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Digital Teaching Competence in Higher Education: Exploratory Study on Patterns of Use and Selection Criteria of ICT

Competencia digital docente en educación superior: estudio exploratorio sobre patrones de uso y selección de TIC

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Palabras clave: alfabetización informática; profesión docente; enseñanza superior; tecnología de la educación; tecnología de la información.

Abstract

This study examines digital teaching competence (DTC) at the University of Cuenca through a concurrent mixed-methods design aimed at understanding teachers' self-perception of their technological competence level and their practices for selecting and using digital tools in teaching. The problem focuses on the gap between institutional diagnostics and the actual integration of technologies in the classroom. Surveys based on the technological subscale of the Information and Communication Technologies (ICT) Competence Pentagon (n = 110) and semi-structured interviews (n = 18) were applied, triangulating qualitative and quantitative data. Results show that DTC self-perception falls within a medium–high level, with no significant associations with sociodemographic variables (age, gender, years of teaching); in contrast, ICT training and frequency of use present significant differences. Qualitative analysis reveals three progressive patterns of use (basic, intermediate, and advanced) and three types of selection criteria (common, specific, and emerging), demonstrating that technological integration depends both on technical proficiency and on the pedagogical and ethical evaluation of tools. The study concludes that DTC development is linked to continuous training and habitual practice, requiring institutional policies to strengthen teacher development, infrastructure, and ethical dimensions related to artificial intelligence (AI). It is recommended to consolidate permanent training programs aligned with international standards.

Keywords: computer literacy; teaching profession; higher education; educational technology; information technology.

Resumen

Este estudio analiza la competencia digital docente (CDD) en la Universidad de Cuenca mediante un diseño mixto de tipo concurrente, con el propósito de comprender la autopercepción de los y las docentes sobre su nivel de competencia tecnológica y sus prácticas de selección y uso de herramientas digitales en la enseñanza. El problema se enfoca en la brecha entre los diagnósticos institucionales y la integración real de tecnologías en el aula. Se aplicaron encuestas basadas en la subescala tecnológica del Pentágono de Competencias de Tecnologías de la Información y la Comunicación (TIC) (n = 110) y entrevistas

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semiestructuradas (n = 18), triangulando datos cualitativos y cuantitativos. Los resultados muestran que la autopercepción de CDD se sitúa en un nivel medio-alto, sin asociaciones significativas con variables sociodemográficas (edad, sexo, años de docencia); en contraste, la formación en TIC y la frecuencia de uso sí presentan diferencias significativas. El análisis cualitativo revela tres patrones progresivos de uso (básico, intermedio y avanzado) y tres tipos de criterios de selección (comunes, específicos y emergentes), evidenciando que la integración tecnológica depende tanto del dominio técnico como de la evaluación pedagógica y ética de las herramientas. Se concluye que el desarrollo de la CDD se vincula a la formación continua y a la práctica habitual, exigiendo políticas institucionales para fortalecer la capacitación, infraestructura y dimensiones éticas ligadas a la inteligencia artificial (IA). Se recomienda consolidar programas de formación permanente alineados con estándares internacionales.

Palabras clave: alfabetización informática; profesión docente; enseñanza superior; tecnología de la educación; tecnología de la información.

Introduction

Teachers' digital competence (TDC) in higher education is essential to ensure quality and flexibility in face-to-face, digital and distance learning. The effective integration of these competencies with Information and Communication Technologies (ICT) is an essential component of educational quality, as their absence limits pedagogical innovation and the response to the demands of the digital environment (Basilotta-Gómez-Pablos et al., 2022; Olmedo-Falconí et al., 2025). ICT literacy is defined as the integration of knowledge, skills and attitudes that enable the relevant, responsible and effective application of ICT (Barbazán et al., 2021; Ghomi and Redecker, 2019). It also involves selecting and using technological resources appropriately to contribute to learning with ethical standards and academic rigour (Velásquez and Batista, 2022).

UNESCO (2019) states that teachers must develop digital skills for both face-to-face and virtual learning environments, thereby promoting active student participation (Redecker and Punie, 2017). Recently, CDD has gained prominence in scientific output (Cisneros et al., 2023; Martínez-Márquez et al., 2025; Palacios-Rodríguez et al., 2024; Paladines et al., 2024). This surge, evidenced bibliometrically by De la Cruz Campos et al. (2023), reflects the growth in publications, driven by the forced digital transition following the COVID-19 pandemic. However, Olmedo-Falconí et al. (2025) caution that this progress should not be limited to the instrumental domain, but should instead involve a pedagogical transformation that bridges the gap between technological availability and critical application.

Likewise, García-Correa et al. (2025) emphasise the need for validated training programmes in ethics and security, whilst Aznar-Díaz et al. (2025) point out that sociodemographic factors and prior training influence the level of digital literacy. Finally, Cabero-Almenara et al. (2023) emphasise that the value of ICT lies in its pedagogical use to foster flexible and interactive processes among students. These arguments are supported by learning theories, explaining how these tools facilitate various educational approaches (Coll et al., 2008; Rubio and Jiménez, 2021; Tejeda et al., 2022). Within this framework, continuing professional development is central to strengthening CDD (Tang, 2021), alongside sustained institutional policies and innovative programmes (Revuelta-Domínguez et al., 2022).

The literature reports various models to explain CDD, evolving from instrumental to transformative perspectives (Fernández, 2003; Kabakçi, 2009). Although international frameworks such as DigComp (Ferrari, 2012) and ISTE (2017) are global benchmarks for systematising levels of proficiency, this study adopts the model of the Colombian Ministry of National Education (MEN, 2013) as its central focus. This choice is justified by its contextual relevance to Latin America and its direct alignment with the Pentágono de Competencias instrument, which operationalises the measured variable across the levels of exploration, integration and innovation.

To strengthen the analysis, this framework is aligned with UNESCO guidelines (2019) and the DigComp model, allowing for a hybrid interpretation that links the MEN's multidimensional structure with international standards of innovation. This integration ensures coherence between the theoretical framework, the empirical operationalisation and the subsequent discussion of findings.

With regard to the level of CDD, the evidence suggests that the integration of ICT depends on the training received and daily practice, rather than on sociodemographic characteristics such as gender, age or years of teaching (Cabezas et al., 2021; Vásquez-Peñafiel et al., 2023). Similarly, Basilotta-Gómez-Pablos et al. (2022) found a predominance of basic technological skills, highlighting the relevance of regulatory frameworks in teacher

training, as well as persistent shortcomings in content creation and problem-solving (technical mastery–pedagogical application). The study concludes that there is an urgent need to move towards models of effective curricular integration, reinforcing the need to explore how teachers select and use tools in their practice. In Ecuador, a predominance of traditional tools (PowerPoint, PDF) was reported, indicating limited adoption of emerging and innovative technologies for teaching (Paladines et al., 2024).

Recent literature has focused on self-perception, sociodemographic factors and training proposals (Aznar-Díaz et al., 2025; De la Cruz Campos et al., 2023; García-Correa et al., 2025). However, there remains a gap regarding how institutional assessments relate to actual practices in the selection and use of tools in the classroom, which hinders an understanding of the pedagogical application of these skills in real teaching contexts.

From this perspective, the University of Cuenca provides an ideal setting for exploring this gap, as, despite its assessment framework (the Competence Pentagon), there is a disparity between institutional standards and day-to-day practice. This study contributes to the triangulation of digital competence with selection criteria and usage patterns, transcending the static nature of self-perception and offering empirical evidence on the mechanics of technology transfer, which is fundamental for configuring hybrid and distance learning scenarios.

Thus, the following questions are posed: How do teachers self-assess their digital competence? What relationship exists between the level of digital competence and sociodemographic factors such as age, years of teaching experience and ICT training? What are their usage practices? And what criteria do they consider relevant when selecting digital tools?

Furthermore, the following hypotheses are proposed: (H1) self-perceived DLC is predominantly at a medium-high level; (H2) there are no significant differences in DLC based on sociodemographic variables; and (H3) specific ICT training and frequency of use are positively associated with higher levels of perceived digital competence.

Thus, the study objectives are: (O1) to determine the level of self-perceived PDC using the ICT Competence Pentagon (technological competence subscale), (O2) to analyse the relationship between PDC and sociodemographic variables, (O3) to describe practices regarding the use of technological tools in teaching activities, (O4) to explore perceptions of the criteria considered relevant when selecting technological tools for teaching practice.

Methodology

Design

This study adopts a concurrent mixed-methods approach, collecting and analysing quantitative and qualitative data in parallel to triangulate results and provide a comprehensive view of the phenomenon (Creswell and Plano Clark, 2018). It has an exploratory-descriptive scope (Hernández-Sampieri and Mendoza, 2018), seeking to detail the practices of selection and use of technological tools by teachers at the University of Cuenca. Furthermore, it incorporates analyses of differences between groups and correlation analyses, examining statistical associations between the level of self-perceived digital competence and variables such as ICT training, frequency of digital technology use, age and years of teaching experience. This study focuses on exploring the phenomenon, providing initial evidence on patterns and criteria for the selection of ICT in university teaching.

Participants

The population consisted of the teaching staff at the University of Cuenca (N = 1098). Non-probabilistic convenience sampling (n = 110) was employed, justified by the availability of participants and the exploratory nature of the study (Hernández-Sampieri and Mendoza, 2018; Otzen and Manterola, 2017). The inclusion criteria comprised tenured lecturers from eight faculties (Medicine, Dentistry, Arts, Agronomy, Economics, Law, Engineering and Philosophy), excluding staff without an active contractual relationship. This sample represents 10% of the population, a proportion that allowed for heterogeneous participation and sufficient disciplinary diversity to identify trends and patterns of CDD.

For the qualitative phase, a subsample of 18 participants was selected using purposive sampling for maximum variation (Creswell and Plano Clark, 2018), taking into account disciplinary diversity, thereby enabling the collection of diverse perspectives from different fields of knowledge and enriching our understanding of patterns

of ICT use. The size of this subsample was determined based on the principle of theoretical saturation, the point at which the interviews ceased to yield substantial emerging categories for the analysis (Saunders et al., 2018). Tables 1 and 2 present the sample distribution and descriptive statistics for the sociodemographic variables, respectively.

Table 1

Sociodemographic characteristics of the participants

Variable	Category	N	%
Gender	Male	62	56.4%
	Female	48	43.6%
Faculty	Agronomy	15	13.6%
	Arts	11	10.0%
	Law	9	8.2%
	Economics	10	9.1%
	Engineering	10	9.1%
	Medicine	19	17.3%
	Philosophy	24	21.8%
	Dentistry	12	10.9%
ICT training	Yes	81	73.6%
	No	29	26.4%

Table 2

Descriptives: age and years of teaching

Variable	M	SD
Age	44.83	9.131
Years of teaching	11.21	7.867

Note: M = Arithmetic mean; SD = Standard deviation

Strategies and instruments

Survey

The Technological Competence Subscale of the ICT Competence Pentagon (MEN, 2013) was used, which has content validity based on expert judgement and has been extensively validated in the regional educational context. The robustness of the subscale was verified through an analysis of internal consistency, yielding a Cronbach's α coefficient of 0.935. Furthermore, the initial construct validity was confirmed through the item discrimination index (corrected item-total correlation > 0.30), ensuring that the items measure technological competence in a consistent and homogeneous manner within the sample analysed.

Interview

Semi-structured interviews were conducted to explore in depth the experiences, patterns of use and selection criteria for ICT. The interview guide was structured around seven dimensions: (a) experiences of ICT integration, (b) selection criteria, (c) ICT training (formal or informal), (d) perception of benefits and challenges, (e) specific examples of application, (f) influence of institutional policies, and (g) personal contributions.

Validation followed a four-stage sequential protocol:

(1) Initial design: Developed by the researcher, following Kvale (2011) and McCracken (1988). Although it follows a structured format, it retains 'Grand Tour' questions and *planned prompts*. This allowed the indicators of the Technological Competence subscale of the ICT Competence Pentagon (MEN, 2013) to emerge from the participant's narrative of their actual practice, avoiding induced responses and ensuring the authenticity of the identified usage patterns.

(2) AI-assisted optimisation: Through a comparative analysis using three language models (Gemini, ChatGPT, Copilot), four questions exhibiting induction bias or ambiguity were reformulated, improving teachers' capacity for spontaneous responses.

(3) External expert judgement: An expert with 26 years' experience in research methodology validated the script using a matrix of seven indicators (language, objectivity, order, intentionality, complementarity, methodology and relevance), achieving the maximum score (5/5) across all criteria. The observations enabled the standardisation of the level of formality in the approach and the elimination of subjective terms. Given the impossibility of calculating Cohen's Kappa, content validity was prioritised due to the high level of specialisation.

(4) Validation by expert judgement and key informant: The previous phase was complemented by a technical validation interview with a key informant (Director of Educational Innovation at the University of Cuenca). This procedure allowed the questionnaire to be compared with the institutional reality, ensuring the procedural rigour required by Kvale (2011). This phase functioned as a mechanism for situated reflective adjustment, compensating for the absence of a multi-expert panel through in-depth qualitative validation, focused on the instrument's relevance in the local context.

Overall, the final script was consolidated into 10 open-ended questions (reduced from an initial set of 12), achieving greater logical progression and the capacity to obtain in-depth information within the context under study.

Procedure

The data were collected by the principal investigator between October and the first two weeks of November 2025, ensuring consistency in the application of the instruments and the quality of the information gathered.

The quantitative phase consisted of administering the survey, which took an average of 7 to 10 minutes to complete. It was conducted in groups at the Faculties of Medicine, Dentistry and Philosophy (n = 55) and individually in the remaining academic units (n = 55).

The qualitative phase comprised 18 individual interviews. Due to the participants' heavy academic workload, a format of focused interviews (8 to 15 minutes) was chosen, which allowed for precise, critical and content-rich responses to be obtained, whilst respecting the working day and avoiding fatigue bias. All sessions were recorded and transcribed in full for analysis.

This study was authorised by the dean's office of each faculty, which approved the study protocol and facilitated access to the premises. Participation was voluntary. In the surveys, the return of the completed questionnaire was considered to constitute implied consent. In the interviews, verbal informed consent was obtained and recorded at the start of each recording, guaranteeing anonymity, confidentiality and the strictly academic use of the information.

Data analysis

Statistical analysis (SPSS)

Version 27 of the SPSS software (IBM) was used.

a) Univariate analysis: frequencies, percentages, means and standard deviations, to describe the general characteristics of the sample and the scores obtained in the questionnaire.
b) Bivariate analysis: non-parametric tests (Mann-Whitney *U* and Kruskal-Wallis *H*) to identify significant differences in self-perceived CDD based on sociodemographic variables. The choice of these tests was due to the ordinal nature of the Likert scale and the non-probabilistic nature of the sample.
c) Correlational analysis: *Spearman's* correlation coefficient was used to assess the relationship between self-perceived CDD and variables such as age and years of teaching experience.

The results were organised into tables to facilitate their interpretation.

Qualitative process (Atlas.ti)

An interpretative approach was employed, detailing the teachers' experiences and perceptions (Hernández et al., 2014); following an inductive method, identifying emerging patterns and constructing general categories from specific instances (Bisquerra, 1989).

The interviews were transcribed in full and subsequently segmented into units of meaning, organised into a system of categories and codes (Li and Seale, 2007; Ritchie et al., 2013), using Atlas.Ti 9 software, with the aim of identifying patterns of ICT use and selection criteria.

The analysis was conducted using open-coding and axial coding, following a thematic approach that enabled the identification of usage patterns and selection criteria.

Results

Quantitative analysis

The frequency of ICT use in teaching practice was assessed, measured on a scale of 1 to 4 (1 = Never, 4 = Always). The results indicate a high frequency of use ($M = 3.39$; $SD = 0.651$), suggesting a generalised predisposition towards the incorporation of ICT.

For digital competence, three levels were established based on the score range (minimum = 18; maximum = 90): (1) low competence (18–42), (2) moderate competence (43–67) and (3) high competence (68–90). The distribution was: 2.72%, 50% and 47.28%, respectively, indicating that the majority of teachers perceive themselves to be at a medium-high level of digital competence, with no extremes observed in the sample. Table 3 presents the descriptive statistics for CDD.

3 Table

Descriptive statistics for CDD

Descriptive		
Mean		66.78
Median		66.50
SD		13.904
Skewness		-0.140
Standard error of asymmetry		,230
Kurtosis		-1.173
Standard error of kurtosis		0.457
Minimum		38
Maximum		89
Percentiles	25	55.00
	50	66.50
	75	79.25

Subsequently, the distribution of the sociodemographic variables was assessed using the *Kolmogorov-Smirnov* and *Shapiro-Wilk* tests. In all cases, the p-values were less than 0.05, indicating a lack of normality in the three variables. Consequently, *Spearman's* correlation was used.

Table 4

Normality tests

Variable	Kolmogorov-Smirnov (p)	Shapiro-Wilk (p)
Age	,004	,021
Years of teaching	,000	,000
CDD level	,008	,001

Note: $p < .05$ indicates that the variable does not follow a normal distribution.

The results indicate that neither age nor years of teaching have a statistically significant relationship with the level of self-perceived CDD.

Table5

Spearman's correlation

CDD	rho (Spearman)	p Sig.
Age	-0.114	0.238
Years of teaching	-0.159	0.098

Note: $p < .05$ indicates statistical significance

The Mann-Whitney *U* test was applied to compare the level of CDD by gender and by ICT training.

In the first case, no statistically significant differences were found between the groups ($U = 1{,}305{,}000$, $Z = -1{,}103$, $p = 0.270$). The effect size was small ($r = -0.105$), suggesting that gender does not have a significant influence on the level of self-perceived CDD in this sample.

For the second variable, the results showed a statistically significant difference between the two groups ($U = 635.000$, $Z = -3.662$, $p < .001$). The effect size was medium ($r = -0.349$), indicating that ICT training has a significant influence on the level of self-perceived digital competence. Teachers with ICT training had a higher average score (62.16) compared to those without (36.90), indicating a higher self-assessment of their digital skills.

Table 6

Mann-Whitney U test for CDD by gender and ICT training.

Group	N	Average Rank	Sum of ranks
Male	62	58.45	3424.00
Female	48	51.69	2,481.00
With ICT training	81	62.16	5,035.00
Without ICT training	29	36.90	1070.00

The *Kruskal–Wallis* test was applied to compare the level of CDD across different faculties. The results showed no statistically significant differences between the groups, indicating that the faculty to which students belong does not have a significant influence on the level of self-perceived CDD in this sample.

Table 7

Kruskal–Wallis CDD by Faculty.

Faculty	N	Average rank
Arts	11	60.40
Agronomy	15	67.59
Economics	10	42.17
Law	9	55.60
Engineering	10	49.85
Medicine	19	47.68
Philosophy	24	60.46
Dentistry	12	55.38

Note. Test statistics: $H(7) = 5.547$, $p = .594$

Furthermore, the *Kruskal–Wallis* test was applied to compare the level of CDD according to the frequency with which they use ICT in their practice.

Table 8 shows statistically significant differences between the groups ($H(2) = 15.206$, $p < .001$). Teachers who reported always using ICT had consistently higher average scores (66.38), followed by those who used it

frequently (48.93) and occasionally (28.75), indicating a positive association between reported frequency of use and perceived level of CDD.

Table 7

Kruskal–Wallis test: frequency of use and CDD

Frequency of use	N	Average rank
Occasionally	10	28.75
Frequent	47	48.93
Always	53	66.38

Note. Test statistics: H (2) = 15.206, p < .001

In summary, the quantitative analyses indicate that the sample's self-perception of CDD leans towards the 'competent' category.

Variables such as age, years of teaching experience, gender and faculty affiliation did not show any statistically significant relationships or differences with the total CDD score, suggesting that these sociodemographic variables do not have a significant influence on the self-assessment of digital competences.

In contrast, ICT training and frequency of ICT use did show significant differences: teachers with ICT training and those who use ICT more regularly achieved higher scores on the DLC scale.

These findings suggest that self-perceived digital competence depends primarily on training experience and regular use of technologies, rather than on sociodemographic or disciplinary characteristics.

Qualitative analysis

Eighteen interviews were analysed. The distribution was as follows: Arts (2), Agronomy (3), Law (3), Economics (2), Engineering (3), Philosophy (1), Medicine (2) and Dentistry (2). This disciplinary diversity forms the basis for identifying cross-cutting patterns and specific differences in relation to the qualitative objectives: to describe the main patterns of use and to analyse the criteria for selecting ICT.

The analysis identified three levels of digital tool use: basic, intermediate and advanced, reflecting a progression in ICT integration, from cross-disciplinary resources to specialised and emerging applications.

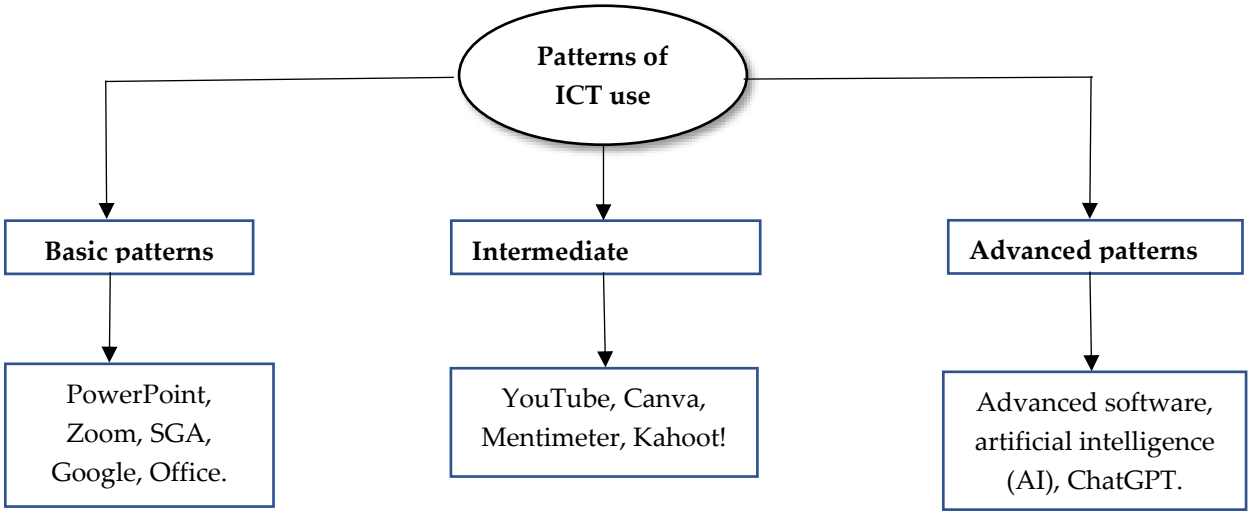
Table8

Patterns of ICT use

Level	Characteristics	Tools	Educational purpose
Basic	Use of institutional and office automation resources	Zoom, Google Drive, Office, Academic Management System (AMS).	Maintaining continuity of lessons, sharing materials, basic teacher-student interaction.
Intermediate	Incorporation of interactive and visual tools that bring teaching to life	Canva, Mentimeter, Kahoot!, YouTube	Encouraging participation, motivation and creativity; diversifying teaching strategies.
Advanced	Integration of artificial intelligence and specialised software in accordance with ethical and technical criteria	ChatGPT, Concensus, MATLAB, statistical packages, audiovisual editors	Optimising processes, responding to subject-specific needs, innovating in teaching practice.

Figure 1 illustrates this progression.

Figure 1. *Patterns of ICT use*



Characterised by the frequent use of institutional and office automation tools, which enable communication and the basic organisation of classes.

"PowerPoint, I think that's the most basic thing we have" (D1 Agronomy).

"We obviously use PowerPoint presentations" (D2 Law).

"What we do on the platform is upload all the assignments, receive assignments and reports, and also some tests" (D2 Engineering).

Intermediate patterns

Characterised by the incorporation of digital tools that promote interaction and the design of more dynamic teaching materials.

"Canva, mainly to improve traditional presentations which, perhaps with PowerPoint… are very flat… and Kahoot! to encourage extra points in the classroom" (D1 Law).

"I use YouTube for things I don't understand… to reinforce my learning and the syllabus; it helps me to proceed in an organised manner" (D4 Agronomy).

Advanced patterns

These involve the incorporation of tools that require greater technical proficiency and explicit ethical judgement.

"We also use software… every student uses Photoshop or Illustrator for their resources. The use of artificial intelligence is permitted for content editing" (D3 Arts).

"I put it into ChatGPT and it does the phonetic-phonological, morphosyntactic, lexical, semantic and pragmatic analysis for me in seconds" (D1 Medical Sciences).

These three levels reflect a progression in the integration of ICT into teaching practice: from basic resources to advanced applications of artificial intelligence (AI) and specialised software, which address specific subject-area needs. This diversity highlights the variations inherent to each faculty, demonstrating that the development of digital skills involves a gradual progression towards more complex uses.

Subsequently, the criteria guiding the selection of digital tools were identified. The analysis identified three main categories of criteria: common, specific and emerging.

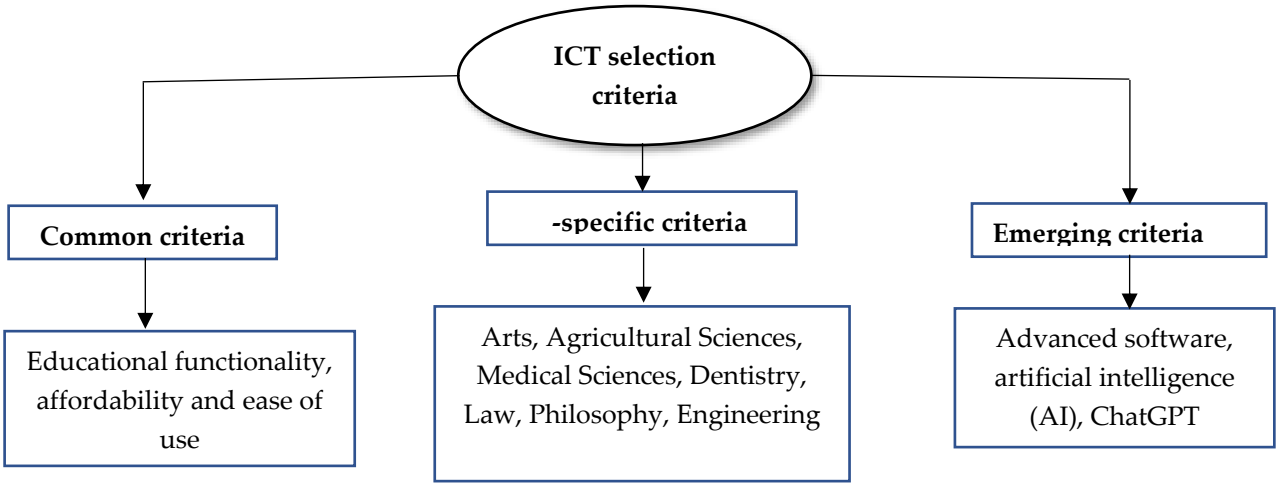
Table9

ICT selection criteria

Type of criterion	Characteristics	Tools	Educational purpose
Common	Applicable across all faculties. They focus on accessibility, ease of use and cost.	Zoom, Moodle, Google Drive, Office	To ensure continuity of classes, promote inclusion and reduce technical/financial barriers.
Specific	Address specific disciplinary needs. They are linked to technical and regulatory relevance.	MATLAB (Engineering), SPSS (Economics), audiovisual editors (Arts)	Adapt the tool to the methodologies and standards specific to each field of knowledge.
Emerging	Reflect recent concerns: AI ethics, continuous professional development and innovative relevance.	ChatGPT, Concensus, Gamma App, Notebook LM	Promote the responsible use of AI, continuous skills development and adaptation to new demands.

Figure 2 summarises the criteria guiding the selection of ICT.

Figure 2. *ICT selection criterio*



Common criteria

These refer to cross-cutting aspects present in all faculties and form the basis for the selection of digital tools.

"They should be easy to use, understandable to both students and teachers, and able to provide rapid feedback" (D1 Arts).

"I always make sure they are free and allow a number of participants that we can manage" (D2 Dentistry).

"The fact that some are free, others are paid for, and each has its own limitations" (D2 Medical Sciences).

"It depends on the pedagogical outcome I want to achieve… then I can select the tools" (D3 Engineering).

Specific criteria

These respond to the particularities of each discipline, reflecting the need for digital tools to align with the content, methodologies and standards specific to each field of knowledge.

"The use of specialised software… I teach a subject called statistics" (D1 Economics).

"There are some applications that can be used here in the laboratory; they are used for haematological counts" (D1 Agronomy).

"ArchiCAD, AutoCAD, Revit, help them to better understand what space is, both two-dimensional and three-dimensional" (D1 Arts).

Emerging criteria

These reflect recent concerns regarding the incorporation of advanced technologies into teaching.

"That everyone continues to train, that they understand the pros and cons, so to speak, and work with ethics, above all… so that we can improve both our use of technology and its effectiveness" (D1 Medical Sciences).

"Above all, courses on new technologies, on learning new software, because new options are constantly emerging that can help us in our teaching… having courses updated every semester is good so we know what we can make use of" (D1 Philosophy).

"These skills must move from digital to digital skills supported by artificial intelligence… I believe we are constantly transforming and developing these digital skills" (D3 Engineering).

Taken together, these three criteria show that the selection of ICT is not limited to the availability of resources, but integrates pedagogical, professional and ethical considerations.

The relationship between usage patterns and selection criteria reveals a progressive dynamic in the integration of ICT: as teachers progress, they move from basic practices towards intermediate , and advanced uses. Likewise, the criteria guiding the choice of tools become more sophisticated: from accessibility and ease of use, towards disciplinary relevance, and finally towards ethical considerations and continuing professional development.

This pattern shows that the development of CDD does not depend solely on technical proficiency, but also on the ability to critically evaluate tools in terms of their pedagogical and professional impact. Consequently, the incorporation of technologies into teaching practice is a gradual process that links cross-cutting needs with specific and emerging demands.

Integration of results and triangulation

The findings reveal a substantial convergence between teachers' self-perception and their reported practices. The medium-high level of digital competence (M = 66.78) finds its qualitative counterpart in the progression towards intermediate and advanced levels of technology integration. This trend is closely linked to continuing professional development, a factor that not only emerged as a determining factor in the participants' accounts but also showed a significant effect size in the statistical tests (r = -0.349, p < .001).

Likewise, a functional correlation is observed between frequency and patterns of use. The data show that greater regularity in the use of ICT (M = 3.39) is associated with higher levels of competence (H = 15.206, p < .001), which explains the transition from basic patterns (office automation, ERP) towards the incorporation of specialised software and AI applications.

However, triangulation reveals a significant methodological divergence regarding selection criteria. Whilst the statistical analysis did not detect significant differences based on faculty affiliation (p = .594), the qualitative analysis identified a marked disciplinary specialisation. Whilst specific technical criteria (e.g. MATLAB, Photoshop) predominate in Engineering and the Arts, in Medical Sciences selection is shifting towards emerging criteria focused on the ethics of AI.

Finally, both phases agree that the development of CDD is a process independent of traditional sociodemographic factors. Variables such as age (p = 0.238) and gender (r = -0.105) were not found to be determinative, confirming that CDD is, above all, a construct derived from educational experience and sustained daily practice.

Discussion and conclusions

The results show that CDD in the sample studied is at a medium-high level (competent category). In line with other studies, the level of CDD is primarily linked to the training received and daily practice, rather than to sociodemographic characteristics such as gender, age or years of teaching experience (Cabezas et al., 2021; Vásquez-Peñafiel et al., 2023).

In the Ecuadorian context, Paladines et al. (2024) reported a predominance of traditional tools such as PowerPoint (80.8%) and PDF files (62.5%), alongside limited use of alternative assessment software and low adoption of creative resources. In contrast, this study indicates that, although teaching staff access and use basic digital tools (PowerPoint, Zoom), the transition towards intermediate and advanced patterns of ICT use (specialised software, AI) is largely associated with continuous professional development (formal or informal), a willingness to innovate, sustained practice and institutional support.

In contrast, Basilotta-Gómez-Pablos et al. (2022) emphasise that teacher training should not be limited to technological knowledge, but should evolve towards pedagogical integration that enables content creation and supports student autonomy. In line with this, this study shows that: (1) these trends (use of basic tools) persist, (2) there has been innovation towards more advanced models, and (3) difficulties remain that hinder pedagogical innovation and the critical adoption of AI, confirming that the gap (teacher training–actual application) identified by this study still persists.

The interpretation of these results suggests:

Firstly, ICT training emerges as a factor linked to the development of digital competence. Recent research indicates that specific training based on frameworks such as DigCompEdu is associated with a better self-perception of competence, enabling teachers to progress from levels of digital literacy to levels of digital innovation and leadership (Cabero-Almenara et al., 2023), as well as confirming that continuous professional development is both a necessity and a challenge for achieving higher levels of ICT proficiency (Aznar-Díaz et al., 2025; Gaona-Portal et al., 2024; García-Correa et al., 2025; Luis-Grados, 2024).

Secondly, that the COVID-19 pandemic was associated with an increase and progression of these dynamics, highlighting progress but also gaps in infrastructure and digital literacy at both local and international levels (Martínez-Márquez et al., 2025), suggesting the urgency of sustained training programmes.

Thirdly, the identified usage patterns (basic, intermediate and advanced) correspond to the DigCompEdu framework (Redecker and Punie, 2017), which describes levels of technological integration ranging from initial use to transformative innovation. The literature on gamification, active methodologies and AI in higher education (Cabanillas et al., 2025; López-Secanell et al., 2025; Martínez-López et al., 2022) indicates that this progression is linked to higher levels of creativity and student engagement, provided that institutional conditions exist to support it.

Finally, the criteria for selecting digital tools (common, specific and emerging) reflect that digital competence is not limited to the technical domain, but is linked to the ability to assess the pedagogical and ethical relevance of technologies (Castañeda et al., 2025; Salvatierra and Kelly, 2023).

However, despite progress towards active methodologies and the use of emerging technologies (AI), basic patterns of digital integration tend to persist over time. These include office automation tools, resources that facilitate classroom communication, and those that ensure the basic organisation of academic activities. In this regard, it is understandable that teachers consistently rely on institutional academic management systems (IAMS) and standardised platforms such as Google (Classroom, Meet), given that they fulfil two fundamental conditions: they are simple and easy to use (basic patterns), and they have also been adopted as shared standards (common criteria) within teaching practice. This persistence suggests that, even in innovative settings, basic tools will remain necessary to ensure the continuity and stability of the educational process.

The findings suggest that the consolidation of open and massive online courses (MOOCs) is linked to institutional policies that incorporate continuous professional development as a strategic priority, ensure adequate infrastructure (equipment, connectivity, licences), and recognise MOOCs as a cross-cutting criterion in university accreditation and quality assurance processes (UNESCO, 2019).

Furthermore, the incorporation of AI and attention to digital ethics are emerging as key competencies that will redefine the future of teaching, requiring a sustained commitment from higher education institutions towards digital innovation (Bonales et al., 2025; Díez and Jarrín, 2025) . In this regard, the findings from the University of Cuenca provide evidence relevant to the international debate on how to move towards a higher education system that is constantly innovative and inclusive, offering information useful for designing comparable policies in other similar global contexts (Chambi et al., 2025; Martínez-Márquez et al., 2025).

However, this study has limitations that must be considered. Non-probabilistic convenience sampling restricts representativeness and limits the generalisability of the findings. The measurement of CDD through self-perception

may be influenced by social desirability bias and by the subjective interpretation of the participants. Furthermore, the study is confined to the University of Cuenca, reflecting a specific institutional context and may differ in universities with different policies and resources. Likewise, the validation of the interview script was based on the expert judgement of a highly experienced professional and the input of a key informant. However, the absence of a broad panel of evaluators limited the calculation of statistical concordance indices, an aspect that future research could strengthen to standardise the instrument. The exploratory nature of the design prevents the establishment of causality, so longitudinal and comparative research is required to confirm trends. Finally, the rapid advancement of emerging technologies, particularly AI, may render some findings obsolete in the short term, necessitating constant updating of the evidence.

In conclusion, teachers' digital competence (TDC) at the international level is at an acceptable level, but is constrained by structural factors that limit its progress towards innovative practices. The proposal for its development must focus on a dual approach: (1) strengthening continuous professional development, recognising the actual patterns of use of information and communication technologies (ICT) among teaching staff, and (2) explicitly integrating emerging criteria for ICT selection into institutional frameworks, particularly those related to ethics and the use of artificial intelligence (AI). In this way, higher education will be able to evolve from the mere provision of tools towards an innovative, inclusive and sustainable pedagogical culture.

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