



Development of digital competencies for teachers of the virtual modality in Higher Education

Desarrollo de competencias digitales para docentes de la modalidad virtual en Educación Superior

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Resumen

The introduction of digital tools and resources arises as a response to technological advances, but to develop an adequate technological education it is not enough to introduce digital resources, but also to educate and develop the digital competencies of teachers and students. Currently, digital competencies are considered enablers of the knowledge society and both students and teachers should consider their participation in virtual environments as a development opportunity. The present study analyzed the digital competencies of 50 teachers of the Polytechnic School of Chimborazo (ESPOCH) in their pedagogical praxis. The survey technique was applied with a non-probabilistic purposive sampling method using the questionnaire as an instrument. The main results showed that there is an inverse relationship between the age of teachers and the use of ICT. However, teachers are able to create their own digital content and educational resources especially those with a working experience between 1 to 5 years and between 6 to 10 years. This study concludes and recommends continuous training of teachers in the use of ICT to improve their teaching-learning process.

Palabras clave: active learning, e-learning, digital competences, information technologies.

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Resumen

La introducción de herramientas y recursos digitales surge como respuesta a los avances tecnológicos, pero para desarrollar una educación tecnológica adecuada no basta con introducir recursos digitales, sino también con educar y desarrollar las competencias digitales de profesores y alumnos. En la actualidad, las competencias digitales se consideran facilitadoras de la sociedad del conocimiento y tanto estudiantes como profesores deberían considerar su participación en entornos virtuales como una oportunidad de desarrollo. El presente estudio analizó las competencias digitales de 50 docentes de la Escuela Politécnica del Chimborazo (ESPOCH) en su praxis pedagógica. Se aplicó la técnica de la encuesta con un método de muestreo no probabilístico intencional utilizando como instrumento el cuestionario. Los principales resultados mostraron que hay una relación inversa entre la edad de los docentes y el uso de las TIC. Sin embargo, los docentes son capaces de crear su propio contenido digital y también sus recursos educativos especialmente aquellos con una experiencia laboral entre 1 a 5 años y entre 6 a 10 años. Este estudio concluye y recomienda una continua capacitación a docentes en la utilización de las TIC para mejorar su proceso de enseñanza-aprendizaje.

Palabras clave: aprendizaje activo, aprendizaje virtual, competencias digitales, tecnologías de información

Introduction

The closure of educational establishments, from schools, colleges, to institutes and universities of higher education due to the COVID-19 pandemic, has caused an accelerated change in the methods and modalities of teaching, moving from face-to-face education to virtual or remote education (Gomez et al., 2020).. This transition forced both students and teachers to adapt to a new normality and new methods with different ways of teaching and learning.

The introduction of digital tools and resources arises as a response to technological advances, but to develop an adequate technological education it is not enough to introduce digital resources, but also to educate and develop the digital skills of teachers and students. (Andrade, 2022). Although most teachers have some knowledge in digital technology, it is necessary to enhance these competencies and strengthen them, as they play a key role in today's education.

Within digital competencies, significant changes have been made through initiatives aimed at implementing the use of new information and communication technologies (ICT) in the classroom to increase the chances of achieving the learning objectives of students, supported by teacher training that allows the use of these technologies to reduce the digital divide between teachers and students (Quiroz and Quiroz, 2019)..

The creation of digital competencies is linked to the appropriate application of knowledge and skills in virtual environments, as well as ICTs and interaction and

participation in networks through the Internet, ensuring that the work contributes to solving societal problems (Vargas-Murillo, 2019).

The transition from a traditional teaching method with a blackboard and memorization of content to a virtual modality with the use of digital tools (Chávez et al., 2021) has generated that teachers have little or no preparation in this field, which has generated a technological and digital illiteracy reflected in a lack of training and understanding of the digital competencies that are currently required within the virtual modality in Higher Education (Icaza et al., 2019)..

The importance of this study is framed in the fact that, at present, digital competencies are considered facilitators of the knowledge society and both students and teachers should consider their participation in virtual environments as an opportunity for development. It also fosters autonomous learning and a critical culture towards knowledge.

Based on the above, the question arises: Do the teachers of the virtual modality of the Admission and Leveling Center of the Polytechnic Superior School of Chimborazo possess digital competencies? That is why this article aims to analyze the digital competencies in the teachers of the virtual modality of the Admission and Leveling Center of the ESPOCH during the academic period 2022-2023 for the improvement of their teaching pedagogical praxis.

Materials and methods

This research was carried out at the Admission and Leveling Center CAN of the ESPOCH located on the Panamerican Highway South km 11/2, in the parish of Lizarzaburu in the city of Riobamba, Ecuador (1°39'29"S; 78°40'35"W). The main campus has 20 ha, and currently has a staff of 1,544 teachers from different areas of knowledge, 22,000 students, 355 professionals in the administrative area and 223 people working as support staff.

The Admission and Leveling Center CAN is an academic unit that guarantees equal access conditions for students, optimizing their learning skills and competencies, and compensating the inequalities produced by the educational heterogeneity of high school, thus promoting favorable academic performance. Responsible for receiving students who have completed their high school studies, and have applied to ESPOCH to obtain their respective quota.

The survey technique was applied to a group of 50 teachers of the ESPOCH through a non-probabilistic intentional sampling method using the questionnaire as an instrument in order to know the teacher's point of view regarding the knowledge, use and application of digital competences in their pedagogical practice.

Table 1. *Research variables*

Variables	Dimensions
Pedagogical practice	Teaching-learning
	Evaluation Strategies
Digital competencies of teachers	Professional commitment
	Digital Resources

The questionnaire was validated by a group of five experts in education and was divided into two parts; the first part of the survey consisted of questions focused on determining the digital competencies of teachers by evaluating the dimensions of ICT use, use of digital platforms, creation of digital content - editing of digital resources, and frequency of ICT use. The second part consisted of questions to evaluate the weaknesses in the pedagogical praxis under the dimensions of teaching-learning and evaluation strategies. The survey had a co-evaluation dynamic, i.e., each teacher evaluated a specific peer or colleague, and not themselves, in order to avoid bias in the information obtained.

The survey phase was conducted online through the Google Forms platform with the prior approval and authorization of the ESPOCH Rector. Google Forms is a digital platform that provides a wide range of applications for quantifying and managing data through surveys (Sainz de Abajo et al., 2019)..

Once authorization was obtained from the rector of ESPOCH, a time and date was set with the teachers to proceed with the application of the surveys. The items are structured with dichotomous and single-choice questions using estimation scales, with additional questions that allow us to obtain demographic data. Additional general information was obtained from the teachers, such as their age, years of teaching experience, level of education, role in the institution, and the area of knowledge they teach. The survey took between five to seven minutes to complete.

Once the results of the survey were obtained, they were exported to SPSS version 29.0.0 and Excel for their respective tabulation, analysis and interpretation of the data. The Chi-square test was applied for the relationship between age and ICT use among ESPOCH teachers. In addition to testing the assumptions of normality, homoscedasticity, and heterogeneity of the data obtained from the surveys.

The research was developed considering the bioethical principles, contemplated in the Constitution of Ecuador, Art. 83 numeral 12: "Exercise the profession or trade subject to ethics". Art.387 numeral 4: "Guarantee the freedom of creation and research within the framework of respect for ethics, nature, the environment, and the rescue of ancestral knowledge." cited in Bravo (2019).

Results

Based on the surveys conducted among the 50 ESPOCH teachers, the following results were obtained.

Analysis of digital competencies in teachers

The treatment of the data in the SPSS statistical software began by verifying the data, from which it was obtained that there were 50 valid data and 0 missing data. The Chi-square statistical test was applied to the dimension of pedagogical practice to verify the existence of the relationship with the use of ICT in the age range of teachers. It was found that there is a relationship between the use of technology and the age range of the teachers, i.e., the younger the teachers are, it is estimated that they almost always and always make use of tools that allow innovation in the classroom. According to the Chi-square test, a p-value of 0.135 was obtained, which shows that there is a correlation between these variables.

Next, the same process was carried out with the variables of educational level and use of educational platforms, observing that teachers use Microsoft Teams to teach classes at the Admission and Leveling Center of the Escuela Superior Politécnica de Chimborazo.

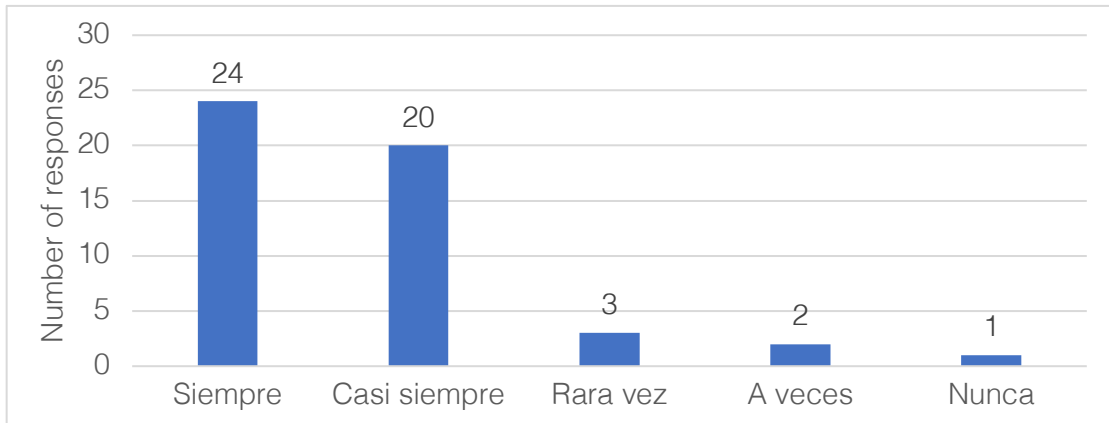
The relationship between the teacher's years of work experience and the creation of content and editing of resources was analyzed, obtaining as a result that those who have recently entered the teaching profession create their own content and have the ability to make edits, which shows that people who have recently entered the work force emphasize the creation of resources.

Finally, the frequency of ICT use was analyzed according to the case or level of training, detecting that almost always those who are trained make use of ICTs in the teaching-learning process in the virtual modality of the ESPOCH Admission and Leveling Center; however, those who are less trained make precarious use of the technological educational tools in the teaching-learning process.

Table 1. Do you consider that good educational practices in students improve the level of learning with the use of ICTs?

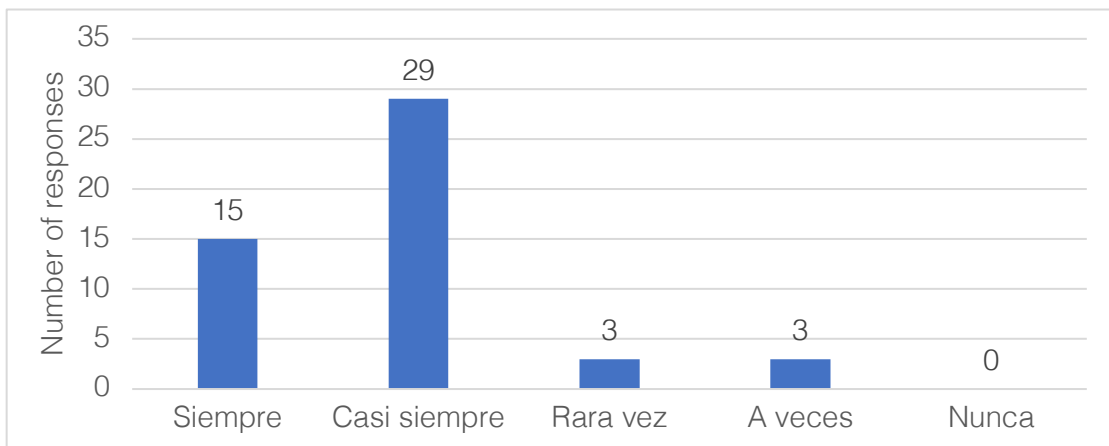
48% of the teachers consider that good educational practices always improve the level of student learning with the use of ICTs. Of these, 40% indicated that good practices are almost always important, while 6%, 4% and 2% considered that ICTs are rarely, sometimes and never, respectively, important for student learning.

Figure 1. Do you receive training as a teacher in digital competencies within the institution?



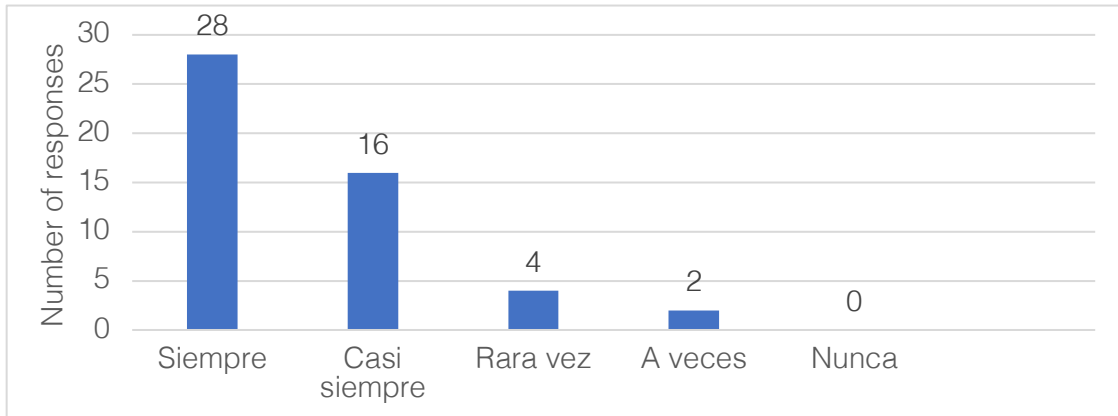
58% of the respondents emphasized that they almost always receive training in digital competencies within the institution by external experts in virtual education and digital competencies. 30% of them mentioned that they always receive training either by people outside the institution, or by their own means with customized courses. Six percent of the teachers mentioned that they rarely and sometimes receive training in this area.

Figure 2. Do you carefully consider how, when and why to use digital technologies to ensure student learning?



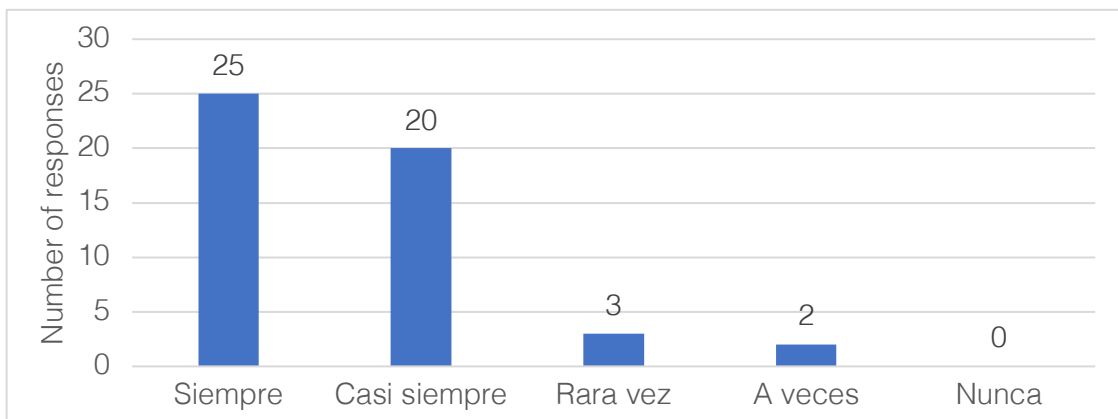
56% of the teachers always consider why, when and how to use digital technologies in order to improve the teaching-learning processes with students. Of these, 32% emphasized that they almost always consider it, 8% rarely take it into account, and 4% sometimes remember to apply it.

Figure 3. Do you monitor student activities and interactions in the online collaborative environments you use?



Half of the respondents (50%) considered that they always supervise the activities and interactions among students within the online collaborative environments used in the classroom (i.e. Microsoft Teams). Forty percent of the teachers mentioned that they almost always do so, while the remaining 6% and 4% supervise rarely and sometimes, respectively.

Figure 4. Do you use digital technologies to enable students to plan, document and monitor learning on their own?



In this aspect, 44% of teachers indicated that they always and almost always use digital technologies to allow students to plan, document and monitor learning by themselves. The remaining 12%, indicated that they rarely (6%) allow students to construct their own knowledge by themselves, and likewise 6% sometimes allow it. The latter consider that the teacher's assistance and supervision is always important to guide them in their learning process. The purpose of this study was to analyze the digital competencies of the teachers of the virtual modality of the Admission and Leveling Center CAN of the ESPOCH during the academic period 2022-2023 to improve their pedagogical teaching

praxis. According to the instrument applied, it was determined that they use technology tools such as Microsoft Teams Moodle or Google Classroom. Gomez (2020) emphasizes that these tools facilitate and streamline the management of the learning process, allowing teachers to create classes, assign homework, post grades, publish comments and access the entire learning process in one place. Their use has proven to be beneficial to students, who have been highly engaged in a virtual environment where they can work with a variety of tools (Kraus et al., 2019).

Despite the fact that most teachers work in different areas of knowledge, most of them have 1 to 5 years of work experience in virtual education, Dias-Trindade et al. (2021) argue that age and educational field are not determinants of greater or lesser digital competence, but work experience contributes to slightly better results in teachers who have worked with digital technologies for several years and/or have taught distance education subjects.

Halpern et al. (2021) points out that to enhance the use of ICTs at a more expert level it is necessary to have clarity in communication (intention of the message to be communicated), establishment of a clear schedule, adequate writing of instructions through virtual environments, guarantee of access to resources, among others.

It was found that teachers are able to create their own resources and edit digital content resources for their virtual classes almost always and always, especially those who have a work experience between 1 to 5 years and between 6 to 10 years. In this regard, Colás et al. (2019) emphasize that, through communication and the creation of content production and editing of digital resources, teachers can transfer their own digital competencies with a greater reach towards students. Therefore, teachers should be able to generate their own digital resources and content in their pedagogical interventions to transform their students through the development of digital competence. Novay and Chacin (2022) determined that the digital competencies most developed in higher education by teachers were related to information access, information management, internet management and virtual environments.

Regarding the pedagogical praxis of the teachers of the Admission and Leveling Center CAN of ESPOCH, they stated that they use ICT in a significant percentage in their classes, taking into account when, how and why to use them with students. In addition, it was found that they do supervise the activities when working with students, allowing them to be the protagonists of their own learning. In this regard, Laurente-Cárdenas et al. (2020) point out that university professors who combine face-to-face classes and ICT in virtual environments have found new ways of teaching and learning, which suggest innovative methods of pedagogical interaction and also help them in their pedagogical praxis.

Various models have been implemented in recent years in distance education training for teachers, among them ICT, which has improved their technological literacy, deepening and creation of knowledge and editing of resources, and complementarily, has facilitated learning, design of practices, digital tools (Hernández et al., 2021). Meneses et al. (2023) suggests that the technological digital tools, which have been

developed within academic training, correspond to interactive presentations, videos, audios, and gamification that allow better participation, collaboration and interaction with students and contribute to their learning process. It is clear that the technological tools developed in academic training correspond to the use of tools and applications that allow participation, collaboration and interaction in real time with students, while allowing the development of self-learning in the workplace. Zumba (2022)

Finally, it is important to emphasize that the use of ICT in the development of digital competencies in teachers of the Admission and Leveling Center CAN of the ESPOCH at the higher level is essential for their pedagogical training, which should be characterized by a comprehensive theoretical and practical training in the framework of ICT. Current education requires teachers who have a holistic knowledge of digital competencies, where not only instrumental or practical training is offered, but also training in technological literacy, (virtual) communication and collaboration between teachers and students, which this training is adjusted according to the needs and requirements of students, and is adapted to the different areas of knowledge and subjects taught by teachers of ESPOCH.

Conclusions

It was concluded that teachers who use ICTs the most are between 25 and 35 years of age, while teachers of older ages (over 40 years) do so infrequently. It was also found that, if they are able to create educational digital content by themselves, and also their own didactic resources, especially those who have a work experience between 1 to 5 years and between 6 to 10 years. It was evidenced that the use of educational platforms such as Microsoft Teams, Moodle and Google Classroom are more used by teachers with third and fourth level of education. In their pedagogical praxis, it was found that teachers do consider that good educational practices in students improve the level of learning with the use of ICTs. These good educational practices refer to the continuous use of virtual tools and resources that promote the construction of the student's own knowledge. In addition, it was found that the use of digital technologies such as Microsoft Teams, Moodle or Google Classroom allow students to plan, document and monitor learning on their own.

Digital competence has changed significantly as a result of initiatives to introduce new ICTs in classrooms to increase students' opportunities to achieve their learning objectives, supported by teacher training that enables the use of these technologies to reduce the digital divide between teachers and students. The development of digital competencies is linked to the appropriate application of knowledge and skills in virtual environments and in ICT and Internet-based interaction and networking, ensuring that the work contributes to solving societal problems. The shift from traditional teaching with blackboard and rote learning of content to virtual teaching with digital tools has resulted in poor or no preparation of teachers in this area, which has led to technological and digital illiteracy that is reflected in a lack of understanding of the digital skills needed in the context of virtual teaching and higher education. This study finally recommends the continuous training of teachers in the use of ICTs in the teaching-

learning process and in the development of digital competencies so that the content of the different subjects is taught in a more technological way, avoiding the traditional teaching of memorization of content (with blackboard and chalk). Digital competencies in today's world are skills and abilities that teachers need to update frequently to develop and improve their teaching-learning and research activities.

Finally, it is emphasized that it is the teachers' responsibility to properly identify and choose the most appropriate technological resources that adapt to the needs and requirements of the students.

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