Research Article

# Digital Learning Ecosystems in Continuing Education. Diagnosis of Teachers' Digital Competence For Transformation And Sustain-Ability

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**Abstract**

Virtual continuing education requires teachers to possess high-level digital skills to develop quality educational resources, as mentioned in [1] and [2] . The objective of the study is to evaluate teachers' digital competence in a Continuing Education Center in order to identify strengths and areas for improvement in the construction of relevant and sustainable digital learning ecosystems [3] . The methodology is mixed, with a predominantly descriptive-quantitative approach . [4] A questionnaire based on the DigCompEdu framework was applied to 76 teachers and 116 students, with the addition of qualitative components. The results indicated an intermediate level of digital competence, along with gaps in areas such as the use, creation, and management of digital content, pedagogy involving cutting-edge technologies such as generative AI, and the use of inclusive active methodologies [5] . These findings support the importance of specific and ongoing training programs to strengthen educators' digital skills, enhance pedagogical innovation, and maximize the effectiveness of educational resources. The assessment is linked to the evaluation of educators' digital competence aimed at educational transformation, thus fostering the development of a high-quality and sustainable virtual continuing education system [6, 7] .

**Keywords:** Teacher Digital Competence, Virtual Educational Resource Design, Sustainability, Educational Innovation

## 1. INTRODUCTION

The incorporation of new technologies in virtual continuing education has posed challenges without distinction to all teachers. The use of digital technologies in virtual classrooms by teachers requires much more knowledge than the use of technological tools. It involves pedagogical design, formative assessment, learning management, as well as interaction in digital environments that are effective. At the international level, the DigCompEdu is a reference framework that allows diagnosing and improving these competencies and has been pointed out as one of the most important at the international level. [8] [2]

The European Framework for Digital Competence in Teachers (DigCompEdu) published by the Joint Research Centre of the European Commission divides 22 competences organised into six fields, which are: Professional engagement, digital resources, teaching and learning, assessment, student empowerment and, finally, the development of students' digital competence. It stands out in Europe and Latin America for its formative approach and the progressivism it offers in education. [2] [8]

In the case of virtual continuing education, these skills acquire particular relevance. Virtual continuing education teachers must master communication through technological platforms and management of digital resources in an ethical and creative way, formative online assessment, as well as autonomous and meaningful learning. Added to this is the difficulty of capturing and serving a diverse audience, with its set of demands for flexibility and quality, which ensures effective educational processes with solid digital skills. [9] [10]

The hypothesis evaluated in this research is that specific training in digital teacher competence for the design of virtual educational resources, complemented by the application of innovative pedagogical strategies and technological strategies, will significantly increase the number and quality of knowledge, skills and competencies in teachers, thus improving the quality, effectiveness and relevance of resources designed for virtual continuing education, and therefore, contributing to the strengthening of sustainable and transformative digital learning ecosystems.

From a methodological perspective, the article has five sections. The first presents the problem and the theoretical

foundation, which is based on the DigCompEdu framework and the most recent literature. In the second section, the author describes the methodology with particular emphasis on the diagnostic instrument and the sample analyzed. The third section presents the results of the diagnosis with respect to the different dimensions and levels of the competencies stated. The fourth section compares the results with some previous studies and presents a training action plan that addresses the gaps analyzed. Finally, in section five, the author presents the conclusions, the limitations of the study and some avenues for future research.

This study is part of the doctoral program "Training in the Knowledge Society" of the University of Salamanca, and aims to strengthen the digital competencies of teachers who in continuous virtual education who develop didactic resources through online education, developing a training system that will provide them with the necessary pedagogical competencies through the integration of innovative pedagogical strategies and the appropriate use of educational technologies, in order to raise the quality and effectiveness of resources. Consequently, based on the challenge of building sustainable digital learning ecosystems that favor pedagogical innovation, collaboration and human development. However, this transition to more open, flexible and technological environments depends, to a large extent, on the level of digital competence of our teachers, who act as the key agents in educational transformation.

Thus, the need arises to analyze how teachers' digital competence contributes to the transformation and sustainability of learning ecosystems, understood as dynamic networks that intertwine technology, pedagogy, institutional culture, and community of practice. And with this, the question: How does the strengthening of teachers' digital competence contribute to the transformation and sustainability of learning ecosystems in the context of virtual continuing education?

## 2. THEORETICAL FOUNDATION

We will now present an analysis of the bibliographic review that is the basis of this article:

**Digital Teaching Competence for Transformation and Sustainability**

The success of implementing digital learning ecosystems in continuing education depends largely on the teacher's digital competencies. They must integrate pedagogical technology in ways that facilitate meaningful and sustainable educational transformation [13] . Over the past decade, educators have had to adapt to a changing landscape that demands more and more digital competencies from teachers. The gradual digitalization of education requires a profound reconsideration of the teacher workforce's skill set. Instructors face new demands that take into consideration not only technical skills, but also methodological and attitudinal skills aligned with the context. [14]

A teacher's thoughtful and effective use of digital technologies in teaching and learning processes constitutes educational digital competence. This includes knowing how to choose and apply relevant digital technologies, stimulating the active participation of students in learning ecosystems, as well as designing learning experiences that properly integrate technology, controlling the elements of ethics and security on the web. Social responsibility in education, focused on teaching competence, is not limited to practical training by a device, software, or technology. It integrates together with pedagogy, putting in a new model education by technology that allows more interactive experiences with a focus on the student. Digital citizenship, critical thinking, creativity, flexibility to change, networking, are just some of the requirements of a digital education. A teacher with digital competencies is able to critically evaluate the information found on the web, to communicate and create content in multiple formats, and to design and manage hybrid or virtual learning environments with inclusion and participation of all students. [15] [16]

At the international level, several frameworks have appeared to assess and systematize the digital competence of teachers. One of the most influential is the European Framework of Digital Competence for Educators (DigCompEdu), created by . DigCompEdu offers a comprehensive reconstruction of an educator's digital competence, including 6 areas of competence (from professional engagement to the facilitation of students' digital competence) broken

down into 22 competences. This framework integrates many of the previous efforts and is a common basis for many countries in relation to teacher training and self-assessment. Thus, Spain adopted them in its common framework of digital competence for teachers in 2017, proposing criteria of areas and levels of performance for teacher training in its educational context. Likewise, other bodies have shown interest in establishing global standards, such as the ICT Competency Framework for Teachers of the , integrates digital competence within a broader approach. Everyone is concerned that the teacher of the 21st century must solidly integrate his pedagogical and disciplinary knowledge, as well as have digital skills, which allow him to design innovative and technological didactic strategies. [8] [6] [17]

The digitalization of teaching and educational transformation is one of the main trends currently and globally focused. In this line of transformation, teachers face not only the challenge of mastering their specialties, but also of developing integrative teaching methodologies that relate discipline, technology, pedagogy and the principles of education for sustainability. Teachers who possess the basic digital skills required by their role will be able to apply active ICT-based methodologies, such as mobile learning, project-based learning, gamification, virtual simulation, among others. These methodologies not only improve the effectiveness of learning, but also provide students with the skills they are expected to possess in the future, while instilling sustainability in them. It indicates that training teachers in the use of educational technologies is crucial to offer inclusive quality education within the framework of the 2030 Agenda. [18] [6]

Indeed, strengthening teachers' information and communication technology skills contributes to achieving Sustainable Development Goal 4 (quality of education) by empowering teachers to foster more open, equitable, and innovative learning environments. Thus, the digital competence of instructors is not only essential to improve teaching processes, but also has a strategic importance in creating more resilient education systems that adapt to sustainable development changes. [19]

Pedagogy transformed by technology forces a change in the role of the teacher. In a digital learning environment, the teacher ceases to be the sole provider of information and becomes a tutor, facilitator and mentor in a connected and information-enriched environment. The Faculty of Educators (ILO) indicates that the emergence of perpetual learning ecosystems encouraged by collaborative technologies requires a "new type of educator" to act as a mediator and coach in larger learning networks. This teacher must promote self-direction in learning, define personalized learning maps and collaborate with other |instructional designers, virtual communities, tutors, among others| to enrich the educational experience. Consequently, this implies that the teacher must become a true leader and evolve the teaching mentality, in this case, abandoning the traditional teacher-centered view to adopt a holistic student-centered vision. A teacher who is digitally competent and who understands sustainability knows that he or she must collaborate online, share in professional networks and receive continuous training for new challenges. [6]

Just as students are expected to be lifelong learners, teachers must also become lifelong learners, updating their competencies constantly. This continuous improvement strengthens innovation and educational transformation over time. Finally, in the context of the sustainability of digital teaching skills, the term has a double meaning. It seeks the equitable development of competencies of all teaching staff with the reduction of gaps, whether by age, gender or geographical context, so that the entire education system evolves cohesively. It also means that the teacher uses technology in a sustainable way, applying socially beneficial practices in the long term. A digitally competent teacher who is knowledgeable in sustainability will incorporate into their teaching not only relevant technologies, but also content and projects on sustainable development, which may include, but are not limited to, climate change, global citizenship and the sustainable development goals, using technology to raise awareness and empower their students. The convergence of digital education and education for sustainability is much stronger than before; A sustainable educational arrangement that combines teaching methods focused on social justice and care for the natural world is proposed. [3] [19]

For all of the above, developing digital teacher competence is a basic element to develop digital learning ecosystems in continuing education and thus achieve a deep and sustainable educational transformation. Innovation is in digital

ecosystems, which provide the tools and scenarios, but come to pedagogical life in the hands of competent teachers, who guide them towards improving learning and training citizens capable of facing the challenges of the twenty-first century. The synergy between digital learning ecosystems and digital teaching competence translates into a transformation engine that empowers the educator, allowing them to renew their practices and at the same time ensuring that this renewal contributes to a more resilient, inclusive and sustainable education system for all, in perpetuity. [20]

**Digital Learning Ecosystems and Teaching Digital Competence in Continuing Education**

The concept of continuing education as lifelong learning has been evolving continuously as technology advances and global connectivity expands. This concept has evolved into "ecosystems in digital learning that integrate people, technologies, content and methodologies in a dynamic and interdependent fabric". In this sense, teacher digital competence (CCD) becomes a key element that, unlike others, is based on a teacher's ability to incorporate technology into training environments that in turn translates into improvements in educational quality. [21] [2]

Currently, the Faculty of Teachers argues that making technological infrastructure available to institutions is not enough: it is equally essential that teachers develop an integrated set of competencies that allow them to create, conduct and evaluate learning activities that use technology and that, at the same time, respond to the needs of diverse and changing students. In the case of virtual continuing education, what is more relevant is that teachers play the role of pedagogical mediators in multifaceted digital environments, in which teaching and learning occur anywhere, do not follow a schedule and, in many situations, are self-directed. The article discusses the relationship between digital learning ecosystems and the aforementioned competence, responding, in particular, to the need for continuing education and presenting an integrative proposal that seeks the transformation and sustainability of education. [6]

The concept of the digital learning ecosystem is inspired by the comparison with natural ecosystems: it is a set of "biotic" (people, content, communities) and "abiotic" (infrastructure, pedagogy, technological platforms) elements that, in an interdependent way, underpin learning [22, 23]

In continuing education, these ecosystems help professionals and students access relevant and up-to-date content, participate in communities of practice, and acquire competencies in authentic contexts using tools that enable collaboration and co-construction of knowledge). Digital technologies, and especially artificial intelligence, have enhanced this interconnectedness and make adaptive pathways possible, customizing itineraries to fit the paces, interests, and needs of each learner. An effective digital learning ecosystem must achieve inclusion by providing equitable access to learning resources and opportunities, have flexibility to allow learning to take place anytime and from anywhere, and must have competency-based learning: focus on critical 21st century skills, such as critical thinking, collaboration, and creativity and have integrated emerging technologies: Incorporate AI, learning analytics, and open educational resources (OER). [24] [25] [20]

In this sense, continuing education is no longer linked only to a classroom, but is based on online courses, virtual learning environments (VLE), academic social networks and digital repositories. Taking as a reference, an engineer from any branch could attend a refresher course in the use of renewable energies, participate with experts in forums, carry out simulations through specialized software and, in addition, receive feedback automatically and in real time. [5]

[22] have shown in the literature that, with the incorporation of active methodologies, formative assessment and constant feedback, digital ecosystems strengthen student motivation and engagement. They also support the shift from paradigms rooted in teaching to learning, in which the student himself controls and directs his or her training process.

Teacher digital competence is defined as the educator's ability to use digital technologies in a critical, creative and pedagogically grounded way in teaching and learning processes. This does not refer only to technical aspects, but to an integrative pedagogical design, in which ethics is addressed, and promoting digital citizenship. [2] [26]

The European DigCompEdu Framework provides us with pedagogical competence in the use of technologies for the classroom. This framework organises teachers' digital competence into six areas: [8] \

- Professional commitment.
- Use of digital resources.
- Teaching-learning process.
- Evaluation.
- Empowerment of students.
- Facilitation of the student's digital competence.

As in the case of framing the digitalization of education in the teacher's self-evaluation, teachers can self-evaluate in each area, since each area is broken down into skills, so different levels of progress can be planned. [27]
According to , the complexity of digital ecosystems gives the teacher the possibility of organizing teaching experiences in a multifaceted environment. With a critical mastery of technology, a teacher is able to: [28]

- Design activities that use digital tools for collaboration.
- Implement the use of learning analytics to give adjusted feedback.
- Stimulate learning through simulations and gamification with collaborative projects.

Likewise, a well-structured digital ecosystem facilitates the development of teachers' digital competence, by providing spaces for pedagogical experimentation and lifelong professional learning. The synergy offered by digital learning ecosystems and teachers' digital competence constitutes continuing education as an engine of transformation. This is much more than a mere use of technology, as the intention is for such technology to be increased in a way that achieves learning that is relevant and sustainable. The teacher, a key mediator, needs to have skills that allow them to deal with a diverse context, design tailor-made experiences and play an active role in building learning communities that are open and collaborative. [13]

## 3. OBJECTIVES

The article aims to evaluate and strengthen teachers' digital competence in the context of virtual continuing education, with the purpose of promoting the transformation and sustainability of digital learning ecosystems. In coherence with the general objective of the doctoral research, it seeks to improve the digital competencies of teachers responsible for the design of virtual educational resources, through the implementation of a training program that develops innovative pedagogical strategies and the use of educational technologies, with the aim of optimizing the quality of the designed material, improving the quality of the programs that train and continue to promote the effective learning of teachers and students. To achieve this purpose, the following specific objectives are proposed: (1) To evaluate the digital competencies of teachers through an initial diagnosis that allows identifying strengths and areas for improvement in the use of educational technology. (2) To create an online self-study course designed to develop the necessary competencies for the optimal design of educational resources and activities, integrating pedagogy and technology in training modules with practical activities and assessments. (3) Implement and evaluate a pilot virtual course that seeks to improve the digital competencies of instructors in continuing education, ensuring the quality of the resources designed and promoting innovative, inclusive and sustainable learning experiences.

## 4. METHOD

A research was carried out with a quantitative approach, descriptive and non-experimental cross-sectional design, with the purpose of diagnosing the level of digital competencies of the teaching staff of a Continuing Education Center in Quito, Ecuador. This diagnosis was proposed as a baseline within a more complex doctoral research, which sought the design, implementation and evaluation of a program to strengthen teachers' digital competencies in the context of virtual continuing education. [4] https://doi.org/10.5281/zenodo.19684513 [30]

The construction of this research is based on a well-defined methodological process that accounts for the coherence, validity and relevance of the results. The line of phases is designed to fully achieve the evolution of a diagnosis, analysis and subsequent intervention in the digital competence of teachers in the framework of virtual continuing education.

Through this approach, it is possible to move from planning, which, in turn, is classified as strategic, since it clearly defines the scope and instruments, to the validation of a form through an experimental formative study. This methodology incorporates criteria of scientific rigor and good practices in educational research and in the use of technology, with the aim of producing results that are innovative and that can be implemented in professional reality and that constitute a reference for other research. Figure 1 shows the methodological research process divided into four stages:

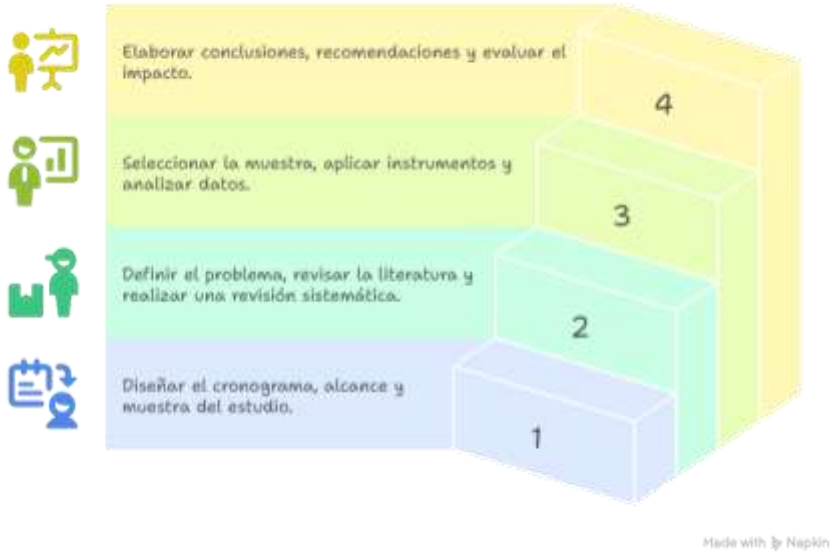



**Figure 1. Methodological research process**

Source: Authors of the article

The first stage develops the design of the study, defining the scope, schedule and sample; in the second, the research is theoretically based through the approach to the problem and a systematic review of the literature; the third has the application of the instruments, the selection of the sample and the analysis of the data obtained; and, finally, the fourth stage consists of drawing conclusions, recommendations and impact assessment, integrating the results to reinforce the validation and relevance of the study.

For this process, data collection was carried out through two five-point Likert surveys (1 = Strongly disagree, 5 = Strongly agree). The first was applied to 76 teachers, and the second to 116 adult students from the center's virtual training program. Participation was voluntary, anonymous, and supported by informed consent. The samples included staff teachers and teachers hired by course, who averaged 40 years of age, and students who, for the most part, were young adults with an average age of 30 years, achieving robust and representative coverage from a descriptive perspective.

The creation of the instruments was based on international theoretical frameworks such as the DigCompEdu: European Framework of Digital Competence for Educators, the INTEF Framework (Spain), as well as adaptations

validated in previous studies. Both questionnaires went through content validation by experts and achieved high levels of reliability: α = 0.94 for teachers (42 questions) and α = 0.96 for students (48 questions). [1]

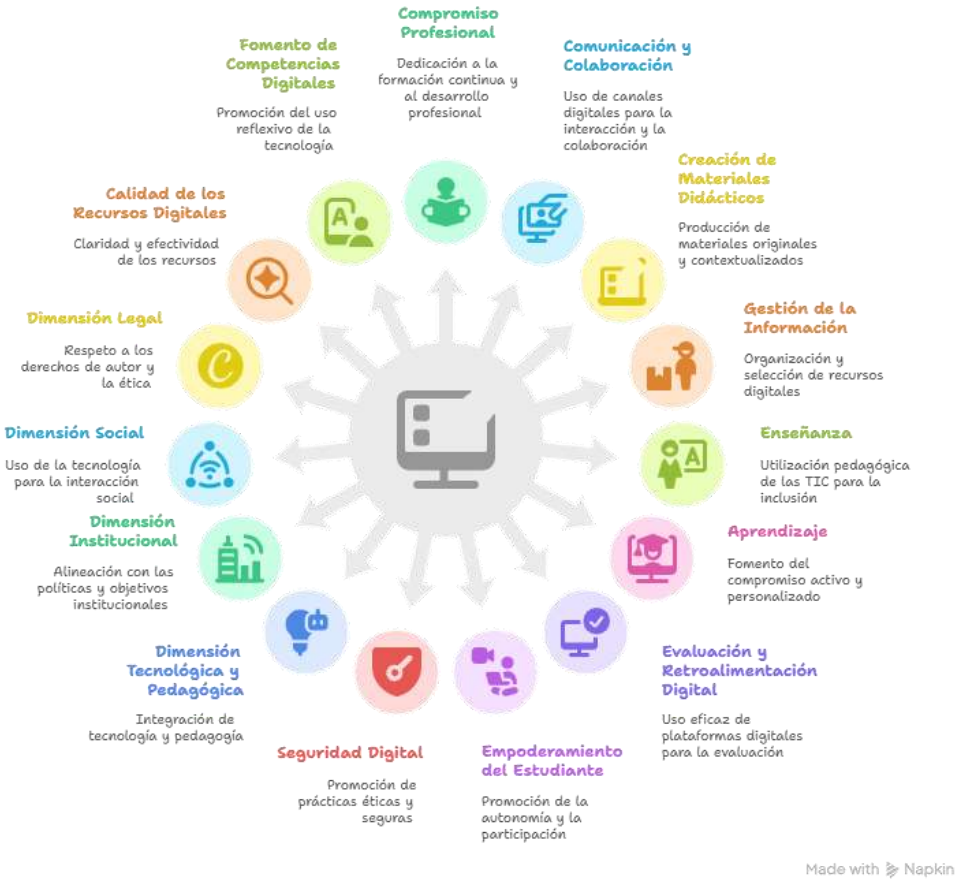



**Figure 2. Dimensions**

Source: Authors of the article

In Figure 2, the 15 dimensions are shown, such a comprehensive approach allowed an analysis of the self-perception of the faculty and a critical analysis from the perspectives of the students. The reliability of both surveys used and their validation as a result of having high internal consistency provides a solid basis for the development of training programs oriented to the real teaching needs of the Center for Continuing Education. [12]

## 5. RESULTS

The surveys were applied online through Google Form, through a link aimed at teachers and students. It was explained to the respondents that in the case of the surveys, the information would be treated with strict confidentiality in terms of their identity and the information provided. They were assured that the data collected would be used exclusively for research purposes for the design and improvement of the training programs of a Continuing Education Center, in their words, 'optimizing learning resources and teaching'. In the case of the students,

the answer was given by evaluating the teaching practice of the virtual education courses they were taking, answering about the comprehensive supervision throughout the course.

The present research went through an ethical review process with the CEI (Research Ethics Committee) of the University of Salamanca. The research aims to strengthen the digital competencies of educators through an educational intervention focused on the design of virtual resources. It involves virtual continuing education courses and does not involve any invasive procedures or the collection of sensitive personal data. In compliance with the requirements of the CEI, a set of mandatory documents was prepared, which included the official application form of the project, an information sheet for participants and a consent form, and a supplementary document on data processing. It is stated that participation is voluntary, that information will be kept confidential, and that participants have the right to withdraw from the study at any time without negative consequences. Surveys will be administered anonymously through digital forms that do not capture identifying information such as names or email addresses.

In this case, the study adopts a quasi-experimental approach based on the implementation of pre- and post-diagnostic survey assessments after a formative intervention. The diagnostic tools are based on the DigCompEdu framework and assess to some extent the digital competence of teachers and the quality of an educator's educational resources in the context of continuing education. The design has safeguards in place to ensure that there are no physical or psychological risks for participants. In addition, the study ensures compliance with the relevant Ecuadorian legislation on data protection, Organic Law on the Protection of Personal Data (2021).

At the end of the collection phase, the data was exported and processed using Google Forms. Due to the descriptive nature of the study, univariate calculation methods, frequency calculation, response percentages per item, arithmetic means and standard deviations per item and by dimension were used, which were obtained by averaging the items in their respective category. The internal consistency of the scales was verified using Cronbach's alpha coefficient where the results obtained were in high ranges, in Students the Cronbach's Alpha was 0.991 and in Teachers the Cronbach's Alpha was 0.990 confirming the reliability of the instruments.

The study lacked an inferential approach, comparisons were made between groups, including teachers and students, using the independent sample t-test for comparisons between groups. A series of dimensions ($p < 0.05$) were found to present statistically significant differences, and these are discussed in the results section.

In general, the teachers of the Continuing Education Center show a little less than a moderate level of digital competence in the initial self-evaluation, while the students consider that their teachers have a somewhat higher level. The overall mean of all the items related to digital competencies was 2.64 in the teacher self-evaluation and 2.96 in the student perception. These values show that, on average, teachers have a moderately critical attitude about their digital competencies (average value between 2.5 and 3.4) and in this sense, students, although they do not assess the situation as positive, have a slightly favorable biased perception. None of the extreme average dimensions (very low <2.0, nor very high >4.5) suggest a profile that lacks both excellence and severe deficiency. Most of the averages are in a range that indicates a slight inclination towards neutrality.

Table 1 summarizes the average results for each five competency dimensions, comparing the scores given by teachers and students. In addition, the corresponding gap (expressed in points on the Likert scale) between teachers' self-evaluation and students' evaluation in each dimension is presented.

**Table 1. Average scores (scale 1-5) by dimension of teachers' digital competencies comparing teachers' self-assessment and students' perception, with the Doc-Est gap.**

| Digital Competence Dimension | Teachers Media | Medium Students | Brecha (Doc–Est) |
|---|---|---|---|
| Professional Commitment | 2.96 | 2.82 | 0.14 |
| Communication and Collaboration | 2.57 | 2.87 | -0.30 |
| Digital Content Creation | 2.38 | 2.92 | -0.54 |

| | | | |
|---|---|---|---|
| Digital Content Management | 2.55 | 2.91 | -0.36 |
| Digital Teaching | 2.61 | 2.89 | -0.28 |
| Digital Learning | 2.70 | 2.91 | -0.21 |
| Digital Evaluation and Feedback | 2.48 | 2.98 | -0.50 |
| Student Empowerment | 2.75 | 3.02 | -0.27 |
| Digital Security | 2.75 | 3.02 | -0.27 |
| Technological and Pedagogical Dimension | 2.67 | 3.02 | -0.35 |
| Institutional | 2.54 | 3.04 | -0.50 |
| Social | 2.62 | 2.98 | -0.36 |
| Legal | 2.73 | 2.97 | -0.24 |
| Quality of Digital Resources | 2.71 | 2.92 | -0.21 |
| Digital Skills Facilitation | 2.60 | 2.98 | -0.38 |
| Media global | 2.64 | 2.95 | |

According to the findings, both teachers and students provide moderate ratings (between 2.41 and 3.05 on average) for the assessed dimensions of digital competence. The highest scores were recorded in Professional Engagement, where the averages were 2.96 for teachers and 2.82 for students, indicating a reasonable willingness to participate in professional development. Also notable are the scores for the Technology Dimension (2.67 and 3.05), the Pedagogical Dimension (2.78 and 2.94), and the Quality of Resources (2.72 and 2.94), signifying positive perceptions of instructional design and infrastructure, although still far from optimal levels (≥4.0).

In stark contrast, in the critically low area of Digital Content Creation and Management, there is one of the largest gaps of 0.47 (2.41 for teachers vs. 2.88 for students). A related pattern is found in Digital Assessment and Feedback (2.64 and 2.92, -0.28 gap) and in Communication and Collaboration (2.57 and 2.90, -0.33 gap). These differences suggest that although teachers recognize certain competencies, students see them as more positive than justified. This could indicate a lower-than-justified self-assessment of skills or a disconnect between theory and practical application.

Gaps are also significant in the Social Dimension (2.55 and 2.97, gap -0.42) and in Digital Security and Ethics (2.48 and 3.03, gap -0.55). The latter is particularly concerning, as it may indicate that instructors do not provide sufficient guidance on safety, ethics, and the responsible use of digital technology. This aligns with research that emphasizes the need to address ethics and data protection as fundamental to the e-learning framework.

The gaps in the Institutional Dimension (2.54 and 2.92, gap -0.38) and the Quality of the Proposed Activities (2.63 and 2.99, gap -0.36) show a more positive perception on the part of students compared to their instructors, which may indicate a lack of visibility, confidence or coordination in the teaching and organization strategies learned and planned.

The only instance in which instructors score higher than students is in Professional Engagement, with a positive deviation of 0.14. This implies that there is an internal perception of greater engagement in professional development processes, which is not necessarily the case from the students' perspective.

The dimension of Learning Empowerment and Facilitation (2.74 and 2.98, gap -0.24) continues to describe an area of concern, because, although students recognize efforts towards promoting self-directed learning and the use of digital tools, teachers feel that their contribution is minimal in this area.

In summary, self-diagnosis combines teachers' self-assessment of their digital competencies with students' assessment of faculty competence, revealing an average to low-average level of digital competence. While there are strengths in the domains of professionalism, pedagogy, and technology, there are critical gaps in content creation, digital safety, collaboration, assessment, and student empowerment. These findings create a strong foundation for

planning specific formative learning interventions aimed at closing gaps and strengthening digital competencies in the context of a virtual learning environment.
In Figure 3, we can see the comparison of the average scores given by teachers with those of students in each dimension of digital competencies, illustrating the strengths and gaps in perception that exist.

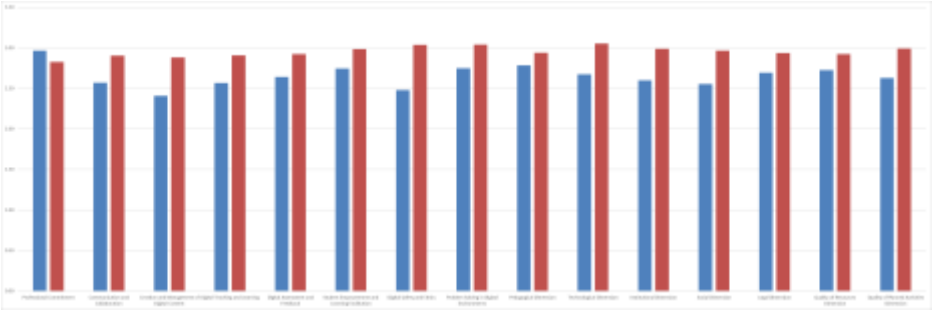


**Figure 3. Comparison of the average scores of each dimension of digital competencies self-assessed by teachers (blue bars) and perceived by students (red bars).**

Source: Authors of the article

The scores were assigned on a Likert scale from 1 ("Strongly disagree") to 5 ("Strongly agree"). It can be seen that in all dimensions the perception of the students exceeds the self-evaluation of the teachers and this is more evident in the Creation and Management of Digital Content, Digital Evaluation and Feedback, Institutional Dimension, as well as in the Facilitation of Student Learning.
Based on the findings and what is shown in Figure 4, we can identify the following gaps:

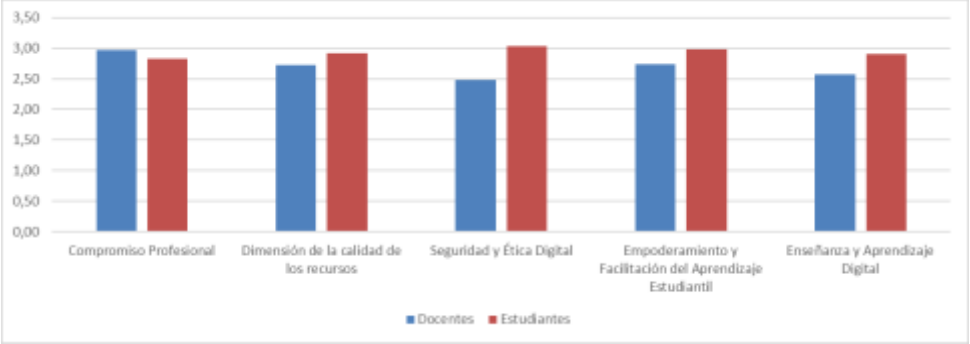



**Figure 4. Gaps found.**

Source: Authors of the article
The image highlights positive perceptions of teachers and students in digital skills, especially in 'professional commitment' and 'quality of resources'. However, gaps are evident in 'digital safety and ethics', as well as in 'digital teaching and learning'. Although there are advances in the promotion of autonomous learning, they are insufficient. Overall, the results highlight the need to strengthen teacher training for a more ethical, effective and sustainable technological integration.

In an analysis you can say:
**Professional Engagement:** This dimension has the highest average self-assessment scores (2.96) balanced with a somewhat positive student score (2.82). This suggests that faculty have an adequate degree of commitment to

professional development, a willingness to be trained in the educational applications of technology, and their initiative to perform in their roles.

**Resource quality dimension:** Both teachers (2.72) and students (2.94) have positive perceptions with a gap of 0.22 indicating a perception of some degree of alignment. This indicates that resources are appropriate, accessible, and used in ways that meet minimum standards of relevance and digital alignment.

**Digital Safety and Ethics:** This dimension illustrates a gap of 0.55, which means that, although students are concerned about a reasonable level of ethics and safety in the digital sphere, teachers dismiss that these elements have only a minor consideration with respect to daily practice.

**Student Learning Empowerment and Facilitation:** This dimension shows a gap of 2.74 and 2.98, showing that both sides recognize efforts to promote digital autonomy in students, even though those (efforts) are indisputably insufficient.

**Digital Teaching and Learning:** Scores of 2.57 and 2.91 indicate a prominence in digital in the delivery of integrated teaching and blended learning and, although higher-order teaching methods that enable active learning are absent, there is a need for a greater balance or presence of interactive methods.

**Areas of Improvement**

With regard to the areas of improvement, as shown in Figure 5, the following dimensions are identified:

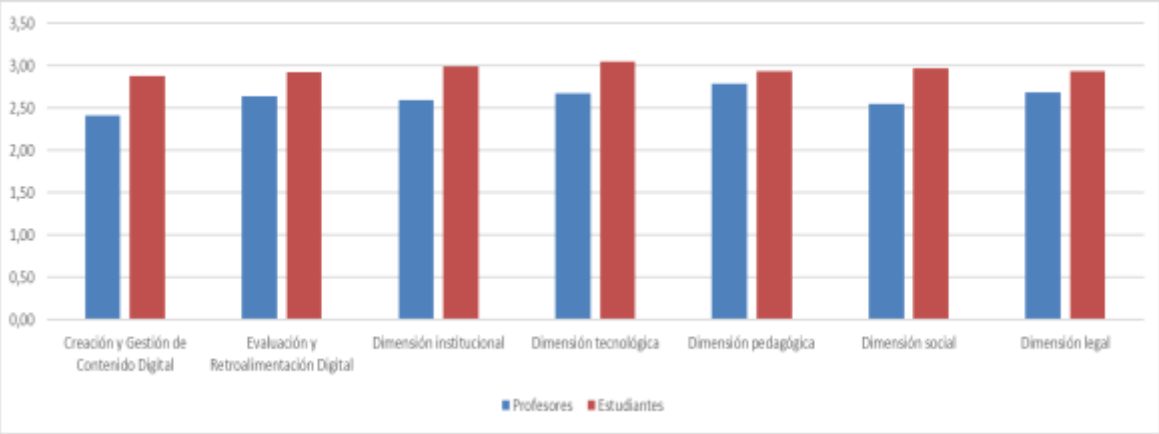



**Figure 5. Areas for Improvement**

Source: Authors of the article

The results of the research indicate the existence of differences between teachers and students and, consequently, the urgency of improving the creation of digital content. In addition, there is little institutional integration and, in addition, pedagogical, technological and regulatory integration is complex. Taken together, this evidence supports the immediate need to develop a more harmonious teaching practice in the digital field.

According to the analysis of each dimension we can say that:

**Digital Content Creation and Management:** Represents the largest gap (-0.47) with 2.41 for teachers and 2.88 for students. These results indicate that teachers' digital content creation skills are lower than is actually the case. In this case, it is necessary to strengthen self-efficacy and share good practices.

**Digital Assessment and Feedback:** Shows a gap of -0.34 (2.64 for teachers vs. 2.98 for students). While students value feedback positively, teachers do not feel that this process is adequately addressed. Improving interactive tools and establishing clear evaluation criteria are critical.

**Institutional Dimension:** Reflects a gap of -0.22 with 2.72 for teachers and 2.94 for students. This shows that,

although students perceive some appreciation of institutional alignment, faculty perceive a lack of active engagement or support directed towards the execution of the designated digital strategy.

**Technological, Pedagogical, Social and Legal Dimensions:** Despite having a smaller gap, these (-0.38, -0.16, -0.42 and -0.24 respectively) articulate specific areas that need attention focused on the pedagogical integration of technology, cohesion within digital communities, clarity in regulatory frameworks and interaction within virtual environments.

Based on the diagnostic assessment, the competencies assessed reveal that the most notable strengths are in professional commitment, quality of resources, and attention to digital ethics. At the same time, however, there are critically marked areas for improvement in content development, digital assessment and feedback, and strengthening student autonomy.

Gaps, where students have more positive perceptions than their teachers, are critical in shaping areas where students' perceptions of their competencies are more positive than instructors' opinions and can help design strategic training interventions aimed at improving professional confidence, realistic self-assessment, and the use of active student-centered methodologies.

Finally, we recommend establishing a teacher training plan that focuses on digital divides, targeting emerging and strategic competencies aligned with international standards such as the DigCompEdu framework.

## 6. DISCUSSION

The results of this diagnostic research provide empirical evidence on the current state of digital competencies in a group of teachers dedicated to virtual continuing education, allowing them to be contrasted with findings from other contexts and with the expectations defined by the current conceptual frameworks. In general terms, our findings confirm trends reported in the international literature: the teachers evaluated are mostly at an intermediate level of digital competence, with some areas well developed and others incipient. This is in line with what has been pointed out by , who highlight that in various countries teachers are usually classified between basic and intermediate levels, and few reach advanced levels without additional training processes. In fact, the identification in our study of significant gaps in aspects such as digital security and digital assessment is in line with what has been observed by those who stress that "educators do not yet have adequate development" in critical areas of digital competence. [16] [29]

In the Ecuadorian case, they warn that the average digital proficiency among teachers is low, especially in the most complex pedagogical competencies, although with a positive attitude towards improvement. Our results, although more encouraging, reflect a similar pattern: no dimension exceeds the mean of 3.1 and a clear difference is observed between teacher and student evaluations. For example, in "Digital Content Creation", teachers averaged 2.38 vs. 2.92 for students, and in "Digital Assessment and Feedback" 2.48 vs. 2.98, showing a significant gap in how material production and digital assessment are perceived. [3]

A positive finding is the coincidence in the best-valued dimensions: "Quality of digital resources" (2.71 teachers; 2.92 students) and "Professional commitment" (2.96 teachers; 2.82 students). This indicates strengths in the pedagogical design and professionalism of the teaching staff. This result can be explained, at least in part, by the experience accumulated during the COVID-19 pandemic, which forced many teachers to migrate quickly to virtual environments. In this context, continuing education teachers, accustomed to flexible and technological environments, show greater mastery in basic digital tools, in line with the findings of . [30] [5]

However, weaknesses are still evident in "Digital Security" (2.75 teachers; 3.02 students) and in "Facilitation of Digital Skills" (2.60 teachers; 2.98 students). As , awareness of digital citizenship, data protection and ethical use of technology is still a pending issue in many contexts. Our findings reinforce this observation: students expect guidance and accompaniment from their teachers in these aspects as well, although they often consider them to be assumed by the adult profile of the continuing education student. [1]

A distinctive contribution of this study is the incorporation of the student perspective in the assessment of teachers' digital competencies. While most research is based on self-evaluations or institutional analyses, a triangulated view was integrated here. As they suggest, the teacher's perception of their competence may differ from the student's perception, which justifies including the student's voice as a relevant indicator in any improvement process. In this sense, tools such as SELFIE and DigCompEdu offer valuable models for a self-evaluation complemented by external evaluations of the actors involved. [5] [8]

Another relevant aspect is the association between teaching experience and the levels achieved. It was observed that younger teachers and those with postgraduate studies in educational technology tended to achieve better scores, which corresponds to previous studies such as those of , who recommend peer mentoring processes to level the development of digital competences. [3]

If we compare with European standards, the scores observed in this diagnosis would place the majority of teachers at a level A2–B1 (explorer–integrator), with no dimension approaching level C1–C2 (leader or pioneer), according to the DigCompEdu scale. This situation shows a clear need for institutional intervention to reach expert levels in key competences such as digital security, personalized feedback and technical problem solving. [2]

Based on these results, it is proposed to design a continuous training plan at the Continuing Education Center, which includes at least five lines of action: (1) workshops on the foundations of digital teaching competence and the ethical use of technologies; (2) courses on instructional design, active methodologies and interactive digital resources; (3) training for the accessible and inclusive design of educational content; (4) spaces for the strengthening of evaluation and feedback processes through digital tools; and (5) technical assistance for the resolution of technological problems linked to the virtual learning environment. The inclusion of official certifications in teaching digital competence can also be a complementary strategy to promote professional development and make visible the progress made. of motivation and recognition, in line with what was suggested by . In conclusion, the results presented here provide specific evidence on the strengths and areas of improvement of continuing education teachers in a Latin American environment. The participation of students as evaluating agents allows for a more complete vision of teachers' digital competence and opens the way to contextualized, strategic and transformative training processes to achieve quality digital teaching. [1]

The results indicate that gaps in teachers' digital competencies have a negative impact on the consolidation of digital learning ecosystems in a sustainable context. Improving content creation, feedback, and institutional support is essential to increase pedagogical and technological integration in continuing education, making it possible to adopt more innovative, inclusive, and sustainable practices. This, in turn, improves continuing education.

## 7. CONCLUSIONS

This study identified the level of digital competence of educators in relation to a group of teachers from virtual continuing education programmes. This was carried out by identifying both strengths and weaknesses through a baseline diagnostic assessment aligned with the European DigCompEdu framework.

The results highlight strengths in digital communication and collaboration, educational content creation and management, technology-enhanced teaching, as well as professional engagement towards virtual teaching. These dimensions received high scores in both self-assessment by educators and assessment by learners, particularly with regard to the clarity, relevance and accessibility of the educational resources provided.

On the other hand, the greatest problems of digital security and citizenship, the solution of technical problems in virtual environments and formative assessment with individualized feedback highlight the greatest weaknesses. These competencies are a priority concern since they directly impact the quality and equity of teaching and learning processes in digital environments.

A perception gap between teachers and students was noted, particularly with regard to professional self-improvement, responsiveness to solve technological problems, and the quality of feedback provided. This discrepancy highlights the integration of the student's voice as an essential element to be used in teachers' self-

regulation processes and in continuous quality improvement systems.

The overall level of digital competence of the teaching staff as a whole can be considered intermediate, with a wide range of core competencies mastered, but lacking expert levels of competence. It is stated that digital professional development is an ongoing process that requires institutional planning, pedagogical guidance and periodic review aimed at improving results.

Following the above findings, the following specific actions are proposed in relation to the strengthening of teachers' digital competencies at the Continuing Education Center:

- Create and run a professional development course on digital competences that is structured around the specific gaps identified above. At a minimum, this programme should cover the following topics: the underlying principles of teachers' digital competence, ethics and responsible use of technology, active teaching and instructional design incorporating digital tools, assessment and feedback in virtual environments, education that is inclusive and accessible, and technological problem-solving.
- Foster collaborative professional development strategies, such as communities of practice, peer mentoring, and micro-workshops led by highly digitally trained teachers. This will help close internal gaps, enable the exchange and internalization of good practices, and strengthen a culture of continuous improvement.
- Incorporate digital teaching competencies as part of institutional planning with minimum course guidelines. These include, but are not limited to: interactive teaching materials, timely feedback, clear digital communications, and the promotion of digital citizenship among learners.
- Encourage formal recognition of professional development milestones by sponsoring pathways to official certifications in digital skills, for example, through Spain's Digital Teacher Competence Framework or Ecuador's Credential Frameworks. This will serve a dual purpose of motivation and professional development.

The results of this study should be considered with caution due to the specificity of the institutional context and the small sample of teachers in continuing education. Even so, the trends that were pointed out are compatible with the hypotheses of the international academic literature, which validates its conclusions and, therefore, suggests transfer to other institutional realities.

Improving the digital competence of teachers is a strategic axis for virtual continuing education. As they say, effective training must be systematic, contextualized and diagnostic. For the Center for Continuing Education, this study is a first step in the direction of training that leads to digitally competent, ethical, inclusive teaching, and that forges learning that is essentially meaningful. [2]

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