apoyo de los sistemas de información científica como Redalyc, Scielo, Dialnet, Elsevier y Google Académico. Los resultados muestran que la competencia digital docente aún no presenta un nivel óptimo, por lo que la propuesta de solución más recurrente es su formación y desarrollo. Ya que a la fecha es incierta la dirección que siguen los actores involucrados en el proceso de enseñanza-aprendizaje, esta investigación culmina planteando una alternativa de solución.

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* Doctora en Tecnología Educativa por la Universidad Autónoma de Querétaro. Profesora investigadora en el Centro de Investigación en Tecnología Educativa de la Universidad Autónoma de Querétaro, México. ORCID: <http://orcid.org/0000-0001-6919-7882>, correo electrónico: beatriz.zempoalteca@gmail.com | ** Doctor en Tecnología Educativa por la Universidad de Rovira i Virgili. Profesor de tiempo completo en la Universidad de Girona, España. ORCID: <https://orcid.org/0000-0002-9175-6369>, correo electrónico: juan.gonzalez@udg.edu | *** Doctora en Tecnología Educativa por la Universidad de Rovira i Virgili. Profesora investigadora y coordinadora del Centro de Investigación en Tecnología Educativa de la Universidad Autónoma de Querétaro, México. ORCID: <http://orcid.org/0000-0001-7330-4556>, correo electrónico: teresa6106@gmail.com

INTRODUCTION

Until a few years ago, digital technologies for face-to-face education had been little used in the teaching-learning process by educational institutions (Baranda, 2021; OECD, 2020). Although the incorporation of information and communication technologies (ICT) in the classroom was already required, in the face-to-face educational model the resistance to change was high and was limited to traditional methodologies, where the use of computer equipment and computer resources were mostly intended to share and transmit information in a single direction (INEGI, 2016; Unesco, 2019); that is, books and notes converted to PDF format were shared and viewed through personal computers or cell phones, where exposure and exchange of opinions was almost nil (European Commission, 2013).

Due to the confinement caused by the global pandemic that occurred at the beginning of 2020, teachers and students were faced with the inevitable need to suddenly migrate from the traditional face-to-face model to dynamic digital environments, with the demand for new knowledge, skills, attitudes and computer resources (Esteban *et al.*, 2020; Díaz-Arce and Loyola-Illescas, 2021). The educational system had not formally prepared for this transition, nor had it foreseen it (Brítez, 2021). In this sense, the adaptation to virtual teaching-learning environments towards the blended and online modality, as well as the appropriation of technological tools for education and knowledge, has been a chaotic process, with a lack of quality standards and without strategic planning to analyze the specific needs for each context (Brítez, 2021; Rama, 2020), since it lacks the necessary knowledge, training, experience and resources (Bates and Sàngra, 2012; Esteban *et al.*, 2020).

The educational community that was in a face-to-face model faced great difficulties in the use and integration of technologies for education and knowledge in virtual environments. In Latin America and the Caribbean alone, more than 160 million students stopped having face-to-face classes (ECLAC-UNESCO, 2020), which promoted digital inequality in different areas (connectivity, equipment and digital competence); this gave rise to two groups with large differences: those with higher and better achievement, and those with lower and worse academic performance, where teaching practice remains focused on traditional methods (Baranda, 2021; Rama, 2020; Ruíz Aquino, 2020; Salinas, 2020), instead of directing its attention to the development of learning processes of a social-constructive nature, with the use of pedagogical models supported by digital technologies (Area, 2007; Unesco, 2020).

Incorporating the academic population into virtual environments presents severe shortcomings (Díaz-Arce, 2021), and Mexico is no exception. Before the pandemic, the teaching-learning process was mostly face-to-face for about two million teachers and almost 36 million active students (see

Table 1). Students and academic staff coincided in space and time in the institution's facilities (SEP, 2018), where praxis followed a banking educational model, meaning that the student received information to memorize and accumulate, and then replicate it without much reasoning (Freire, 2005). This differs from what is possible today with virtual environments, based on the active role of the student and where computer resources, interactivity strategies, inter-learning and self-learning are basic for the construction of knowledge (Peñalosa, 2013; Varona-Domínguez, 2020).

Table 1. Enrollment of students and teachers in Mexico between 2019 and 2020

<i>Educational level</i>	<i>Teachers</i>	<i>Students</i>
<i>Basic</i>	1 225 341	25 253 306
<i>Upper secondary school</i>	412 353	5 144 673
<i>Upper secondary school not in school</i>	8 089	399 935
<i>Higher education</i>	394 189	4 061 644
<i>Non-schooled higher education</i>	72 905	869 556
<i>Total</i>	2 112 877	35 729 114

Source: Authors' own elaboration with data from the Continuous Statistics System, of the Ministry of Public Education (SEP), period 2019-2020.

According to the above, the following questions arise: what are the situations faced by the academic community for effective didactic intervention in virtual environments, what is the digital competence that teachers have developed in praxis during the covid-19 pandemic, and what is required to achieve an optimal didactic intervention in mixed virtual environments? Thus, the objective of this research is to describe, based on research, the development of teachers' digital competence during the pandemic, the main problems faced by the educational community in incorporating into virtual environments, as well as the proposals that originated to perform expeditiously in this modality, which has had to work in an emergent way due to the health condition.

To achieve the above, a documentary research method with content analysis was used, following this research assumption: the didactic intervention is still focused on the technological resource instead of the method or strategy with or through ICT, due to the fact that there is not enough digital competence for mediation in virtual environments of blended or blended learning. In addition, there is no adequate communication to achieve the objectives on the part of all the actors involved in the teaching-learning process within a modality with which they have had to work unexpectedly.

BLENDED TEACHING-LEARNING MODELS

Blended learning, blended learning or blended learning (b-learning) refers to the study modality that incorporates face-to-face or traditional teaching spaces with ICT support (Mortis *et al.*, 2015). In Mexico, this teaching model has been officially recognized for the higher education level. The SEP (2018) defines it as a flexible model that integrates strategies, methods and resources of school and non-school modalities, i.e., it combines temporal coincidences between students and academic staff with the use of a technological platform or electronic media, or through autonomous processes and didactic supports. Teaching and technological mediation is mandatory for the teaching-learning processes in the online or virtual educational option.

Since blended learning depends essentially on the context, it is difficult to construct an absolute concept (Moskal *et al.*, 2013); since its emergence in 1960, it has had different conceptions in the mixture of face-to-face and non-face-to-face. At the beginning it focused mainly on the teacher's action, while in the 1990s it considered more the context, combining face-to-face teaching with technology for a non-face-to-face modality according to the educational need (since this model dealt with instrumental aspects over didactic intervention), with the aim of providing a solution to the apparent failure of online education (Morán, 2012).

Currently, as a result of the covid-19 health emergency, ICTs were used to provide continuity to school activities, incorporating various virtual work options and adapting several applications and computer resources abruptly for such purposes (Castaño, 2020; González, 2021). In this sense, the blended learning modality acquired different meanings and nuances, depending on the availability of resources of teachers and students, and the circumstances of the learning environment.

Due to the adaptations demanded by the academic community in view of the need to avoid face-to-face attendance, it was necessary to integrate multiple resources (digital or physical) according to the availability of the student or teacher: synchronously or asynchronously, and considering the ease of face-to-face or virtual facilities. In this way, a hybrid model emerged with which work has been done in virtual or online mode,

depending on the timing and degrees of use, according to the learning objectives, the digital competencies of the teacher, the contents and the activities (automated and manual). This originated more flexible processes according to the fields of knowledge and social situations, since it is mainly supported by the internet, videoconferences and computer equipment (Esteban *et al.*, 2020; Rama, 2020); however, the roles of teachers in these mixed virtual spaces have not been clear.

Didactic involvement in virtual environments

Since virtual learning environments require new forms of educational practice, there is a need to identify the characteristics involved in this practice. In this regard, and according to Morán (2012), a virtual educational experience requires the configuration of space, time, the teaching-learning process, socialization processes and the resources offered by ICT. In this order of ideas, the teaching work for the design of didactic interventions that combine the different factors plays an essential role, as it is related to the planning and organization of classes, evaluating educational processes and designing digital mediation to meet the educational needs of students, through the design of environments that favor positive attitudes (Bracho and Bracho, 2020). In relation to the above, digital mediation "refers to the use of digital media and in general the use of ICT for the intervention of students and teachers" (SEP, 2008, art. 2).

According to Calvo *et al.* (2013), didactic intervention in virtual environments has an important impact on the three components of the didactic triangle (teachers, students and content), since in the new teaching-learning environments, where usually the teacher or the media are not real in their traditional form, technological intervention affects all elements of the process. In this model, the student has a greater possibility of working collaboratively and accessing information in different ways, as well as complementing or confronting this information independently and expeditiously; in view of this, teachers adopt a primordial role, since they are responsible for the participation processes that strengthen the construction of knowledge and support for the achievement of goals (Peñalosa, 2013), and those who can enhance and provide the exchange and communication environments for students to perform optimally (Fandos *et al.*, 2002).

With the above, we recognize that didactic intervention in virtual environments is not a simple and improvised activity; it is a complex process that requires the intelligent and calculated foresight of different actions, considering two fundamental aspects: the constitutive elements and the conceptual elements (Herrera, 2006). The constitutive elements refer to the means of interaction, resources, physical factors and psychological relationships; the conceptual elements refer to the educational concept in these environments, i.e., the instructional design

that describes each of the moments of interaction between the actors of the didactic process, and the interface design, which details the formal presentation of the virtual space where students will coincide (Amaro, 2011). Thus, the teacher must develop competencies to manage both the constitutive and conceptual elements, in addition to generating learning spaces that are flexible and that support the needs that arise in the educational context (Unesco, 2019).

Digital competence of teachers in mixed virtual environments

When analyzing the actions carried out, derived from the abrupt changes caused by the pandemic, we highlight that these modifications impose new and growing needs for which there is no preparation for the various competencies and specializations required (Chiavenato, 2014). This incorporation to new ways of learning has implied a different way of life mediated by technology (Castaño, 2020). Prior to the pandemic, teachers' competence with ICT was not the most optimal (Falcó-Boudet, 2017; Fernández and Fernández, 2016; Hinojo *et al.*, 2019; Rodríguez *et al.*, 2016); however, derived from the confinement, there was a need to use the available computer resources and apply the scarce digital competencies they possessed, while learning by trial and error and discovering new teaching methods, breaking paradigms and training empirically without any guidance (Baque-Castro and Vigueras-Moreno, 2021; Bracho and Bracho, 2020).

For the purposes of this research, it is necessary to define the concept of competence and digital competence. To this end, Braslavsky (2001, p. 249) defines competence as "knowing how to do with knowledge and awareness of the impact of that doing"; similarly, Cano (2005, p. 329) understands competence as "the set of knowledge, procedures and attitudes linked to personality traits, only definable in action that is acquired with training plus experience and that allow to develop a function efficiently in a given context". Regarding digital competence, the European Parliament and Council of the European Union (PECUE, 2006, p. 394/10) defines digital competence as "the confident and critical use of information society technologies for work, leisure and communication. It is based on basic ICT skills, the use of computers to obtain, evaluate, store, produce, present and exchange information, and to communicate and participate in collaborative networks through the Internet".

In this way, digital competence in the educational field also contemplates the concept of teaching digital competence, since it is required to transmit these digital skills to students (INTEF, 2017). In this sense, INTEF (2022) defines this competence as "the integration of knowledge, skills, abilities and attitudes that have to be simultaneously put into play to perform their functions, implementing digital technologies and to solve problems and unforeseen events that may arise in a specific singular situation as education professionals" (p. 11).

Based on the above definitions, the concept of teaching digital competence in mixed virtual environments is understood in this research as the set of knowledge, procedures and attitudes, applied with awareness of the impact of teaching, to select the appropriate ICT resources and give direction, articulate, facilitate, evaluate and provide feedback to the teaching-learning process in virtual environments of exchange and intentional direct communication, by means of methodologies and the design of strategies that allow configuring the constitutive and conceptual elements, as well as solving problems and unforeseen events that may arise, generating flexible learning spaces that favor positive attitudes according to the educational context, in order to meet the curricular requirements of the subject and promote both disciplinary and technological learning of students (Bracho and Bracho, 2020; Braslavsky, 2005; Cano, 2005; Fandos *et al.*, 2002; Giné and Parcerisa-Aran, 2014; INTEF, 2022; Peñalosa, 2013).

Development of teachers' digital competence in mixed virtual environments.

It is necessary for teachers to develop their own digital competence, accentuating it in blended environments (Lizárraga *et al.*, 2021). Teachers need particular digital skills, as reported in the study by Esteban *et al.* (2020), who identified that a teacher must master, in addition to the subject to be taught, the virtual classroom, and at the same time use good didactics, and have a proactive and positive attitude to teach a quality class. Likewise, they must favor the development of soft skills and reflect on the relevance of their didactic intervention; this with the objective of adapting the curriculum and methodology to current requirements by assuming responsibilities, commitments and initiatives in a synchronous and asynchronous manner. All the above without forgetting the institutional support to provide the relevant equipment and an adequate internet connection, and taking into consideration the preparation time, the search for materials, the design of activities and the orientation for the management in virtual environments.

In this sense, Baque-Castro and Vigueras-Moreno (2021) identify that one of the greatest challenges of face-to-face migration to virtual environments is curriculum planning, where teaching qualities are an important factor. Among these, the authors highlight: cooperativism, concern, compassion, creativity, dedication, decisiveness and empathy. It is important to remember that the role of the teacher must be modified to become a facilitator, so he/she must acquire a high level of ICT use skills that allow him/her to create habits in the management of information search, selection and processing. Digital mediation should be based on a holistic and integrative perspective, since the authors consider that both the behavior and personal attributes of the teacher are key elements for effective and observable learning results in students; thus, it is considered necessary to have sessions where the interaction between students is

enjoyable and not only instructive meetings with individual activities that often do not provide meaningful learning.

With the above it becomes evident that, more than an option, teacher preparation in digital competencies in mixed virtual environments, the generation of attitudes necessary for cooperation and collaboration in the teaching-learning processes is an obligation (Barja-Ore and Gallardo-Pastor, 2021). This is not a recent need, in recent years various agencies at local, national and international levels have worked on digital competence training standards for ICT vocational training providers, such as Enlaces (2011), ISTE (2018), Unesco (2019), DigCompEdu (2021) and INTEF (2022). In this sense, and because digital competence training standards are general, it is necessary to contextualize them to local realities (Díaz-Arce and Loyola-Illescas, 2021). One of the proposals closest to the requirements in virtual environments is the one established in 2017 by the European Teacher Competence Framework (also known as DigComEdu), which specifically presents six areas of professional and pedagogical competencies of the teacher Redecker (2017), which are summarized in Table 2.

Table 2. Teaching areas and competencies according to DigComEdu

Areas	Professional and pedagogical competencies
Professional Commitment	Use of digital technologies for communication, collaboration, and professional development
Digital content	Search, create and share digital content
Learning	Management and organization of the use of digital technologies in teaching and learning
Evaluation and feedback	Using Digital Technologies and Strategies to Improve Assessment
Empowering Students	Using digital technologies to improve inclusion, personalisation and active engagement of students in their own learning
Developing students' digital competence	Empowering students to use digital technology creatively and responsibly for information, communication, content creation, well-being, and problem-solving

Source: Authors' own elaboration with data from Redecker (2017).

Despite the efforts of various agencies, to this day the direction followed by all the actors involved in the teaching-learning process is uncertain, as raised by various investigations that demonstrate adverse situations through which the teaching intervention in digital environments goes through (Fardoun *et al.*, 2020; Gallo, 2020; Lion, 2020; Maldonado *et al.*, 2020). Therefore, it is necessary to identify the channels of communication, motivation and promotion of human interaction (Salinas, 2020), so that the personnel involved know specifically what is required, since there are several elements that must be taken into account and it is not enough to have good intentions.

Chiavenato (2014) states that "better communication leads to better performance", for this it is required "to provide the necessary information and knowledge to support people's efforts, in addition to generating the necessary attitudes" (p. 95), and thus develop skills and capabilities to the maximum. From this follows the relevance of the present research: to identify proposals and situations that help the process of change in virtual blended learning environments.

METHOD

The research was based on a systematic review of various sources of authors and national and international organizations, extracted from the Scopus database, with the support of scientific information systems such as Redalyc, Scielo, Dialnet, Elsevier and Google Scholar, taking into account the following descriptors obtained from the Unesco thesaurus: teacher competencies, pandemic, blended learning, virtual learning and pedagogical practice. Additionally, the terms didactic intervention and covid-19 were used, joined with the Boolean operator OR. It is worth mentioning that the descriptor teaching digital competence was not used because it does not provide results in the Unesco thesaurus; however, it is a keyword that is frequently used.

The keyword search was limited to the years 2020-2022 in research articles and systematic reviews, in Spanish and English, open access for Iberoamerican countries, on topics related to digital competence in teaching in virtual environments in the context of the pandemic. Only documents reporting research on the performance of teaching-learning processes in formal education institutions, from a practical or documentary perspective, were taken into account, and those that were the product of theoretical foundations, essays or that only mentioned the terms but did not contain any contribution based on empirical work in academic praxis were discarded, as well as those cases where there was no access to the complete document.

The total number of documents where the main keyword teacher competencies was found was 2,957. Applying the Boolean operator OR, using the words 'pandemic' and 'covid-19', yielded a total of 1,330 articles. It was also necessary to filter the documents that included the keywords: blended learning, virtual learning, pedagogical practice and didactic intervention, and 132 documents were found. Subsequently, a summary table or bibliographic matrix was prepared, an instrument where all the elements that make up the study are recorded with their characteristics (title, author, country, year and keywords) (Gómez *et al.*, 2015), on which the selection filters were applied. Based on this table, documents that were repeated, those that did not have full text or those that did not meet the selection criteria in their content were discarded, leaving a total of 115 research articles.

For the content analysis, the characteristics of each document were reviewed, considering the thematic review strategies of Urrútia and Bonfil (2010) in reference to: title, summary, stated objectives, study context, research methods, eligibility criteria, sources of information, discussion of results and conclusions, in order to verify the information and identify the situations that the educational community has faced during the change from face-to-face to virtual modality, as well as to observe the solutions they have implemented or proposed for this adaptation process. Based on the proposed classification, the data were categorized and coded to perform a qualitative analysis and identify new concepts, assessments or the presence/absence of a content; in addition, a quantitative analysis was performed to establish frequencies, with the purpose of identifying priorities according to the proposed research objectives (Monje, 2011).

Once the information from the 115 articles was recorded and verified, another summary table was prepared to relate the categories and codes of analysis, in reference to the objectives of the article, the level of studies investigated, the research approach, the instrument, the type of institution and the sample. Finally, to answer the questions and meet the objectives of the present research, a mixed analysis was carried out, derived from the qualitative analysis and making use of descriptive statistics in the matrices made to identify frequent, sporadic, new and priority topics, in addition to exposing gaps and solution alternatives.

RESULTS

General characteristics of the scientific articles studied

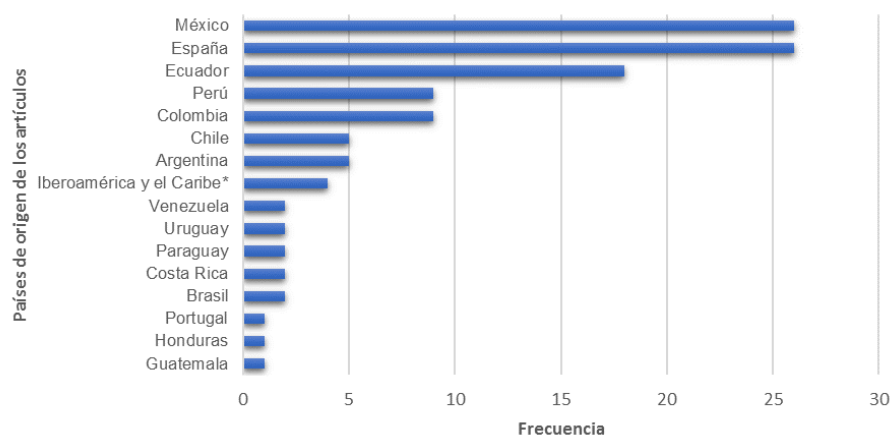
From the data obtained from the 115 research contributions, it was found that the titles of the articles studied addressed ten general topics (see Figure 1). Regarding the country of origin of the scientific production considered, it was observed that it was distributed mainly in fifteen countries, with Spain, Mexico and Ecuador standing out (see Figure 2).

Regarding the research objectives of these scientific articles, 20 study categories were identified according to the codes recorded (see Table 3).

Figure 1. Main themes of the titles of the scientific production examined



Figure 2. Countries of origin of research articles



* Estudios con más de dos países analizados.

Table 3. Categories of research objectives identified in the articles analysed

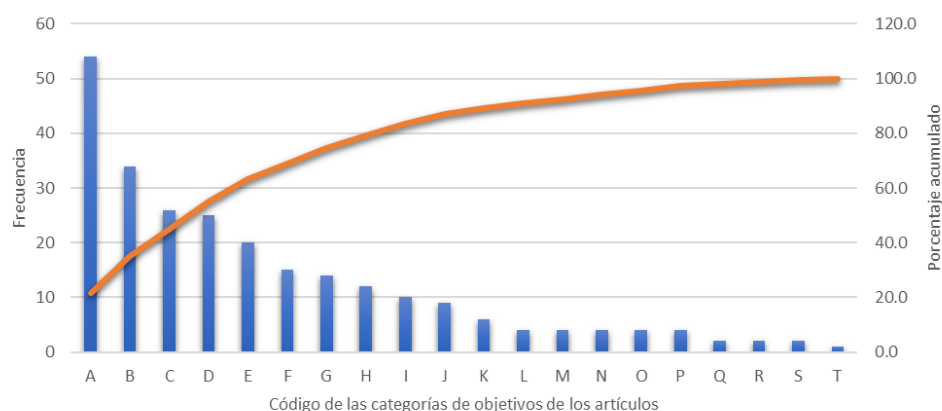
Code	Categories of research objectives	Code	Categories of research objectives
A	Challenges, reflections, experiences, effects and impact of the change to EVEA	K	Aspects related to the quality of the E-A process
B	Evaluation of the DC	L	Actitud docente
C	Teaching strategies in the E-A process in EVEA	M	Brecha digital
D	Use of ICT	N	Estudio del estado del arte
E	CDD Analysis	O	Estudios comparativos entre países
F	Formación y capacitación docente	P	Gestión de EVEA
G	Visión del estudiante sobre la CD o uso TIC	Q	Análisis de factores relacionados con el bienestar docente
H	Acciones y propuestas realizadas durante la pandemia	R	Emociones en educación remota
I	Desempeño docente	S	Evaluación en EVEA
J	Percepciones y reflexiones sobre la CDD	T	Influencia de la CDD para atender la diversidad

Nota: CD = competencia digital, CDD = competencia digital docente, E-A = enseñanza-aprendizaje, EVEA = entornos virtuales de enseñanza-aprendizaje.

It can be seen that the research objectives are concentrated in six main categories, representing about 70% of the total, which correspond to codes A, B, C, D, E and F in Table 3; of these, the category: challenges, reflections, experiences, effects and impact of the change to EVEA stands out. Rare

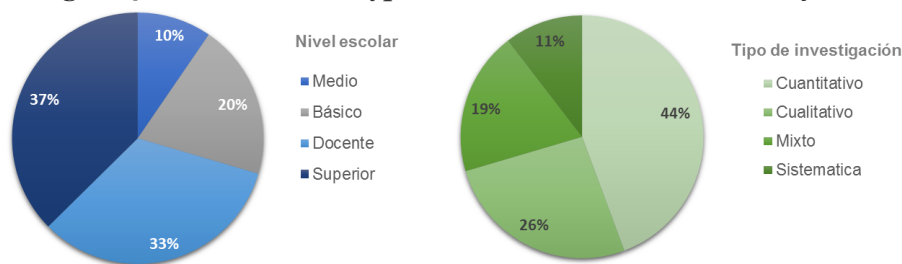
categories are also identified, such as the influence of teachers' digital competence in addressing diversity, and analysis of factors related to teachers' well-being (see Figure 3).

Figure 3. Priorities identified in the research objectives of the articles studied



Similarly, it was found that the scientific articles that were the object of study were oriented more towards higher education (undergraduate level in public and private universities) and teaching (pre-school, primary or secondary teacher training level), where the types of research conducted leaned towards quantitative methodologies, with the questionnaire being the most commonly used instrument and descriptive statistics the most recurrent analysis technique (see Figure 4).

Figure 4. School level and types of research in the studies analysed



Most common conditions when migrating from the face-to-face to the virtual modality

To answer the research questions, after the data analysis, coding was performed to identify the most common situations in the change from face-to-face to virtual mode, in order to know what were the circumstances faced by the academic community regarding didactic mediation in virtual environments, these were divided into three categories: conceptual elements, constitutive elements and professional and management aspects, each with five different situations (see Figure 5).

Figure 5. Situations that were detected in the scientific articles of study



Solutions for the change process

With regard to the last research question posed: what is required to achieve an optimal didactic intervention in virtual environments, the results and conclusions were analyzed, as well as the research proposals of the scientific articles studied. Twenty-one subcategories were found, which are presented in Figure 6, organized according to the above categories. Of these, the category of technical-pedagogical and curricular teacher training stands out for its frequency of appearance, while the least frequent categories were: supporting research, and improving and guaranteeing inclusion and equity.

Figure 6. Proposals or solutions implemented for the change process



DISCUSSION OF RESULTS

According to the articles studied, the main situations faced by the academic community for effective didactic intervention in virtual environments were: lack of teacher digital competence, lack of teacher education and training, lack of knowledge of didactic and pedagogical strategies with ICT, lack of ICT resources, communication gaps and negative attitudes. The above corroborates the assumption that the didactic intervention is focused on the technological resource because there are neither the necessary ICT resources nor the digital competence for effective mediation in virtual learning environments, in addition to the fact that there is inadequate communication on the part of the actors involved in the teaching-learning process, since there are no clear work guidelines, nor a real interaction between students and teachers.

In the category referring to professional and management aspects, it was found that the most recurrent situation is the lack of teachers' digital competence, since most of the research reports that digital competence is medium to low -or in many cases insufficient-. Based on the DigComEdu (Redecker, 2017), it can be seen that there are deficiencies in all areas of teachers' professional and pedagogical competencies. Although in most cases it is reported that teachers have generated a good attitude for use, they also had to learn by trial and error -in certain cases they even had to self-train-, as mentioned by Acevedo-Duque *et al.* (2020), Alvarado-Rodas (2020), Domínguez-Lloria and Pino (2021) and Reyes *et al.* (2021).

In the same category, a high percentage was found regarding the lack of teacher education and training. The authors of the articles identify that there is a need for teachers to acquire the knowledge and skills to create digital content, use ICT tools with greater skill and ease, and acquire the techno pedagogical and curricular knowledge to apply strategies; this, at

the same time, would allow them to make more efficient and effective use of learning platforms, since most use them as a repository or find it difficult to manage them (Brenis *et al.*, 2021; Quiñonez *et al.*, 2021; Saldaña, 2020). According to the OECD (2020), many teachers report having had training in the use of ICT, a statement that contrasts with the results, so it is necessary to review how and in what they have been trained.

According to the above, and in reference to the conceptual elements category, it was identified that in most of the occasions the strategies or methodologies with and through ICT are unknown, which causes communication gaps between teachers and students, since it is inferred that this relationship has an informational character, due to the fact that mainly the videoconference is used to expose the class or the videos and readings to explain the topics. The same happens with instructions, which are shared through messaging, chat or email, with little use of other collaborative tools such as forums, blogs, games or surveys (García and García, 2021). In this aspect, one of the greatest challenges is how to encourage participation and collaboration, so it is urgent to create innovative spaces that promote human interaction (Salinas, 2020).

In the constituent elements, the lack of ICT resources is evident, since it was found that the Internet service is not of good quality or there is no connectivity, particularly in rural communities; in addition, there is a lack of sufficient equipment to meet the needs of online work, which coincides with the OECD report (2020) regarding deficient access to ICTs and a connection speed below the world average, which limits the type of services and applications available. Similarly, the little equipment that is personally available does not have the capabilities or functionality to meet the activities and content that are presented, especially in vulnerable groups, as indicated in the study by Mateus *et al.* (2022).

A recurrent situation is negative attitudes: sometimes students perceive classes as boring, disjointed or unplanned, and activities as meaningless or poorly executed, as shown in Guevara's study (2020). In turn, teachers notice difficulties in their educational practice, which generates high levels of stress and anxiety due to fear of misuse of computer equipment, lack of attendance, lack of ethics in exams and negative attitudes on the part of the students (Bracons and Ponce de León, 2021).

In this way, teachers and students expose work overload, as they invest too many hours and there is not enough time left to integrate innovative strategies and tools; for example, they point out the monitoring of students in different formats, ensuring adequate conditions, many emails to be answered and reports to be made, as well as the use of space and own resources (George, 2020; Tejedor *et al.*, 2020 and Santos *et al.*, 2020). This coincides with data from Cepal-Unesco (2020), where it is stated that 63% of teachers consider that they are working more, and over 50% perceive lower working conditions than before the pandemic.

In this sense, and in a decisive way for the professional and management aspects category, the most frequent proposals are technical-pedagogical and curricular teacher training and the development of digital competence; however, as mentioned by Díaz-Arce and Loyola-Illescas (2021), it is necessary to contextualize training standards to local or national realities in order to concentrate efforts, since as Herrera (2006) warns, integrating a virtual educational experience is not a simple and improvised activity, it is a process that requires the intelligent and calculated foresight of different actions, together with the analysis of the context (Morán, 2012), since there are many variants that must be adapted.

It is urgent to work on conceptual elements, such as the specific instructional design for mixed virtual environments. Lizárraga *et al.* (2021) highlight the need to differentiate between the online modality and the blended modality, this in good part because teacher intervention is mandatory in the blended modality, this is also pointed out by SEP (2018); however, teachers are not clear about this specific form of mediation. González Martín *et al.* (2021) state that face-to-face teaching can be complemented, but not substituted, so that in such abrupt conditions of change it has been difficult to resolve that the didactic intervention be efficient and effective. It is important for the teacher to reflect on the use of ICT to apply interactive strategies and student-centered activities and, in general, to implement an adequate management to enhance and provide exchange and communication environments for the student to perform in an optimal and enjoyable way (Fandos *et al.*, 2002; Unesco, 2019).

In relation to the constituent elements category, it is vital to focus efforts on improving or supporting the infrastructure for mixed virtual environments, in addition to transforming the role of teachers and revaluing the profession, taking into account their well-being and valuing their efforts, by redefining a new teacher profile and identity and promoting digitally prepared teachers. It is essential to be aware that the design of virtual classes requires greater investment of time and work than face-to-face classes, so it is important to encourage better performance, because if teachers feel good, they will better motivate students and generate effective learning (Alves *et al.*, 2021; Morales and Bustamante, 2021).

Finally, it is necessary for institutions to work on structuring a pedagogical model that takes into account the environment and considers the blended learning situation in order to be able to define the different modalities derived from it, with the intention of meeting general interests without forgetting specific requirements.

It is also important to consider the implementation of quality standards for these modalities, to take advantage of reference frameworks but contextualizing them to the local reality, and to establish strategic plans

for teacher training, as stated by ECLAC-UNESCO (2020). Likewise, it is vital to work on better management, to establish timetable guidelines and virtual work standards for the different school levels, to have contingency plans and specialized institutional support in conditions of isolation, and to create new educational policies or review current ones, as proposed by Borrego (2021) and Tejedor *et al.* (2020).

CONCLUSION

The sudden change from the traditional face-to-face model to virtual environments has uncovered several difficulties in the attempts of educational innovation towards socio-constructivist methodologies. In this research different situations (favorable and adverse) were identified, among which stands out the lack of digital competence of teachers to work in virtual environments, a situation that is particularly caused by the lack of knowledge in didactic strategies in mixed virtual environments. The absence of continuous and permanent training has also been evidenced, in addition to the lack of pedagogical-curricular knowledge with and through ICTs, where, according to research and despite self-training -specific training in some cases- and good attitude to adapt to sudden change, the digital competence of teachers is still not the most optimal, since there are no clear guidelines for them to channel their self-training efforts and didactic intervention work in the classroom.

Similarly, several proposals were identified to improve teaching practice in the different modalities that emerged from the covid-19 pandemic. The most recurrent proposal was the training and development of teachers' digital competence; however, we suggest that it is necessary to work on further research to optimize efforts and identify the best direction in terms of training and development of teachers' digital competence. When reviewing the objectives of the articles studied, it was observed that most of them have focused on knowing and analyzing the situations that have been generated by the change of modality, as well as on the evaluation of digital competence -particularly of teachers-, and only about 6% of the studies have focused on the monitoring of professional training. With this in consideration, the central proposed solution is to contextualize standards locally, according to the level of studies and depending on the specific requirements of the infrastructure, space and time of each institution, taking advantage of the existing teacher training standards.

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