Instructional design and technological resources in the improvement of teachers' digital competencies

El diseño instruccional y los recursos tecnológicos en el mejoramiento de las competencias digitales de los docentes

http://dx.doi.org/10.32870/Ap.v11n2.1518

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Keywords Digital competencies; teaching competencies; instructional design; virtual learning environments; digital resources

ABSTRACT

This article presents an instructional design for strengthening competencies in the use of information and communication technologies, specifically in the dimension of digital resources. The ADDIE (analysis, design, development, implementation and evaluation) instructional design model was used; in addition, a virtual learning environment was implemented that allowed the development of synchronous-asynchronous sessions and the pedagogical elements around the training process. For the methodology, a designbased research was used with a non-probabilistic convenience sample composed of 32 elementary school teachers from Los Quindos institution, Colombia. Two research instruments were implemented: a Likert-type scale questionnaire for the analysis of teachers' social representations in the diagnostic phase, and a test that measures digital competencies according to the common European framework DigCompEdu. The application of the instructional model allowed the improvement of competence levels in all dimensions, constituting an innovative strategy in the educational field that favors interaction processes (collaborative learning) and autonomous learning.

Palabras clave
Competencias digitales; competencias docentes; diseño instruccional; ambientes virtuales de aprendizaje; recursos digitales

RESUMEN

En este artículo se presenta un diseño instruccional para el fortalecimiento de las competencias en el uso de las tecnologías de la información y la comunicación, específicamente en la dimensión de recursos digitales. Se utilizó el modelo de diseño instruccional ADDIE (análisis, diseño, desarrollo, implementación y evaluación); además, se implementó un ambiente virtual de aprendizaje que permitió el desarrollo de sesiones síncronasasíncronas y los elementos pedagógicos en torno al proceso de formación. Para la metodología se empleó la investigación basada en diseño con una muestra no probabilística a conveniencia integrada por 32 docentes de educación primaria de la institución Los Quindos, Colombia. Se aplicaron dos instrumentos de investigación: un cuestionario con escala tipo Likert para el análisis de las representaciones sociales de los maestros en la fase diagnóstica, y una prueba que mide las competencias digitales conforme al marco común europeo Dig-CompEdu. La aplicación del modelo instruccional permitió el mejoramiento de los niveles competenciales en todas las dimensiones, constituyéndose como una estrategia innovadora en el campo educativo que favorece los procesos de interacción (aprendizaje colaborativo) y el aprendizaje autónomo.

Received: March 30, 2022
Accepted: August 08, 2022
Online Published: September 30, 2022

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INTRODUCTION

Educational processes must be consistent with the development of society and the new demands of the digital era (Losada and Peña, 2021). In this sense, digital competencies in educators play a determining role in the construction of an adaptive training of school communities, contributing to their integration into the current social and cultural dynamics mediated by technology (Tejada and Pozos, 2018).

In accordance with the above, digital competencies in educators have become one of the most relevant requirements in the teaching profile (Pérez *et al.*, 2017), and have allowed the use of new materials, digital resources and tools in the design of pedagogical proposals that integrate information and communication technologies (ICT) in the curriculum, thus favoring motivational factors (Huertas and Pantoja, 2016) and attention in the teaching-learning process. These aspects are linked to the approaches of Unesco (2017), where the urgency of executing permanent training initiatives for teachers in pedagogical modes from ICT is expressed.

Educational innovation processes mediated by ICTs are closely linked to the economic growth and social development of nations (Florez et al., 2018); however, from an institutional or local level, indicators should be analyzed according to inclusion indexes, educational quality and growth in the quality of life of school communities. Therefore, it is essential to discuss the relationship between quality education and levels of economic and social development. In this regard, Unesco (2013) points out that the insufficient levels of educational quality in Latin America are the result of the inadequate use of ICTs, where efforts have been concentrated on carrying out import processes.

Consequently, the transformation of practices with a view to improving educational quality depends on factors associated with teacher training in digital competencies (Unesco, 2017). In this scenario, digital resources are positioned as tools that can be integrated into the educational process, generating structural changes in curricular planning towards pedagogical innovation supported by technologies (Colombia Aprende, 2021).

In the service of education there are countless digital resources, and within their classification, we find open digital educational resources (REDA, by its acronym in Spanish), which correspond to "all types of materials are intended to and with the purpose of being framed in an educational action, whose information is digital, [these] have a public network infrastructure, such as the Internet, under an open access licensing that allows and promotes their use, adaptation, modification and/or customization" (Cabrales and Sanjuán, 2017, p. 44).

With the above, it can be argued that mastery over this type of digital resources favors the design of pedagogical activities that enhance the levels of motivation in students (Anguita *et al.*, 2020), becoming an input of great importance to achieve the goals established in the subjects and the improvement of educational quality (Ministry of National Education, 2021).

Digital competencies in teachers

Traditionalist practices are opposed to the demands of the current information society, where pedagogical actions must be directed by the digital tools available on the network (Engen, 2019), which encourages motivation, creativity and reasoning of students. In this sense, Luna and Hernández (2020) say that the elements that define quality online teaching correspond to "disciplinary commitment (content); pedagogical/didactic commitment that includes methodological competence, communicational competence, tutorial competence, evaluative competence; technological commitment and research and innovative commitment" (p. 4).

Likewise, being competent to face an educational process in the virtual mode requires extensive digital skills on the part of educators, which allow them to guide and provide feedback to the academic process. These must be strengthened for the benefit of students, thus fulfilling their leadership role within society. Engen (2019) states that:

> The term professional digital competence for teachers must be directly related to concrete uses and situations: we can no longer speak of a single type of digital competence, but of several interconnected digital competencies. We have shown that the decisive competencies that teachers need to use ICT to support teaching and learning activities involve their ability to translate and reconfigure ICT in different settings and contexts (p. 17).

In this sense, from higher education levels, education strategies in virtual mode have been promoted (Zempoalteca, 2018); however, a setback of these processes is evidenced in primary education, where traditional pedagogies have not allowed innovating in school strategies.

With the arrival of covid-19 (SARS-CoV-2), the absence of conditions to provide ICT-mediated teaching was determined; meanwhile, from the findings of the transition from the face-to-face mode to a virtual and remote mode, Colombia has been at a disadvantage and setback in educational practices in relation to other countries. This should be an indication to establish a training program to strengthen digital capabilities and to face situations that require ICT-driven processes.

At the university level, actions are being taken to reduce the digital divide through teacher training processes and the systematic use of digital resources to monitor daily academic processes. The need to train teachers

in digital competencies has been detected by higher education institutions and materialized in processes of continuous education and training in the management of basic technological tools, which allows teachers to have better skills to face the challenges of today's society (Paredes, 2019).

The reality in early education is different, since the use of digital resources by educators is basic, which is reflected in the low digital competencies of primary education students, as mentioned by Calle and Lozano (2019), who also point out that:

> Through digital literacy, it is possible to develop citizenship competencies that give meaning to plurality, identity and valuing of differences in elementary school students, with the development of didactic proposals that involve the continuous use of ICTs. Encouraging students to acquire digital competencies that allow them an analytical and reflective treatment of information, leads to the transformation and integration of today's society, which is characterized by the construction and dissemination of online information (p. 51).

Instructional Design (ID)

ID is counterpoised as an engineering process formed by several interrelationships, which benefits learning processes in a flexible and effective way, and is used in the design of courses, workshops, training plans, among others (Domínguez *et al.*, 2018). Its origins are recorded in face-to-face educational contexts, but since the integration of ICTs in educational innovation scenarios, it has been closely linked to the construction of virtual learning environments (VLE) (Luna *et al.*, 2021).

The conception of ID from the virtual learning modes has also changed, which has allowed reorienting the meaning of online courses, where the benefits of e-learning, b-learning, u-learning and m-learning modes are identified, processes that recognize the massification of devices and the flexibility of access to knowledge from the factors of time and place. The ID have generated guidelines for balancing content, planning training and selecting the most appropriate digital tools for instruction (Belloch, 2013).

Currently, there are several instructional design models and, within these, we find the ADDIE (analysis, design, development, implementation and evaluation), which manifests itself as a flexible model linked to a instructional assessment process (Saza et al., 2019). Among its areas of opportunity is the possibility of adjusting the design at any time, returning to the stage where programmatic changes are desired and allowing to continue sequentially with its implementation (Belloch, 2013).

METHODOLOGY

Objective

The objective of this research is to contrast the digital competences of teachers before and after the application of an instructional design that integrates the recognition of digital resources in its structure from the appropriation of the phases established in the ADDIE and based on the competency framework DigCompEdu: European Framework for the Digital Competence of Educators.

Likewise, we seek to identify the social representations of teachers in the diagnostic phase and integrate them as elements that direct the construction of the instructional design. On the other hand, the application of the instructional design is expected to have a direct impact on the digital resources dimension defined in the DigCompEdu framework; however, the effects of the educational intervention on the other competencies will be determined.

Research design

From the perspective of educational innovation, through school intervention processes, design-based research (IBD) is envisioned as an instructional alternative that accommodates the needs of teachers in the search for solutions to learning problems in their natural contexts, with the purpose of producing changes that improve learning (Gibelli, 2014).

Thus, the methodological strategy will be implemented under the parameters of the IBD aimed to design an instructional model for the strengthening of digital competencies in teachers, adhering to educational innovation processes. To achieve this purpose, a series of stages directed by the ID ADDIE have been established for the achievement of the goals established in the study (De Benito and Salinas, 2016), which are mentioned below.

Instruments

Two research instruments were designed to obtain the information. The first one includes a questionnaire with a Likert-type scale to determine the initial conditions of the educational context (diagnostic phase), the data obtained were processed from the SPSS statistical software (version 25), with a descriptive cut.

As a second instrument, a pre-test and a post-test were formulated to measure the digital competencies of teachers. These were based on the six dimensions of the common European framework DigCompEdu, which correspond to: professional commitment, digital resources, digital pedagogy, evaluation and feedback, empowering students, and facilitating

students' digital competence. For this purpose, 22 items were formulated, taking the Colombian context into account and the pedagogical aspects that characterize the teaching work. Finally, for each item, five levels of performance were structured to catalog the digital competencies of educators on a graduated scale. A Google form was used to collect the information from the tests.

For the validation of the pre-test and post-test instrument, the expert judgment method was used, with the participation of three scholars who hold doctoral degrees in areas related to educational technology. To determine the reliability index, Cronbach's alpha and Guttman's test of two halves were applied. Results greater than 0.84 were obtained, which methodologically means that it is a good value. Descriptive statistical techniques were used for data analysis using SPSS.

Participants

Thirty-two teachers from the Los Quindos educational institution, Armenia, Colombia, participated in the study. The sample was a non-probabilistic convenience sample composed of elementary school teachers, whose age ranged from 30 to 67 years old.

General considerations of the instructional model

In ID for the strengthening of digital competencies for teachers, a VPA was designed through the Teams platform, with the acquisition of Office 365 A3 licenses, which allowed the development of synchronous and asynchronous sessions. In addition, the training plan was composed of six modules integrating 32 digital resources organized in six categories, a structure that will be detailed in the ID ADDIE phases.

The activities were carried out sequentially under the ID ADDIE approaches, which were distributed in the phases of: analysis, design, development, implementation and evaluation, as shown in Figure 1.

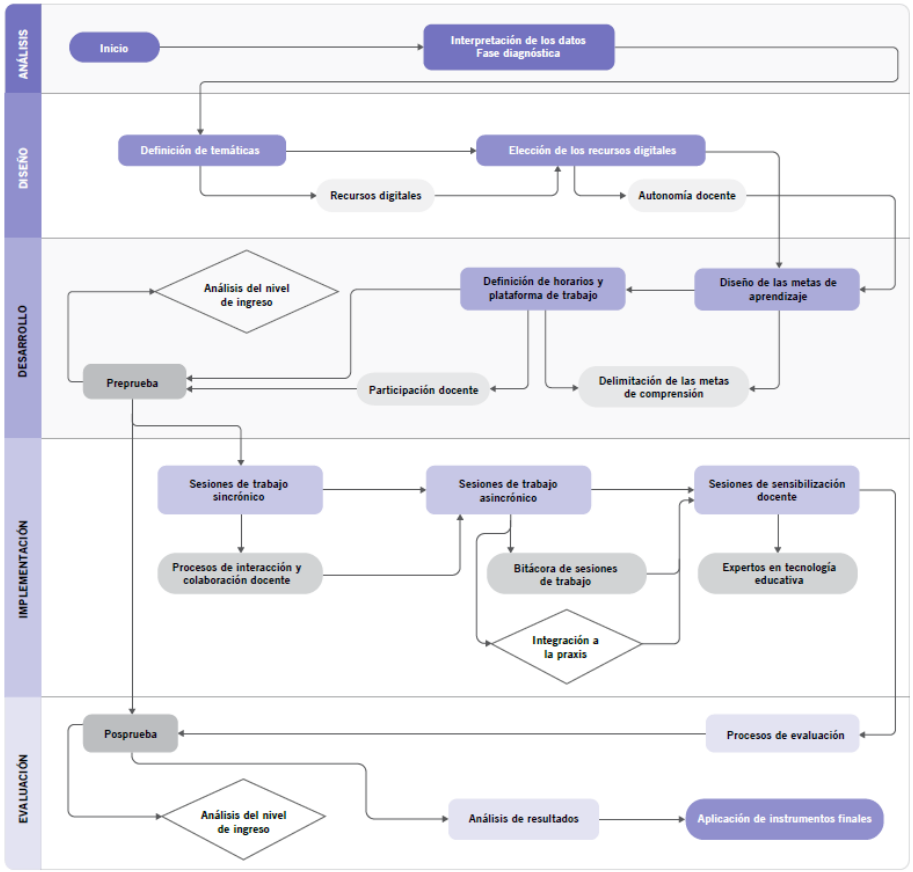


Figura 1. Esquema del modelo instruccional.
Fuente: elaboración propia.

ANALYSIS

In the first phase, the field analysis of the teachers' social representations was carried out, which allowed the interpretation of the data in the diagnostic phase from the application of the questionnaire, defining several dimensions for the categorization of the information and the integration of the findings in the design of the instructional model. Among the dimensions are: collaborative work, previous knowledge about digital resources and the current state of ICT integration in the educational field.

Design

In the second phase, the topics and digital resources that would guide the ID were defined (see Figure 2). In this regard, a specialized search was conducted on the Internet to find out which digital resources fit into the curriculum of the different subjects at the primary education levels. More than 200 resources were analyzed and, with the support of an interdisciplinary group, the 40 resources that would most intensively support the integration of ICT in educational practices were selected. The

bank of digital tools was consolidated by thematic areas and some of them with applicability in all subjects of knowledge, discarding the resources that did not provide benefits for the educational level.

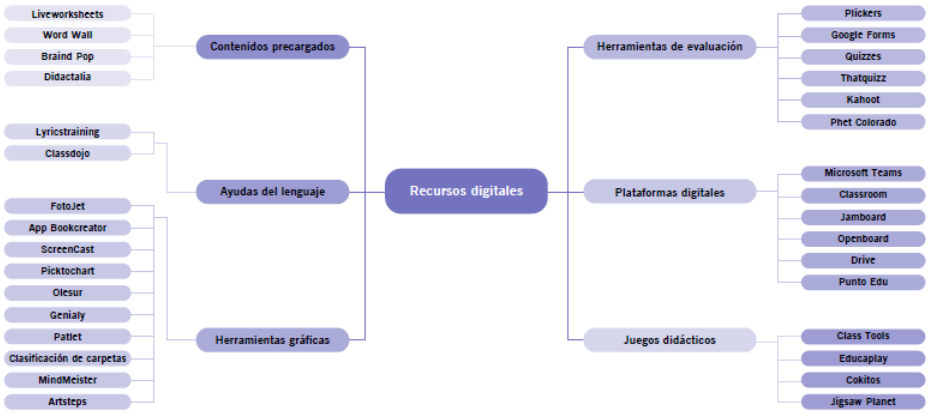


Figura 2. Temáticas y elección de los recursos digitales.
Fuente: elaboración propia.

Likewise, the educational practices were discussed with the teachers and a list of 32 digital resources was consolidated, where each one selected autonomously and voluntarily the digital resource with which he/she considers to have greater affinity, which will be presented in the synchronous sessions to the group of teachers, motivating the exploration of the operation, adjustments, related areas and other factors that contribute to their understanding.

In this phase, the importance of generating democratic spaces that allow the active involvement of the participating teachers in the construction of the ID is perceived, coherent with the constructivist theoretical perspective on which the strategy is based, where teachers can understand that they are the ones who will participate in the creation of their own knowledge and will collaborate in the achievement by their peers (collaborative learning).

Development

In the third phase of the ID, the learning goals were defined for each digital resource selected, here the competencies, comprehension goals and indicators were defined (see table 1); in addition, several meetings were formalized with the institution's board of directors to schedule the sessions for the application of the training plan. A total of 34 sessions were held in four months of the academic calendar. Regarding the work platform, 40 Office 365 A3 licenses were managed for teachers, for which Microsoft Teams was considered as the one that provides the best guarantees for the development of the VPA (see figure 3). At the same time, work teams were

generated in the virtual ecosystem, intended to provide feedback to the work sessions developed.

Tabla 1. Competencias e indicadores de aprendizaje

Modelo instruccional para el mejoramiento de las competencias digitales de los docentes de la institución educativa Los Quindos			
Competencias	C1: Reconoce alternativas pedagógicas para el proceso de aprendizaje de los estudiantes a partir de la integración de los diferentes recursos digitales C2: Aplica distintos recursos educativos digitales de acuerdo con su utilidad en un proceso de aprendizaje para el alcance de una finalidad formativa determinada C3: Administra procesos del aula, con la aplicación de nuevas herramientas digitales que permitan un mejoramiento en los procesos de atención y calidad en el aula C5: Se comunica de manera eficiente y asertiva con los estudiantes, desde la aplicación de plataformas virtuales que facilitan la transición de la educación presencial a la virtual	*Participantes:* *Modalidad:* *Plataforma:*	Docentes de los niveles de preescolar y educación primaria de la institución educativa Los Quindos Educación remota (encuentros sincrónicos y asincrónicos) Microsoft Teams

Recurso digital	Temáticas	Indicadores
Lyricstraining	Ayudas del lenguaje	El docente tiene la capacidad de coordinar su clase con las canciones que están en la plataforma y medir la interpretación con las funciones del programa
Classdojo		El docente configura en la plataforma el nombre de todos los estudiantes de su curso y tiene el dominio de la asistencia en este espacio virtual
Liveworksheets	Contenidos precargados	Las actividades escolares son programadas al interior de la plataforma y los estudiantes son invitados al desarrollo de las mismas, a través de un enlace de WhatsApp que los direcciona al trabajo académico propuesto por el educador.
Word Wall		Diseña un muro de clase que le permita retroalimentar las palabras utilizadas en su planeación con los estudiantes
Braind Pop		Diseña una planeación de clase donde se integren los videos, los cuestionarios y las actividades que sugiere la plataforma
Didactalia		Aplica actividades que han sido descargadas de la plataforma y las incorpora a sus clases
Plickers	Herramientas de evaluación	Realiza preguntas de forma virtual a los estudiantes con la configuración de tarjetas y equipos
Google Forms		Realiza evaluaciones con opción de respuesta
Quizzes		Realiza evaluaciones a través de la plataforma de forma lúdica y divertida
Thatquizz		Configura una evaluación en línea y la aplica a los estudiantes
Kahoot!	Herramientas de evaluación	Configura una evaluación en línea y pone a los estudiantes a jugar, además de retroalimentar los resultados
Phet Colorado		Realiza simulaciones con los estudiantes, donde se pueda observar la interfaz hilada a los contenidos de las diferentes áreas
FotoJet	Herramientas gráficas	Diseña un póster que integre información de sus actividades académicas y lo exporta para compartirlo por WhatsApp
App Bookcreator		Realiza el video de bienvenida a los estudiantes con apoyo de la plataforma y lo comparte
ScreenCast		El recurso permite grabar la pantalla del computador y habilitar un recuadro en los extremos donde se observa la cámara en vivo del educador, facilitando el direccionamiento de la actividad escolar
Picktochart		Crea una infografía sobre una temática que se maneje en el aula
Olesur		Diseña una sopa de letras sobre una temática que se esté estudiando actualmente en el grupo
Genialy		Configura, con ayuda o de manera individual, un recurso digital en un área de conocimiento fundamental
Padlet		Abre un espacio de interacción, configurando la plataforma y extrayendo el enlace de acceso
Clasificación de Carpetas		Configura sus carpetas para almacenar la información de la evaluación del desempeño anual
MindMeister		Diseña un mapa conceptual desde la plataforma y lo comparte en la clase
Artsteps		Realiza una presentación visual donde se expongan los trabajos de los estudiantes en el museo/espacio virtual que permite desarrollar la aplicación
ClassTools	Juegos didácticos	Configura una ruleta y la integra en las actividades que tiene planeadas en el período
Educaplay		Realiza una secuencia didáctica corta, donde se integre los beneficios de la plataforma
Conitos		Selecciona y realiza los juegos didácticos que sean del agrado de los estudiantes y se vinculen a las temáticas del nivel escolar
Jigsaw Planet		Diseña un rompecabezas como actividad adicional a la secuencia didáctica que se esté trabajando
Microsoft Teams	Plataformas digitales	Crea un grupo con estudiantes y programa reuniones sincrónicas
Classroom		Configura un grupo de estudio y carga allí actividades para realizar su evaluación y retroalimentación
Jamboard		Realiza una clase con uso del tablero virtual, vinculado a las aplicaciones de Google y graba la sesión con la aplicación Screencast
Openboard		Realiza una clase con uso del tablero virtual, exporta archivos y graba la sesión con las funciones integradas de la plataforma
Drive		Configura una carpeta de trabajo colaborativo con los docentes que pertenecen al área
PuntoEdu		Exporta planillas del grupo, carga notas en la plataforma y realiza el proceso de asistencia virtual

Fuente: elaboración propia.

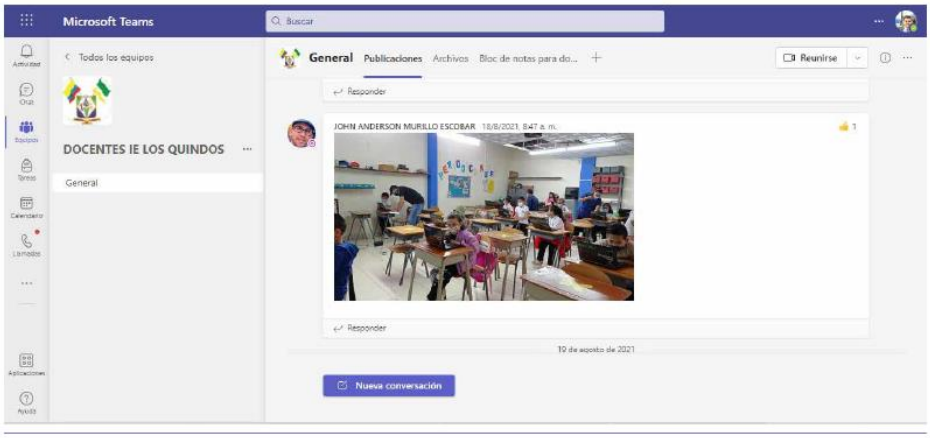


Figura 3. Ambiente virtual de aprendizaje.
Fuente: captura realizada del ambiente virtual de aprendizaje.

Finally, in the development phase, the pre-test was applied to measure and determine the entry level of the digital competencies of each educator and, based on these, define the pairs that would make up the Godfather Plan, where the teachers who obtained the best scores (high and higher) worked collaboratively with those who reached low and basic levels in the pre-test, with the intention of strengthening teamwork and ensuring the permanence of teachers in the process.

To collect the data, a three-day Google form was used, which was completed by all the teachers in the sample. In this way, it was possible to know the initial state of the participants in each of the dimensions; this would allow, at the end of the procedure, to make a comparison of the conditions of entry and exit of the training plan.

Implementation

In the fourth phase of ID ADDIE, synchronous and asynchronous sessions were carried out in the VPA and teacher awareness-raising spaces that were motivated by the incorporation of ICTs in the educational field. A total of 34 synchronous sessions were carried out, with the full participation of the sample, during which the digital resources were presented under the characteristics shown in Figure 4, which were projected in the light of the multimedia learning theory and structured by moments, which served as a tool to guide the teacher on class planning.

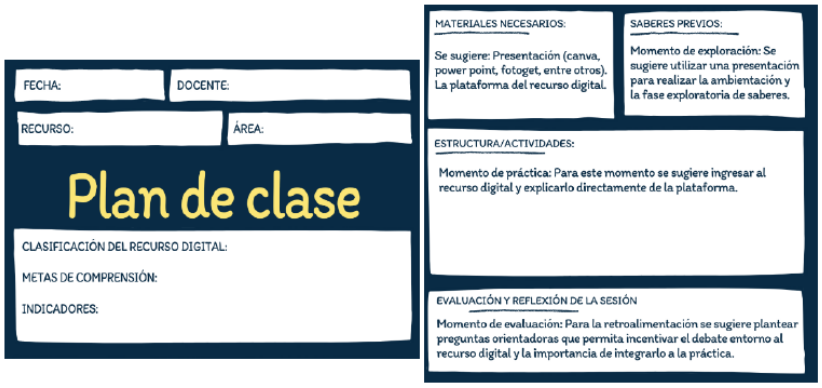


Figura 4. Planificación de clase.
Fuente: elaboración propia.

The asynchronous sessions were conducted independently by each educator, where they, on their own, took up and recorded in the autonomous work log (see Table 2) their opinions about each digital resource, as well as their experiences and impressions in the synchronous-asynchronous work. Likewise, the sessions provided the routes related to the registration processes in the different platforms, the guidelines for downloading the pedagogical material and other processes.

Table 2. Experiencia con la bitácora de trabajo autónomo

Teacher formation in digital competences program					
	Teacher				
	Resource	Resource appropriation			
		During the session	After the session	Score	Observations
	Genialy	It is one of the most complete platforms. It has a lot of preloaded resources about all areas, but also allows to design new forms	I could access predesign items and I was able to edit some that were already designed. I adjusted them to what I needed, and I saved them in my library		Consider which are the free resources

	Liveworksheets	It is one of the best available resources on the web. It allows me to access a variety of predesigned guides pertaining to all topics, which everyday gets updated	I configured my account and I found how to personalize the link to allow the children to share their activities with each other		It has a great aid potential to our labor
	Classroom	It is an attractive option for organizing our virtual classroom. It is easy to integrate resources	I have been observing the blessings and I like how it links with jamboard and with other resources that allow the explications		For my work, it is required that the children have connectivity

Source: Adapted from the data provided by a teacher from the Los Quindos educational institution.

The teacher awareness sessions were executed transversely to the recognition of digital resources, promoting activities to encourage innovation in educational practices; therefore, for the development of the sessions, relevant actors in the educational field were sought, with the participation of two PhD experts in areas related to educational technology in the national and international context.

Evaluation

The ID has a constructivist perspective and adheres to instructional evaluation processes, where learning rhythms, context conditions (covid-19 pandemic) and other aspects that influence their performance are recognized. Therefore, in their presentations, each educator had the opportunity to provide feedback on the approaches presented in the sessions, motivating them to perform practical exercises within the sessions and increasing the levels of understanding of the digital resource presented.

Another aspect considered included teacher's evaluations of their own performance; in these they reflected on their efforts, processes and strategies that allowed them to achieve the performance indicators proposed in each session. The above made the adjustment of failures possible in the autonomous work and guaranteed the permanence of the teachers in the training plan, factors widely related to self-evaluation.

Finally, the post-test was applied to measure the digital competencies of teachers in the ID graduation. This tool allowed obtaining a summative evaluation process (see Figure 5), where the results are reflected first in

the dimension of digital resources until a vision of the overall process has been reached, which is detailed in the results section of this article.

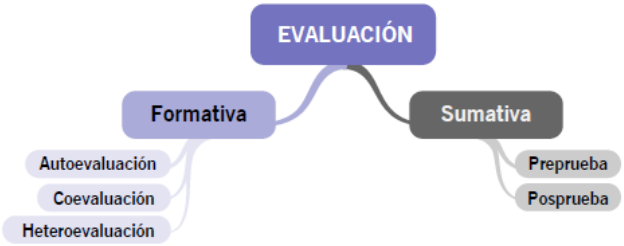


Figura 5. Proceso de evaluación.
Fuente: elaboración propia.

RESULTS

This section is divided into two parts, the first part analyzes the findings found in the diagnostic phase and the effects achieved since the implementation of ID, while the second part compares the digital competencies of teachers before and after the intervention.

One of the main findings corresponds to the execution of work activities on an individualized basis. The training process contributed to the development of shared curricular planning processes and the execution of common activities by school levels, enhancing teamwork and group teaching spaces, in addition to developing synchronous meetings in the VPA that enhance the processes of intervention between peers in a progressive manner.

Conversely, the analysis of the preliminary data shows the plurality of levels in digital competencies. In this sense, the model was detached from the stages or cycles that suggest prerequisites to access from one level to another. On the contrary, it sought to homogenize the curricular structure based on the mastery of different digital resources, where each participant had the possibility of improving their digital skills regardless of their income level. In spite of this, it is worth mentioning that under this ID the graduation levels depended on participation and commitment in the process.

Another element that was analyzed was prior knowledge about digital resources and the integration of ICT in educational practice, where it was determined that only 30% of educators know some digital resources and only 18% integrate some of these in their pedagogical activities. The most frequently used tools are: Microsoft Teams, Zoom, Google Forms and Google Drive, resources that have favored their activities during the

pandemic. The results of these factors drive the relevance of the study and the focus on the dimension of digital resources (DigCompEdu).

Contrasted results of the pre-test and post-test

The second part of the results shows the contrast between the digital competencies of the teachers before entering the training plan from the ID (pre-test) and the results once concluded (post-test); these have been segmented until a global visualization of the improvement obtained in the digital competencies after the intervention have been reached.

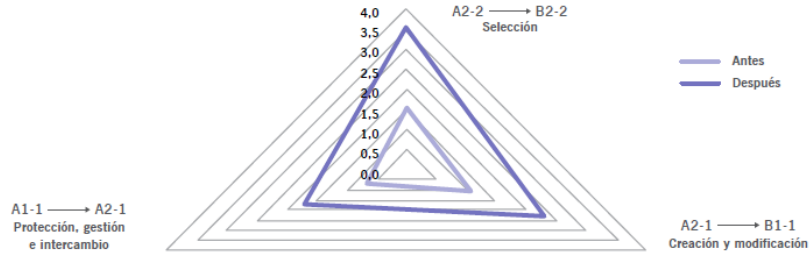
To analyze and compare the results by dimensions, the rating scale shown in Table 3 was implemented, which allows a better understanding of the level of entry-return and the effectiveness of the implementation of ID; in addition, the levels (A1, A2, B1, B2 and C1) are described with respect to the dimensions of digital resources and digital pedagogy (Annex 1).

Tabla 3. Escala de valoración preprueba y posprueba

Valor	Nivel	Clasificación
0.0	A1-1	BAJO
0.5	A1-2	
1.0	A2-1	BÁSICO
1.5	A2-2	
2.0	B1-1	INTERMEDIO
2.5	B1-2	
3.0	B2-1	ALTO
3.5	B2-2	
4.0	C1	SUPERIOR

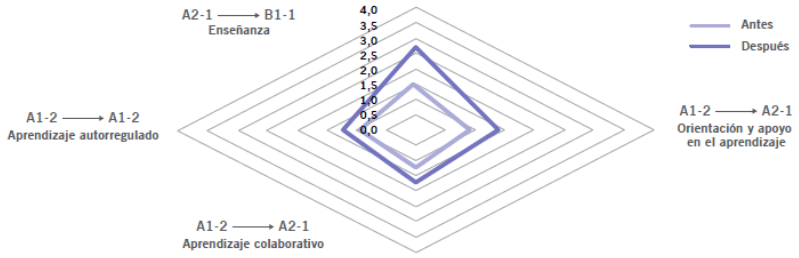
Fuente: elaboración propia.

The findings obtained in each competency as a result of the educational intervention are shown below. The first dimension examined corresponds to Digital resources (see figure 1). At the end of the course, it is noted that teachers have the ability to locate those resources that fit the characteristics and needs of the student community (Selection), in addition to being able to create videos and presentations that fit the curricular programming of the area (Creation and change); it is also noted that the intervention provided them with the tools to manage and organize the digital files they create (Protection, management and exchange), which facilitates access and use of the information.



Gráfica 1. Dimensión: Recursos digitales.
Fuente: elaboración propia.
Nota: el gráfico contrasta los datos de ingreso y egreso del DI, donde se observan tres competencias pertenecientes a la dimensión Recursos digitales, la primera de estas corresponde a Selección, donde su nivel de ingreso pasa de un A2-2 (básico) a B2-2 (alto); asimismo, Creación y modificación aumenta en el nivel de competencias digitales, pasando de un A2-1 (básico) a B1-1 (intermedio); finalmente, en Protección, gestión e intercambio se mantiene el incremento de las competencias producto de la estrategia, avanzando del nivel A1-1 (bajo) al A2-1 (básico).

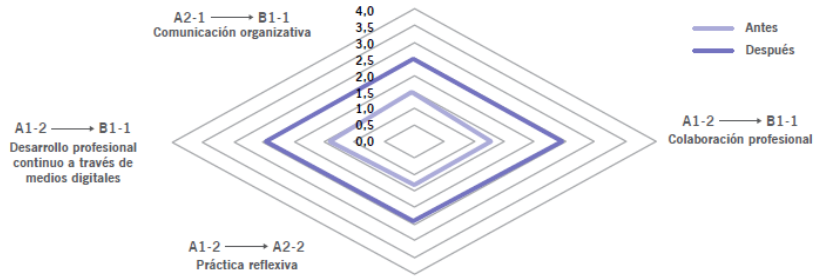
The second dimension of the DigCompEdu framework relates to digital pedagogy (see figure 2), made up of four competencies: Teaching, which evidences an advance in the use of digital resources and electronic devices in the development of educational practices; Guidance and support in learning, educators use platforms that tend to the development of collaborative learning (it should be noted that these do not exercise supervision processes on the execution of academic activities); Self-regulated learning, a competence that does not show an increase in the level at the end of the course, since teachers do not project spaces that favor the development of student autonomy from digital tools; and Collaborative learning, where the possibilities and advantages offered by the platforms are manifested, but does not obey a structured process that allows its strengthening within the school process.



Gráfica 2. Dimensión: Pedagogía digital.
Fuente: elaboración propia.
Nota: el gráfico contrasta los datos de ingreso y egreso del DI, donde se observan cuatro competencias pertenecientes a la dimensión Pedagogía digital. En la competencia Enseñanza se percibe un progreso en el nivel, avanzando de A2-1 (básico) a B1-1 (intermedio). Asimismo, se observa que Orientación y apoyo en el aprendizaje aumenta su nivel del A1-2 (bajo) a A2-1 (básico). La competencia Aprendizaje autorregulado no muestra un avance y se detiene en el nivel A1-2 (bajo), mientras que, de forma contraria, Aprendizaje colaborativo presenta un incremento de las competencias digitales docentes, pasando del nivel A1-2 (bajo) al A2-1 (básico).

Figure 3 is linked to the dimension Professional Commitment, which is built on four digital teaching competencies; at the end of the intervention, an advance in these competencies is identified. As part of Organizational Communication, teachers improved communication channels with the educational community using digital tools. The second competence relates

to Professional Collaboration, which allows the linkage in collaborative work networks, replicating the strategies in their school activities, while in Reflective Practice the teacher selects digital resources that awaken the motivation and attention of students towards the knowledge presented. Finally, in the Continuous professional development competency, it is observed that teachers have been motivated to participate in different courses that allow them to advance in the strengthening of digital competencies.

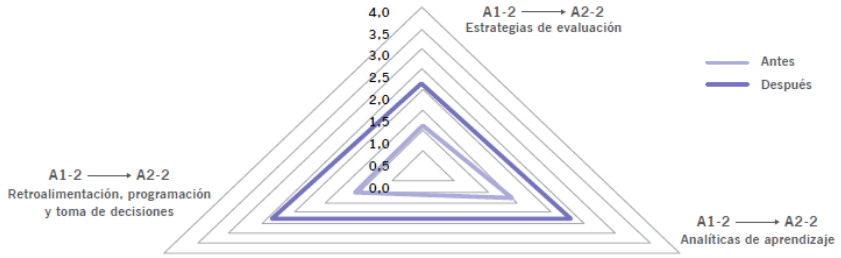


Gráfica 3. Dimensión: Compromiso profesional.

Fuente: elaboración propia.

Nota: el gráfico contrasta los datos de ingreso y egreso del DI, donde se observan cuatro competencias pertenecientes a la dimensión Compromiso profesional. La primera corresponde a Comunicación organizativa, donde el nivel de ingreso pasa de un A2-1 (básico) a B1-1 (intermedio). Colaboración profesional aumenta en el nivel de competencias digitales, pasando de un A1-2 (bajo) a B1-1 (intermedio). Entre tanto, Práctica reflexiva mantiene el incremento de las competencias producto de la estrategia, avanzando del nivel A1-2 (bajo) al A2-2 (básico). Por último, la competencia Desarrollo profesional continuo tiene un avance significativo del A1-2 (bajo) al B1-1(intermedio).

Figure 4, which refers to the Evaluation and feedback dimension, shows the findings reflected in the three digital competencies that comprise it. In the competence Assessment strategies, progress is observed in teachers from the training plan to the design of their assessment guides, which they later print and apply physically. In Learning analytics, a satisfactory behavior is identified in educators, when analyzing the data provided by digital platforms and integrating them in the development of the academic process. Likewise, the competency Feedback, programming and decision making demonstrates the use of virtual rubrics, which are integrated into the school process as a first approach to the digitalization of the evaluation and feedback processes.

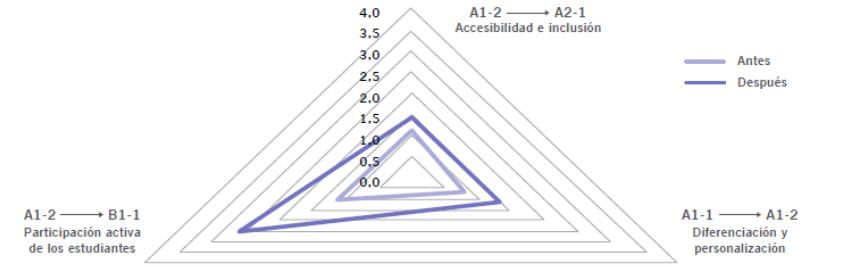


Gráfica 4. Dimensión: Evaluación y retroalimentación.

Fuente: elaboración propia.

Nota: el gráfico contrasta los datos de ingreso y egreso del DI, donde se observan tres competencias pertenecientes a la dimensión Evaluación y retroalimentación. Al partir de la competencia Estrategias de evaluación se percibe un progreso en el nivel, avanzando de A1-1 (bajo) a A2-2 (básico). Además, se observa que Analíticas de aprendizaje aumenta su nivel del A1-2 (bajo) a A2-2 (básico); al igual que Retroalimentación, programación y toma de decisiones, que pasó del nivel A1-2 (bajo) al A2-2 (básico).

The fifth dimension is Empowering students (see figure 5) and is made up of three digital competencies that start from Accessibility and inclusion, showing that teachers use digital tools to support the development of learning processes in students who require it. In the Differentiation and personalization competency, the training plan exit data show that progress was minimal since teachers perform the same activities for all students. In contrast, in the Active participation of students, the greatest increase in the dimension is perceived, thanks to the integration of virtual forums with the purpose of increasing the motivation and participation of students in school activities.



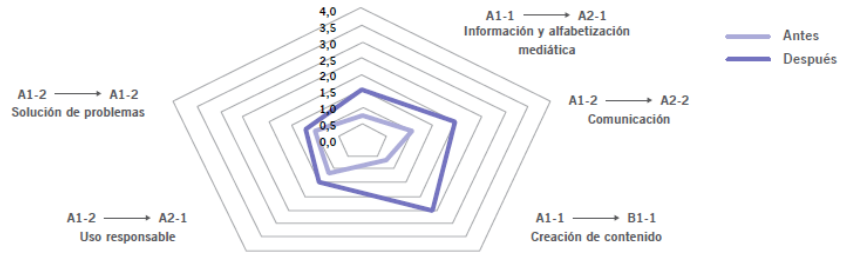
Gráfica 5. Dimensión: Empoderar a los estudiantes.

Fuente: elaboración propia.

Nota: el gráfico contrasta los datos de ingreso y egreso del DI, donde se observan tres competencias pertenecientes a la dimensión Empoderar a los estudiantes. La Accesibilidad e inclusión avanza del nivel A1-2 (bajo) al A2-1 (básico). Por otro lado, se observa que la competencia Diferenciación y personalización no alcanza un aumento significativo, ubicándose de A1-1 (bajo) a A1-2 (bajo). En la competencia Participación activa de los estudiantes se percibe un incremento de las competencias digitales docentes, pasando del nivel A1-2 (bajo) al B1-1 (intermedio).

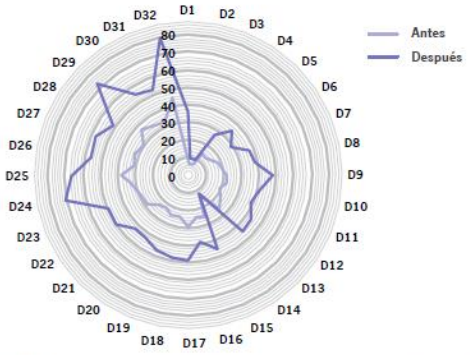
Figure 6 shows the last dimension of the DigCompEdu framework, called Facilitating students' digital competence, composed of five digital competencies favored by the development of the training plan. In the first one, Information and media literacy, teachers implement surveys through reliable pages that guarantee safe browsing and reliability of the information obtained by students. The Communication competence considers the design and projection of presentations through the use of

digital channels. The significant progress in the competence Content creation has allowed the guidance of students for the design of digital content from digital platforms. The Responsible use competence allowed teachers, together with the educational community, to reflect on the benefits of integrating ICT in school processes and their use in the integral development of the human being. Finally, Problem solving does not show progress, which is reflected in the low use of digital tools to respond to the needs of the social environment.



Gráfica 6. Dimensión: Facilitar la competencia digital de los estudiantes.
Fuente: elaboración propia.
Nota: el gráfico contrasta los datos de ingreso y egreso del DI, donde se observan cinco competencias pertenecientes a la dimensión Facilitar la competencia digital de los estudiantes. La primera competencia corresponde a Información y alfabetización mediática, donde su nivel de ingreso pasa de un A1-1 (bajo) a A2-1 (básico). Asimismo, en la segunda, denominada Comunicación, aumenta el nivel de competencias digitales de un A1-2 (bajo) a A2-2 (básico). La competencia Creación de contenido presenta un avance significativo del A1-1 (bajo) al B1-1 (intermedio). En esta misma línea, Uso responsable alcanza mejoras al pasar del nivel A1-2 (bajo) al A2-1 (básico). Por último, la competencia Solución de problemas no muestra avance desde el desarrollo de la estrategia, anclándose en el nivel A1-2 (bajo).

Finally, Figure 7 shows the general results of the ID application, where the entry and exit levels are described, which should be analyzed with respect to the scale defined in Table 4. The growth of digital competencies in general is evident, however, it is worth mentioning that three educators did not reach these improvement processes, which is linked to factors of resistance to change and low levels of motivation towards achievement.



Gráfica 7. Resultados generalizados de la muestra en el diseño instruccional.
Fuente: elaboración propia.

Tabla 4. Escala de valoración preprueba y posprueba

Valor	Nivel	Clasificación
0 – 10	A1-1	BAJO
10 – 19	A1-2	
20 – 29	A2-1	BÁSICO
30 – 39	A2-2	
40 – 49	B1-1	INTERMEDIO
50 – 59	B1-2	
60 – 69	B2-1	ALTO
70 – 79	B2-2	
80 – 88	C1	SUPERIOR

Fuente: elaboración propia.

DISCUSSION

The digital dimension represents the starting point for the definition of the instructional model. In the intervention, the pre-test showed the need to carry out training processes that tend to the flourishing of digital competencies (see graph 1), results that coincide with Scherer et al. (2020). The ID presented defines a methodological proposal that guarantees intervention in this area by substantially improving and strengthening teachers' skills to enable the inclusion of ICT in the school environment.

The professional aspect is another of the dimensions that require greater attention in the training of educators (Vega et al., 2021), which should seek to strengthen the teaching-learning processes, guarantee an active role for teachers as guides for the attainment of students' knowledge, as well as develop pedagogical activities aimed at obtaining collaborative and autonomous learning.

Since the application of the instructional model, aspects of improvement in all the digital competencies defined by the DigCompEdu framework were obtained in a generalized manner. Despite this, Figure 7 shows that progress differs among educators, some of them reaching higher levels, reaching B2 and C1, while others did not advance and were located at low levels (A1). This situation may be associated to motivational issues of the teachers, which did not allow them to achieve the learning goals defined in the ID. These results are related to those obtained by Espinoza and Medina (2021), where motivation is linked as a determining factor in the improvement of digital competencies and in the willingness to be part of ICT training processes.

The ID allowed contrasting the digital competencies of teachers in the educational institution Los Quindos, demonstrating the effectiveness of integrating teacher training proposals from the ID and the VPA, results that are consistent with those obtained by Vega *et al.* (2021), where the benefits of pedagogical strategies from the VPA for the assurance of educational quality around digital competencies are exposed.

Educational quality processes require intervention proposals that guarantee the integration of ICT in the educational field. The instructional model described above is based on the use of digital resources applied sequentially from the ID ADDIE for the improvement of digital skills in teachers. This approach is linked to the proposal of Sandoval *et al.* (2020), who designed digital audiovisual modules (DAM) under the ADDIE phases, which allowed the development of digital content in parallel to the strengthening of digital skills.

CONCLUSIONS

In this study we can conclude that the ID and the VPA are projected as innovative strategies for educational environments and that within its benefits the improvement of digital competencies of educators is manifested. Together with theories such as constructivism, they guarantee the active participation of learners in the search for collaborative and autonomous learning.

In the network we find countless open access digital resources that significantly contribute to the acquisition of knowledge in a dynamic and playful way; however, one of the difficulties is focused on the absence of educational intervention processes that seek the training of teachers in digital skills, integrating new modes that recognize the needs and potential of this population.

From the findings of the educational intervention, the strengthening of digital competencies in educators is observed, especially in skills involving the selection of digital resources, the execution of collaborative school activities from virtual platforms and the use of digital tools that tend to favor school evaluation processes, aspects that are linked to the professional development of teachers and the coherence of an education provided in the digital era.

From the analysis of the data, different areas that did not achieve progress after the educational intervention are observed; these require further deepening to become areas of opportunity for possible works, focused on the processes of educational inclusion, the personalization of education and the promotion of self-learning, indispensable spaces that rescue the rhythms of learning and the democratization of knowledge, and that linked to new technologies could become alternatives that would benefit the most vulnerable populations of the educational context.

The proposed ID is a contribution to the innovative strategies that integrate ICT, by allowing the focused strengthening of digital competencies that have been defined in the DigCompEdu framework; it also provides spaces for interaction where teamwork and the recognition of different digital resources are strengthened, contributing to the improvement of educational quality.

With a view to future studies, this proposal opens the door for new ID to be carried out that address the different digital competencies and that tends to a gradual improvement of teaching skills and the re-signification of educational practices.

ANEXO 1. DIMENSIONES DEL INSTRUMENTO QUE MIDE LAS COMPETENCIAS DIGITALES CONFORME AL MARCO EUROPEO PARA LA COMPETENCIA DIGITAL DE LOS EDUCADORES DIGCOMPEDU

Dimensión: Recursos digitales

Competencia: Selección de recursos digitales

A1	No suelo utilizar recursos digitales en mis clases
A2	Utilizo los mismos recursos digitales que tengo previamente identificados
B1	Investigo los recursos digitales existentes en la web y aplico los que considere que se ajustan a mi práctica educativa
B2	Genero bases de datos referentes a recursos digitales y selecciono el que se ajuste a las características de mi comunidad educativa
C1	Sugiero recursos digitales a mis compañeros de acuerdo con las temáticas planteadas

Competencia: Creación y modificación de recursos digitales

A1	No diseño mis propios recursos digitales
A2	Genero fichas en programas como Word, Excel, etcétera, que me permiten direccionar mi práctica educativa
B1	Diseño presentaciones y videos que facilitan la comprensión de las temáticas planteadas
B2	Modifico recursos digitales que son de acceso libre y los adapto a mis necesidades
C1	Diseño recursos digitales que impliquen procesos de programación (ejemplo: Scratch)

Competencia: administrar, proteger y compartir recursos digitales

A1	No tengo conocimiento de cómo proteger ni identificar las características de los recursos digitales
A2	Uso mi ordenador personal y almaceno mis documentos en carpetas de acceso personal
B1	Protejo mis archivos a través de claves de seguridad, pero no sé diferenciar las licencias de los recursos digitales que circulan en la red
B2	Almaceno la información en carpetas de seguridad y utilizo recursos digitales que integran licencias y protegen los derechos de autor
C1	Implemento protocolos de seguridad de la información y discrimino los recursos digitales de acuerdo con sus licencias para la adaptación a mis prácticas educativas

Dimensión: Pedagogía digital

Competencia: Enseñanza

A1	No utilizo en mis prácticas dispositivos ni recursos digitales
A2	Utilizo adecuadamente dispositivos analógicos, pero no incorporo recursos digitales en mis prácticas educativas
B1	Combino en mis prácticas educativas el uso de los dispositivos y los recursos digitales
B2	Establezco sistemática y rigurosamente en mi planeación el uso de diferentes dispositivos y recursos digitales
C1	Diseño mis recursos digitales y los implemento a través de diferentes dispositivos

Competencia: Orientación y apoyo en el aprendizaje

A1	Mis alumnos no pertenecen a ninguna plataforma donde pueden interactuar entre ellos
A2	No superviso la interacción de mis alumnos en las plataformas educativas
B1	Eventualmente observo las interacciones y realizo comentarios de los hallazgos
B2	Establezco planes de seguimiento a las interacciones que garanticen el uso adecuado de las plataformas educativas
C1	Diseño planes de seguimiento e interviene oportunamente en las situaciones que se presenten en las plataformas por uso inadecuado de las interacciones entre pares

Competencia: Aprendizaje colaborativo

A1	Mis prácticas educativas no contemplan el trabajo colaborativo
A2	El trabajo colaborativo no es abordado desde las TIC
B1	Motivo a mis estudiantes a comentar algunos trabajos de sus compañeros y a realizar reflexiones educativas
B2	Establezco en temáticas puntuales redes de colaboración a corto plazo
C1	Fortalezco redes de colaboración que me permiten integrar las TIC desde el diseño y la apropiación de herramientas digitales

Competencia: Aprendizaje autorregulado

A1	En mi planeación no estipulo momentos que permitan el desarrollo autónomo del estudiante
A2	Los estudiantes reflexionan sobre los resultados de sus trabajos, pero los procesos de mejoramiento son direccionados por el docente
B1	Los estudiantes reflexionan sobre sus trabajos y realizan mejoras puntuales de forma autónoma
B2	Se generan protocolos para que los estudiantes realicen actividades de forma autónoma
C1	Se planifica proyectos educativos, donde los estudiantes experimentan un aprendizaje autónomo

Fuente: elaboración propia a partir de la clasificación por niveles realizada por Marco Europeo para la Competencia Digital de los Educadores DigCompEdu (Redecker, 2020).

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HOW TO CITE

Losada Cárdenas, Miguel Ángel y Peña Estrada, Claudia Cintya. (2022). El diseño instruccional y los recursos tecnológicos en el mejoramiento de las competencias digitales de los docentes. *Apertura*, *14*(2), pp. 40-61. http://dx.doi.org/10.32870/Ap.v14n2.2241