Artículos científicos

Indicadores e índices para evaluar el uso y apropiación tecnológica en docentes de licenciatura

Indicators and indices to evaluate the use and appropriation of technology in undergraduate teachers

Indicadores e índices para avaliar o uso e apropriação da tecnologia em professores de graduação

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Resumen

El objetivo de este trabajo fue evaluar el uso y apropiación de las tecnologías de la información y comunicación por parte de los docentes como un factor de calidad e innovación en la enseñanza y aprendizaje en la educación superior. Para ello, se usó una metodología descriptiva, con un método cuantitativo, mediante una encuesta aplicada a 100 docentes de educación superior de una universidad privada de la zona metropolitana de Guadalajara, Jalisco, México. Los resultados indican que el índice de grado fue de 60.72, el de frecuencia de 79.87 y el de conformidad fue de 87.5; finalmente, el índice general fue de 76.03, lo que indica que tienen un nivel medio de uso y apropiación de las TIC. Se sugiere, por tanto, que las instituciones diseñen planes de entrenamiento alineados al plan institucional e incorporarlos en la planeación didáctica de cada asignatura, de modo que se puedan aprovechar para mejorar la enseñanza.

Palabras clave: calidad de la educación, evaluación, tecologías de la información y comunicación.

Abstract

The objective was to evaluate the use and appropriation of Information and Communication Technologies by teachers as a factor of quality and innovation in teaching and learning in higher education. A descriptive methodology was used with a quantitative method, through a survey applied to 100 higher education teachers from a private university in the metropolitan area of Guadalajara, Jalisco, Mexico. They do not resist the use of technology, the degree index was 60.72, the frequency index was 79.87 and the conformity index was 87.5 finally, the general index was 76.03, which indicates that they have a medium level of use and appropriation of ICTs. Institutions will have to design training plans, aligned to the institutional plan and incorporate it into the didactic planning of each subject, and take advantage of it to improve teaching.

Keywords: quality of education, evaluation, information and communication technologies.

Resumo

O objetivo deste trabalho foi avaliar o uso e a apropriação das tecnologias de informação e comunicação pelos professores como fator de qualidade e inovação no ensino e aprendizagem no ensino superior. Para isso, utilizou-se uma metodologia descritiva, com método quantitativo, por meio de uma pesquisa aplicada a 100 professores do ensino superior de uma universidade privada da região metropolitana de Guadalajara, Jalisco, México. Os resultados indicam que o índice de titulação foi 60,72, o índice de frequência foi 79,87 e o índice de conformidade foi 87,5; Por fim, o índice geral foi de 76,03, o que indica que possuem um nível médio de utilização e apropriação das TIC. Sugere-se, portanto, que as instituições desenhem planos de formação alinhados ao plano institucional e os incorporem no planejamento didático de cada disciplina, para que possam ser utilizados na melhoria do ensino.

Palavras-chave: qualidade da educação, avaliação, tecnologias de informação e comunicação.

Introduction

The world is no longer the same. The way we relate, interact, live, play, buy, sell, work, teach and learn has changed. The covid-19 pandemic left, among other things, the evident need for greater use and appropriation of information and communication technologies (ICT) in all fields, including education. However, we have become dependent on them, since no one needs to memorize anymore. It seems that we no longer need to create or innovate, since everything is solved with the use of a device and/or application. When thinking about the consequences and its effects, there are those who are for and against. However, whether we like it or not, our students use them with increasing intensity, so we have to learn to live with them. In short, it is better to see them as allies than enemies, since thanks to ICT, classes continued during the pandemic. They were the only option to continue teaching (Colmenares, 2021) .

Technological changes as causal and non-causal phenomena are explained and are part of capitalism, which is always evolving (Elster, 2006) . In this sense, we agree with Schumpter (1944) , who points out that, in times of crisis, innovations can be an opportunity to correct and readapt processes that allow us to survive and take advantage of the scenarios that are generated.

In the case of higher education institutions (HEIs), they have adapted and adopted ICT efficiently. However, those that are useful now will be obsolete in the future, which requires constant updating.

Historically, technology has made work and everyday activities easier, improving productivity and processes. In education, we have used different technological devices and gadgets that have promoted teaching and learning. For example, the use of the blackboard has been replaced by projectors, cameras, screens, computers, digital platforms, applications, among others, which reduces the time spent writing and taking notes. The type of furniture inside the classroom has even been changed to others of different shapes, sizes and arrangements. Of course, these scenarios make us rethink and question what we have been doing, especially the new role of the teacher, who must now be a leader and specialist who facilitates and guides the student in recommending content and methodologies.

However, it should be noted that teachers do not always have positive attitudes towards ICT. According to Raja and Nagasubramani (2018), this is due to lack of time, access, resources, experience and technical support. It is these factors that most of the time make teachers continue with their traditional teaching.

However, it must be taken into account that much of what you want to teach is already somewhere on the Internet. In fact, a large amount of *software, applications and digital platforms for education* have been developed that allow the interaction and motivation of students. In addition, many of the traditional processes and forms of teaching in the classroom have been accelerated and questioned, since most learning does not happen in it, but outside.

The above suggests rethinking education and what we are teaching to reflect on what, how and where. In this sense, we should ask ourselves the same question as Zhao (2020): is learning happening if the majority of the content continues to come from the teacher? In this regard, it should be taken into account that video tutorials published by countless content creators have become a non-formal tool for autonomous learning (Roque, 2020).

Additionally, as of November 30, 2022, OpenAI made ChatGPT public, an artificial intelligence (AI) system that creates personalized content widely used by students according to their needs. This has set off alarm bells in many universities, which review their evaluation methods and adopt measures that do not neglect compliance with the objectives and competencies of the study programs (De Aldama, January 28, 2023).

This is because the use of AI can result in plagiarism and, therefore, a detriment to the quality of learning. In this sense, according to Sullivan *et al*. (2023), there must be an institutional positioning around the establishment of a surveillance and support committee made up of teachers, directors and students, not so much to sanction, but to teach appropriate uses, always taking care of integrity.

It is about seeing AI as an opportunity to enhance student learning, and not so much as a threat. Macías Lara *et al*. (2023) suggest adequate training of teachers to take advantage of the potential of AI in higher education.

Before the pandemic, it was believed that teachers were resistant to the use of ICT or did not know how to use it. However, experience showed that they adapted easily, and now use more technological tools in their classes. For example, Ricardo and Vieira (2022) They demonstrated the change in beliefs and conceptions towards teaching with the use of technology after teachers had the experience of remote teaching during the pandemic.

Indeed, the pandemic forced the implementation of an emergency remote teaching modality, which, by the way, should not be confused with distance education, since the latter involves very defined instructional design processes (Hodges et al., 27 March 2020). This health situation caused teachers to accelerate the uses and appropriation of ICT, hence a large number of free training courses have been created to help improve performance. However,

as Servín (August 23, 2022) explains , it is still pending to integrate ICT with pedagogy efficiently.

HEIs have seen the need to digitize many of their processes and teachers are quickly incorporating the use of technological tools to be able to teach. Despite all these changes, some of the conclusions reached by Rodríguez -Abitia *et al* . (2020) were that "the integration and use of technologies in educational systems in general, and in teaching processes in particular, is not occurring as digital agendas suggest" (p. 11).

The uncertainty in which most HEIs live demands a change in agendas and a reorientation of policies to be able to move forward. According to Cadena López and Ramos Luna (2023) , we have to rethink the substantive functions of universities such as teaching, lines of research that incorporate new methodologies, knowledge, skills and management of electronic media to teach differently. Likewise, innovate in pedagogical models, which incorporate new objectives, contents and ways of evaluating in accordance with reality and the current context. In this regard, UNESCO (2019) points out:

> With the use of new technologies, teachers assume new roles, and new pedagogies and methods are adopted for teacher training. The effective integration of ICT in the learning environment will depend on the ability of educators to structure learning in innovative ways, appropriately combine technology with pedagogy, develop social activity in the classroom, and encourage cooperation, collaborative learning. and group work. In many cases, this evolution will require new skills, different from those they already possess. The teaching competencies of the future will include the ability to devise innovative ways of using technology, in order to improve the learning environment and promote the acquisition, deepening and creation of knowledge. Teacher professional learning will be a central component of this educational improvement (p. 19) .

Current education, therefore, is in constant movement and the teaching and learning processes have been greatly impacted, especially as a result of the pandemic. Some authors had already foreseen the existing void. Bauman (2005), for example, even before the pandemic, was already talking about what is temporary, since what we use today is no longer useful tomorrow. We see this with ICT, since newer applications are emerging that make teaching easier and more attractive, which makes it difficult to always be up to date.

Even so, we must not lose sight of the objectives of education so that the student demonstrates appropriation of knowledge, skills, attitudes and values.

From the Recrea vision of the Government of the State of Jalisco in Mexico (2022) , one of the positions on which we base our work is the use of technology to help solve problems and improve coexistence in the community. In the case of education, its use in the classroom must translate into achieving quality learning so that the individual learns to be a better human being.

The study of the use and appropriation of ICT is a topic that has already been studied by several authors - including Aparicio Gómez (2019), Martínez -Domínguez , (2020) and Meza and García-Quintero (2018) - and will continue to be studied by be a topic in constant evolution and because it is linked to changes in the social and economic environment.

Therefore, what motivated this research was the need to update studies in relation to the uses and appropriation of ICT by teachers, especially as a result of the pandemic. In the words of the teachers themselves, there are problems with the training offered by universities, especially considering the very complex scenarios and the needs of the new generations of students.

A study carried out by Claro (2010) for the Economic Commission for Latin America and the Caribbean (ECLAC) identified that teachers who make greater use of ICT improve the academic performance of their students. Although it should be noted that technologies alone do not have any effect, as they must be incorporated into didactic planning. Indeed, the incorporation of technology in education helps in addressing and solving the problems that arise in the classroom, motivating and qualifying the teacher to a greater extent; Therefore, their uses must be evaluated to identify their effectiveness and enhance them.

Some questions that we consider fundamental for reflection are the following: what is the role that technology has in teaching? What technology-related learning needs do teachers have? What characteristics do teachers who use and appropriate ICT have? What skills enhance or inhibit the use of ICT in teachers? What factors are associated with the use of ICT? Are there differences by age groups, gender, educational level, teaching experience and academic training regarding their degree and use of ICT? How have teachers incorporated the use of ICT into teaching practice? To what degree did ICT use increase post-pandemic? What are the ICT most used by teachers? How do you choose the ICT you use? Do you agree to its use? What public policy actions could be considered to develop teachers' skills in the use of ICT? How often do teachers use ICT? What are the main motivations for

using them? Since when did you start using them during your classes? How much did the emergence of the Covid-19 pandemic accelerate its use? We could summarize all of these in a general one: how do we explain the use and appropriation of ICT in higher education teachers?

Having explained the above, the objective of this document was to evaluate the use and appropriation of ICT in higher education teachers. Through the construction of indicators and indices we will show and identify in a diagnostic way the needs that teachers have so that HEIs can design support and training programs, and thereby improve quality and innovation in teaching and learning.

As a hypothesis, we believe that teachers resist the use of ICT and its incorporation into their lesson plan. Their lack of willingness would have to do with ignorance, as well as differences in age, gender and years of experience, which would translate into low levels of use and appropriation.

Regarding the technological context in Mexico, according to the National Survey on Availability and Use of Information Technologies in Homes (ENDUTIH) (Inegi, 2022), 76.2% of homes in Mexico have an internet connection. Of Internet users, the following stand out: 93.8% use it to communicate, 90.6% to access social networks, 89.6% for entertainment, 89.3% search for information, 83.3% to support training or education, and 79.5% to access audiovisual content.

Regarding internet users in Mexico, according to the MX Internet Association (2023) , in 2022 there were 96.87 million internet users (80.8% of the population aged 6 years or older): 49% are women and 51 % men. 80.80% use the internet to access social networks. The most used are WhatsApp, Facebook, Instagram with 95.6%, 84.9%, and 76.2%, respectively. They use them to stay informed (77%), connect with friends and family (76.8%), and consume entertaining content (62.6%). 57% of internet users have used artificial intelligence, and 55% consider it very useful as a tool.

The benefits of a digital transformation in HEIs for students, according to the National Association of Universities and Higher Education Institutions (ANUIES) (2021), translate into better learning experiences that are very consistent with their context and daily reality, since that they have at their disposal different technological devices with various applications. In addition, technology supports and develops their synthesis and collaboration skills with uses of various platforms and increases access to knowledge.

On the other hand, according to ANUIES (2021), the incorporation of new learning models that highlight the use of ICT in HEIs in Mexico are e *-learning* (100%), which focuses on people who work and they cannot travel to their study center. Likewise, *active learning* (31%), instructional approach in which all students participate in the learning process; *b-learning* (26%), blended learning of materials and online interaction opportunities with traditional methods and physical presence of the teacher and student ; *badges to accredits learning (5%), digital learning* tracking badges/shields that serve to recognize the achievement of skills, specific achievements of the student during their teaching-learning process through an online platform; *adaptive leaning* (4%), use of computer algorithms and artificial intelligence to orchestrate the interaction with the student; *m- learning* (3%), educational strategy that takes advantage of internet content through mobile phones; *learning analytics* (1%), form of transformation of impact and results metrics in learning environments so that HEIs can develop new teaching-learning models .

Each of these models has been incorporated into the HEIs according to the context, needs and available resources. This means that the development and implementation of these complementary approaches to the traditional learning model are still incipient in their development, with the exception of *e-learning*, which practically all HEIs in Mexico have already incorporated due to the covid-19 pandemic.

Despite the health emergency, the HEIs sustained the digitalization processes with the extraordinary management of an equally extraordinary situation, adapting processes and actions. Due to this, we must reflect on the need to reformulate many of the paradigms of being and acting of higher education to assume the changes and meditate on the need to reformulate the educational system, that is, design or update models of operation and governance (ANUIES, 2021).

Finally, inequality in access to higher education has not been eliminated with the virtualization of teaching, since in less developed countries dropout rates have increased due to problems with access to the network or lack of financial resources to acquire or maintain electronic devices that support remote teaching.

Methodology

The present study was descriptive, with a quantitative method. The Saber-TIC survey was used as a starting point, which considers five dimensions: 1) technological (knowledge, use and innovation), 2) pedagogical/didactic (planning, implementation and self-management), 3) social, ethical and legal, 4) curricular management and self-management, and 5) attitudinal, perceptions, disposition and participation, which was validated and tested by the researchers. Specifically, we sought to reflect on the role of the teacher (Taquez *et al* ., 2017).

To this end, a survey-type questionnaire was applied to 100 professors (25% of the total) at the higher level at a private university in the metropolitan area of Guadalajara, Jalisco, Mexico. This was created and sent to the participants through Google Form during the last semester of 2022. The calculations were carried out in SPSS, version 23, and were complemented with Excel.

It is essential to comment that other questions were added to the Saber-TIC survey related to the motivations and intensity of use of ICT since the appearance of the pandemic.

Figures 1, 2 and 3 show the classification of the levels: beginner, medium and expert, and the weighting of the score given by the teachers to the 25 items in table 1 is observed.

To construct the indicators, section 3, chapter 2, of the book *Methodology of Quantitative Social Research* by López and Fachelli (2016) was used. The questions were presented on a Likert scale with five response options. Likewise, the frequency was calculated and in order of importance it was multiplied by 100, 75, 50, 25 and 0, respectively. Finally, it was divided by the sum of the total proportions obtained.

Indicator data were evaluated on a scale from 0 to 100. A score closer to 100 indicates greater use and appropriation of technological tools. When the indicator is between 1 and 50, it is considered low, while between 50.1 and 80 it is classified as medium level. Finally, when the indicator is between 80.1 and 100, it is considered a high level.

Teachers who have obtained indicators above 80 are characterized by acceptable use and appropriation of ICT, although they are recommended to stay updated. Those who obtained scores between 60 and 80 need to improve their use of technologies and should selectively enroll in training programs that fit the needs of their teaching, subject, and disciplinary field. On the other hand, teachers whose indicators are below 60 urgently need to enroll in training courses to strengthen their digital skills. In this sense, institutions must

provide the necessary means and resources to support these teachers in their digital development.

Formula to calculate the indicators (López and Fachelli, 2016):

$$\frac{100P1 + 75P2 + 50P3 + 25P4 + 0P5}{P1 + P2 + P3 + P4 + P5}$$

To construct the general index of use and appropriation of ICT, the degree, frequency and conformity indices were added and divided by three. Regarding the construction of the indices, the indicators of each category are added and divided by the total indicators of the category.

$$\frac{indicador\ 1 + indicador\ 2 + \cdots + indicador\ 3}{número\ de\ indicadores}$$

To construct the general index of use and appropriation of ICT, the indexes of each category are added and the number of categories is divided (in our case 3).

$$\frac{índice\ 1 + índice\ 2 + \cdots + índice\ 3}{número\ de\ categorías}$$

Results

55% of the participants are men and 45% women. The average age is 50.60 years (between 27 and 72 years old), 20% are *millennials*, 59% are generation X and 21% *are baby boomers*. 88% have experience of more than 5 years in teaching.

In Figure 1, we can notice that female teachers are more expert than male teachers in the degree to which they use ICT.

Figure 1. Use of ICT by gender
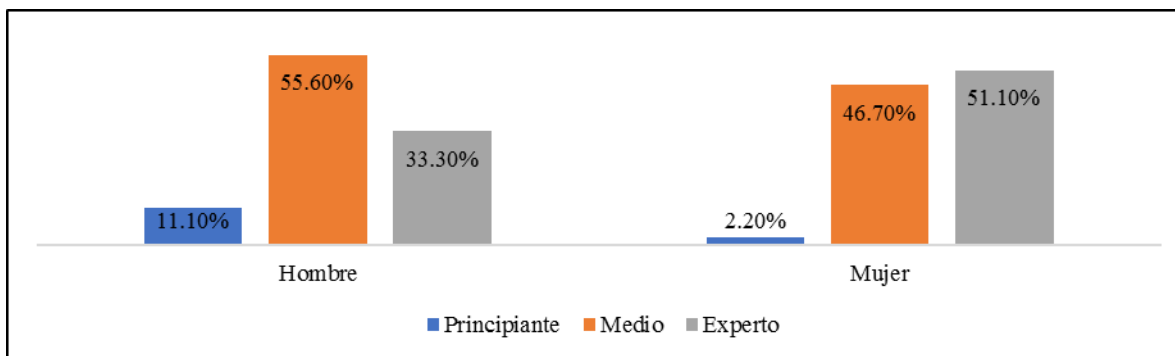
Source: self made. Note: Pearson's chi square is significant at the 5% level.

Teachers who belong to generation *millennials* (1980-2000) and *baby boomers* (1944-1964). One explanation is that *millennials* , although they were born with the Internet (Prensky, 2001) , have little experience teaching classes, given that they are incorporated into the academy. While *baby boomers* are a generation that is already on its way out and are only interested in the most basic tools to continue remaining active.
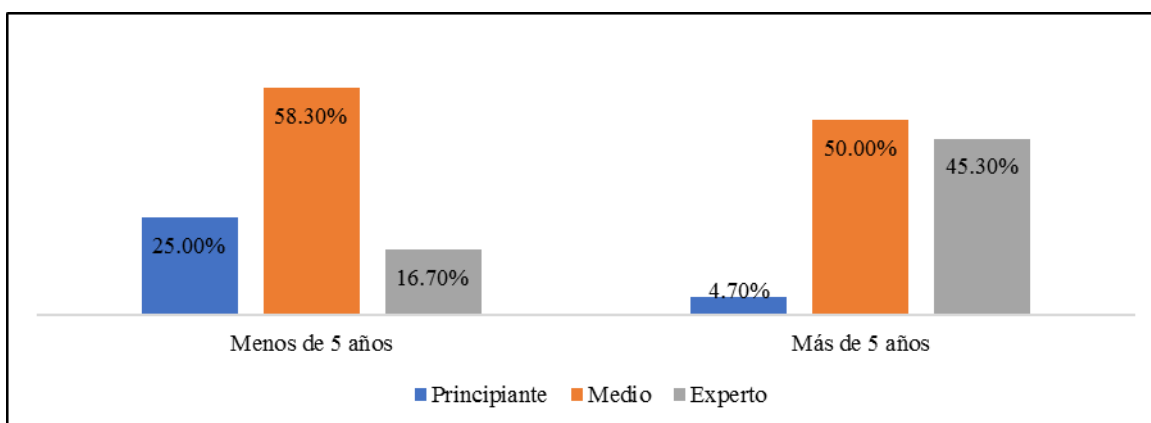
Figure 2. ICT use by generation
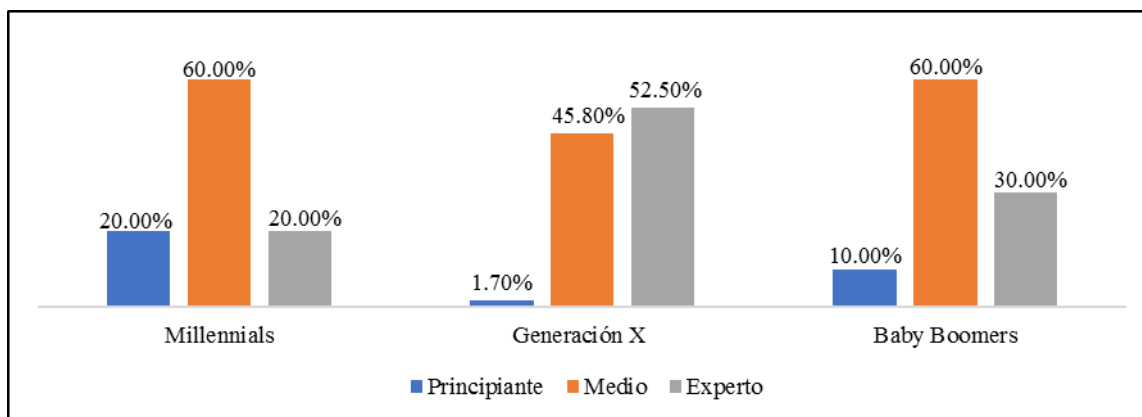
Source: self made

In Figure 3, we observe that teachers with more than five years of teaching experience are more experts than those who are joining.

Figure 3. Use of ICT due to experience in teaching

Source: self made

Indicators and indices of use of technological tools

The index of the category *degree of use of ICT* was 60.72 (valued between 1 to 100), which indicates that its use and appropriation must be improved. Of the 25 indicators evaluated in this category, seven obtained an expert level, seven average levels and 11 a beginner level (see table 1).

Likewise, high levels are evident in information search tools (93.4%), office tools (93%), email (92%), learning management platforms (88.2%), forums (84%), chats (82.2%) and spaces to manage digital files (80.8%). Even tools evaluated at a medium level such as video conferencing (78.6%) and audiovisual content platforms (77.4%) are significant.

What catches our attention is that 11 of the 25 technological tools mentioned have a low level of use and appropriation. For example, content management systems (49.2%), screen capture tools (48.8%), note organization tools (47.6%), image editors (42.2%), font management and review tools citations (38%), video editors (37.8%), social bookmarking (37.8%), RSS readers (35.6%), real-time response systems (34.8%), audio editors (30%).

On the other hand, we are concerned about coincidence detection tools (25.6%) due to the great amount and ease that students have to plagiarize information from the Internet, especially considering that students have positive attitudes towards plagiarism (80 %) (Hernández Moreno and Moreno Reyes , 2023) . Furthermore, with the emergence of *chatbots* it is very easy to plagiarize. This means that *software* like Turnitin and others have to evolve, as they still show deficiencies in relation to artificial intelligence (Díaz Arce, 2023) .

The above leads us to rethink, update and train teachers in new ways to detect plagiarism, accompanied by dissemination and sanction processes.

Table 1. Degree of use of ICT

No.	Indicator (%)	Technological tool	Level of use
1	93.4	Information search tools (Google, Yahoo, Academic Databases, etc.)	Expert
2	93	Tools office automation (Word, Excel, Powerpoint, Google Docs, Openoffice ...)	Expert
3	92	Email (Gmail, Office 365, Yahoo, etc.)	Expert
4	88.2	Learning management platforms (Moodle, Blackboard, Sakai, Google Classroom, Teams, etc.)	Expert
5	84	Forums (Moodle, Google groups, etc.)	Expert
6	82.2	Chat (Whatsapp, Facebook Messenger, etc.)	Expert
7	80.8	Digital file management spaces (Dropbox, Google Drive, OneDrive, etc.)	Expert
8	78.6	Video conference (Skype, Hangouts, Zoom, Teams, etc.)	Half
9	77.4	Audiovisual content platforms (YouTube, TED, Vimeo, Souncloud, etc.)	Half
10	68	Institutional repositories (Merlot, Icesi Digital Library, Moodle, etc.)	Half
11	66.8	Quiz creation tools (Google Forms, Surveymonkey, PollDaddy, etc.)	Half
12	65.6	Social networks (Facebook, Twitter, Google+, Instagram, Linkedin, etc.)	Half
13	65	Content creation tools (Prezi, Office Mix, Powtoon, etc.)	Half
14	56.2	Collaborative network work tools (Blogs, Wikis, Google Suite, etc.)	Half
15	49.2	Content management systems (Google Sites, Wix, Wordpress, Blogger, Joomla, etc.)	Beginner
16	48.8	Screenshot tools (Camtasia, Screencastomatic, etc.)	Beginner
17	47.6	Note organization tools (Google Keep, Onenote, Evernote, etc.)	Beginner
18	42.2	Image editors (Photoshop, Gimp, etc.)	Beginner

19	38	Source management and citation review tools (Mendeley, Endnote, Zotero, etc.)	Beginner
20	37.8	Video editors (Windows Movie Maker, Imovie, Adobe Premiere, etc.)	Beginner
21	37.4	Social bookmarks (Pinterest, Scoop.it, Tumblr, Diigo, Pocket, etc.)	Beginner
22	35.6	RSS readers (Flipboard, Feedly, Apple Podcasts, RSS Owl, Sage, etc.)	Beginner
23	34.8	Real-time response systems (Turning Point, Learning Catalytics, Socrative, Kahoot, etc.)	Beginner
24	30	Audio editors (Audacity, Wavepad, etc.)	Beginner
25	25.6	Match detection tools (Turnitin, Safe assignment, Plagiarism, etc.)	Beginner

Source: Own calculations made taking as reference the technological tools used in the know-ICT survey (Taquez *et al* ., 2017) .

The efforts and frequency of the actions carried out by teachers to make use of ICT (mentioned in table 1) are reflected in table 2, where of the 23 indicators valued in this category, 14 were located in one expert level and nine at a medium level, that is, none at a beginner level. This shows that teachers have all the disposition and adaptation to increase use and appropriation.

Regarding the index of the category *frequency of use of ICT,* this was 79.87, which indicates that the frequency of the actions carried out by teachers when using ICT is acceptable. That is, they inform themselves and carry out tests to ensure their usefulness (87.7%) and they assess the possibility of students' access to the selected technological resources in a way that is equitable (86.7%).

Furthermore, when required, they adapt the resources offered by ICT to achieve class objectives and meet the needs and expectations of the students (86%), and when they plan their classes they define which ICT they can use (85.2%). Likewise, they take into account students' suggestions regarding the use of ICT in classes (84.2%), and they use ICT in different activities of the learning process in their courses (84%).

On the other hand, teachers value the skills, attitudes and cultural capital of their students before implementing ICT (83.5%). Furthermore, when they use them, they do so to facilitate planning and implementation processes of projects in the classroom and at the

university (83.5%), identify the learning objectives, needs and expectations of their students to decide which are the most appropriate ICT (82%), reflect on the benefits and/or difficulties that the use of ICT implies in the students' learning processes (82%), plan their classes and seek information on the way in which the use of ICT can improve them (81.5%), include in their classes those technological resources that have worked well for other teachers (81.25%), and use ICT in the design of strategies that promote active learning and the comprehensive training of students (80.5%).

Table 2. ICT use frequency indicators

No.	Indicator (%)	Actions done	Level of use
1	87.7	Before using any ICT resource in class, you are informed and tested to ensure its usefulness.	Expert
2	86.7	When proposing activities that use ICT, assess the possibility of students' access to the selected technological resources, so that it is equitable.	Expert
3	86	When required, adapts the resources offered by ICT to achieve class objectives and meet the needs and expectations of students.	Expert
4	85.2	When you plan classes you define which ICT you can use.	Expert
5	84.2	Takes into account students' suggestions regarding the use of ICT in classes.	Expert
6	84	Uses ICT in different activities of the learning process in their courses.	Expert
7	83.5	It assesses the skills, attitudes and cultural capital of its students before implementing activities that involve the use of ICT in classes.	Expert
8	83.5	It uses ICT to facilitate project planning and implementation processes in the classroom and at the university.	Expert
9	82	Identify the learning objectives, needs and expectations of your students to decide which are the most appropriate ICT to use in class.	Expert

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10	82	Uses ICT in different activities of the evaluation process in their courses.	Expert
11	82	Reflect on the benefits and/or difficulties involved in the use of ICT in students' learning processes.	Expert
12	81.5	When planning your lessons, you look for information on how the use of ICT can improve them.	Expert
13	81.25	Include in your classes those technological resources that have worked well for other teachers.	Expert
14	80.5	Use ICT in the design of strategies that promote active learning and the comprehensive training of students.	Expert
15	79.75	He is constantly searching for new spaces and new ways in which he can implement ICT in the teaching and learning processes.	Half
16	79	Uses ICT to provide advice and resolve situations outside of class.	Half
17	76.5	When carrying out ICT-mediated activities, include reflections to promote their respectful use and avoid harmful behavior (example: *cyberbullying*).	Half
18	73.5	Use ICT to help/teach citing sources and preventing plagiarism.	Half
19	73.5	Reflect with your students on the advantages and disadvantages of the new forms of socialization promoted by ICT. Exchange with other teachers your reflections, experiences and resources on the use of ICT.	Half
20	73.25	Analyzes, participates in or promotes educational policies for the responsible use of ICT at the university (example: respect for privacy, copyright, environmental impact, etc.).	Half
21	73	Promotes the use of technological resources for the classroom among colleagues.	Half
22	72.2	Promotes the use of technological resources outside the classroom among colleagues.	Half
23	66	Participates in work networks that promote the integration of ICT in the planning, development and evaluation of their classes.	Half

Source: Own calculations carried out taking as reference the technological tools used in the know-ICT survey (Taquez *et al* ., 2017)

On the other hand, the index of the *conformity category in the use of ICT* was 87.5, which shows a quite acceptable level. In 16 of the 17 indicators assessed, the level of agreement was expert (see table 3). This means that there is no resistance regarding the benefits represented by the incorporation of ICT. Teachers agree that the use of ICT in their teaching activities favors the dissemination of educational projects (91.25%), encourages the development of educational projects that stimulate self-learning (90.75%), and promote the production of knowledge (89.75%). Likewise, they facilitate self-evaluation and improvement of teaching activity (89.25%), research activities with students (89%) and the generation of innovative educational strategies (88.75%).

Its use allows personal monitoring and timely feedback to students (88.25%), the exemplification or illustration through ICT of course concepts (88%), and increases the skills to search, select and manage information available on the Internet (87.5%). In addition, they support collective knowledge construction activities in networks and learning communities (87.5%), they clarify the goals to be achieved in teaching activities (87.5%), they are fundamental in professional work and development (87.25%), and they facilitate the analysis of students' academic performance (85.5%) because they have a better disposition for learning. Finally, they are fundamental for lifelong learning (85.25%), and students have a better disposition for learning (84%). Ultimately, they find it easy to implement them in their course (79%)

Table 3. Compliance indicators in the use of ICT

No.	Indicator (%)	Affirmations	Level of use
1	91.25	ICT favors the dissemination of educational projects.	Expert
2	90.75	ICT favors the development of educational projects that promote self-learning.	Expert
3	89.75	ICT favors the development of educational projects that promote the production of knowledge.	Expert
4	89.25	ICT facilitates self-assessment of teaching activity.	Expert
5	89	ICT favors the development of research activities with students.	Expert
6	89	ICT facilitates the improvement of teaching activity.	Expert
7	88.75	ICT facilitates the generation of innovative educational strategies.	Expert
8	88.25	ICT facilitates the personal and detailed monitoring of each student in my class. The use of ICT makes it easier for me to offer timely feedback to students.	Expert
9	88	There are concepts from my courses that can be exemplified or illustrated through ICT.	Expert
10	87.5	I have sufficient skills to search, select and manage information available on the Internet.	Expert
11	87.5	ICTs are essential support in collective knowledge construction activities in networks and learning communities.	Expert
12	87.5	I am clear about the goals I want to achieve regarding the use of ICT in my teaching work.	Expert
13	87.25	I consider that the use of ICT is fundamental in teaching work and professional development.	Expert
14	85.5	ICT facilitates the analysis of students' academic performance.	Expert
15	85.25	ICT is essential for lifelong learning.	Expert
16	84	By integrating ICT into my classes, students have a better disposition for learning.	Expert
17	79	Implementing ICT in my course program is easy.	Half

Source: Own calculations carried out taking as reference the technological tools used in the know-ICT survey (Taquez *et al* ., 2017)

Finally, the calculation of the general index of the level of use and appropriation of ICT was 76.03, which indicates that the teacher has a medium level in the use and appropriation of ICT. This means that they know many of them and use and integrate them into their classes, and they have become experts in implementing a large number of them. In short, they use them frequently and feel satisfied incorporating them into their teaching practice. In this regard, Ramírez (2009) points out:

> The university professor has knowledge and skills in managing information and communication technologies. Know the pedagogical and communicational qualities of technological tools to apply them in the creation of learning environments of different educational modalities (p. 15) .

Teachers show willingness and are open to continue learning and incorporating ICT in teaching, as they are innovators on their own initiative. Even so, institutions will have the task of evaluating the mastery, use and appropriation of ICT in each of their teachers to identify their level and follow up on those who show beginner levels.

Discussion

Authors such as Del Prete and Cabero Almenara (2020) had already pointed out the decrease in the digital gender gap, which previously affected women teachers. In fact, our study reveals that female teachers have acquired a higher level of expertise in the use and appropriation of ICT compared to male teachers. In other words, they have overcome them and now feel empowered in their use.

On the other hand, Pinto *et al* . (2022) found that younger teachers possess a broader set of digital competencies, implying greater knowledge, superior skills, and more favorable attitudes compared to older teachers. In our case, we have observed differences, but based on generation. Generation X teachers exhibit a higher degree of competence in the use of ICT compared to *millennials* and *baby boomers.* In this regard, we share the conclusion of Blanc Pihauve and León Rodríguez (2018) about the existence of generational digital gaps between Generation X teachers and the generations of *millennials* and *baby boomers.* This reveals differences in the degree of use of ICT, which suggests the existence of an important generational digital divide, especially to connect with students who frequently use technology.

On the other hand, according to the results, it can be stated that teachers have intermediate digital skills, which allows them to join mixed and even online teaching modalities. On this point, we agree with Díaz *et al.* (2021), since a solid command of ICT is required to be able to face situations such as those experienced during the covid-19 pandemic and continue with the teaching work. However, it is essential that they are trained in the use of a greater variety of tools appropriate for the subjects they teach, especially for younger and older teachers. Your knowledge in the field of ICT will be an added value in your teaching work.

Authors such as Alarcón *et al.* (2019) have used the ICT-knowledge questionnaire and, like us, have come to the conclusion that the use of ICT is of vital importance as a dynamic pedagogical strategy and to strengthen the teaching-learning processes. However, in our opinion, insisting on its application or abusing its use could have counterproductive effects. Therefore, we firmly believe that, to incorporate ICT effectively in teaching, it is necessary to have a complete mastery of these tools and their planned integration, so that improvisation is avoided and they are always considered as a complement to achieve the objectives. teaching objectives. Otherwise, students might focus more on fun and entertainment than on achieving educational goals.

In this sense, keep in mind that the use of technology should facilitate teaching instead of adding an additional burden or generating stress for teachers. Otherwise, its implementation is meaningless.

On the other hand, the evidence collected shows the needs of teachers in terms of technological skills, pedagogical competencies, attitude towards technology and management, which provides a solid basis for designing training and training plans. Consequently, and as Freixas *et al warn.* (2022), it cannot be assumed that the fact that teachers master ICT will ensure that they can implement it effectively in their classes. Although we found willingness on the part of teachers, we believe that incentives are needed to encourage their interest, since the effective integration of technology requires an additional investment of time to identify relevant technological resources for each subject.

For all of the above, we agree with Sangrà *et al.* (2023) on the importance of teachers improving their digital skills to be able to more effectively use technological devices and tools in the context of digital education. This is essential to develop and implement new educational methodologies based on technology.

The Covid-19 pandemic marked a significant turning point, as the use of ICT increased and the benefits of technology in education were highlighted. However, it was also clear that the lack of mastery and adequate training has negative consequences and can lead to demotivation of both teachers and students.

In this regard, our results indicate that teachers mainly use basic tools, such as search engines, office suites, emails, learning management platforms, forums, chats and file management systems. To reach more advanced levels of use, it is essential that institutions implement training processes, and that teachers commit and actively participate in them.

In another order of ideas, we identify primary needs in areas such as content management systems, screen capture tools, note organization, image, video and audio editors, as well as information management and administration tools, social bookmarks, readers RSS and real-time response systems.

Finally, compared to Pinto *et al.* (2022), who found that teachers' digital skills were at beginner and medium levels, our results reflect a medium level of digital skills. Even so, we agree on the importance of incorporating training processes focused and directly applied to teaching and learning into the institutional agenda.

Conclusions

The results achieved in this research allow us to conclude that the teachers participating in the study do not resist the use of ICT and show a great willingness to incorporate them into their teaching practice, although they are unaware of some of them. Furthermore, although differences were found in age, gender and years of experience, these factors are not determining factors for its resistance, since both men and women and young and adult teachers (with little or several years of experience) show a good attitude towards its use. However, it is worth noting that female teachers use them more than male teachers.

On the other hand, teachers are convinced of the benefits of ICT, which is why they use them as pedagogical strategies and resources, considering the needs of the students and the learning objectives of the subject. Simply put, the barrier and fear that used to exist regarding its use has been overcome.

Now, to improve the level of use of ICT, it is enough to provide them with training plans in new technologies that allow them to incorporate them into their teaching plans. Over time, they can become experts in the use of these technologies, which in turn will positively impact quality and innovation in teaching and learning.

Likewise, it is important to reflect on the impact and significance of the incorporation of ICT in higher education without being easily captivated by its use and taking into account those cases where it has been shown that they have worked. It is also essential to consider the opinions and needs of students, learn from the successful practices of other colleagues, and stay abreast of new technological tools that constantly emerge.

The indicators and indices developed in this study may be useful for other higher education institutions that wish to quickly and easily evaluate the use and appropriation of ICT by their teachers. These results can help focus and enhance institutional policies, as well as reorient objectives.

Therefore, it is recommended to implement a training plan for both teachers and students, aligned with the institutional strategy and adapted to current circumstances. This will ensure continuous integration of ICT into the curricula. In short, it can be assured that the use of these resources has empowered teachers, which has had a positive impact on their work. They are now able to improve their teaching practice and, consequently, raise the quality of teaching through innovation.

Future Future lines of research

Some future lines of research have to do with the study of the skills that enhance or inhibit the use of ICT in teachers, as well as their impact on students. This would allow us to identify useful elements to design and implement pedagogical strategies in institutions.

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