Research Paper

Self-Perceived Teacher Digital Competence Among University Teachers: A Gender-Based Analysis in Accredited Colombian Universities

Competencia digital docente autopercibida en el profesorado universitario: un análisis de género en universidades colombianas acreditadas

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Abstract

Introduction: Teacher Digital Competence (TDC) has become increasingly recognized as a component of educational quality in digitalized university contexts. However, evidence on factors associated with its development and self-perception, particularly regarding gender, remains limited in Latin America. This study examines gender differences in self-perceived TDC among faculty at Colombian universities with High-Quality Accreditation and whether these differences vary by age, teaching experience, and institutional type. **Method:** A cross-sectional design was employed with 765 teachers who completed the *SELFIE for Teachers* instrument, aligned with the DigCompEdu framework. Independent-samples t-tests examined gender differences in overall TDC and in six competence areas. Factorial General Linear Models assessed whether gender differences varied according to contextual and professional variables. **Results:** The study found a general pattern of gender parity in self-perceived TDC. No statistically significant differences emerged in the overall score or in five of the six DigCompEdu areas, and the observed effect sizes were trivial. The only notable difference was a small advantage for women in Facilitating Learners' Digital Competence ($d = -0.15$), concentrated among less experienced teachers. Institutional type showed modest associations with TDC levels, suggesting that institutional context may be relevant for understanding variation in self-perceived TDC. **Conclusions:** These findings challenge assumptions of inherent gender gaps in TDC. Within the analyzed accredited university context, gender showed minimal association with self-perceived TDC. Faculty development strategies should prioritize age group and institutional conditions over gender-based approaches, while also considering structural differences between public and private institutions.

Keywords
Digital competence; higher education; professional training; educational technology; gender

Resumen

Introducción: La Competencia Digital Docente (CDD) se ha reconocido cada vez más como un componente de la calidad educativa en contextos universitarios digitalizados. Sin embargo, la evidencia sobre los factores asociados con su desarrollo y autopercepción, particularmente en relación con el género, sigue siendo limitada en América Latina. Este estudio examina las diferencias de género en la autopercepción de la CDD entre docentes de universidades colombianas con Acreditación de Alta Calidad, así como si dichas diferencias varían según la edad, la experiencia docente y el tipo de institución. **Método:** Se empleó un diseño transversal con 765 docentes que completaron el instrumento *SELFIE for Teachers*, alineado con el marco DigCompEdu. Se aplicaron pruebas t para muestras independientes con el fin de examinar

Palabras Clave
Competencia digital; educación superior; desarrollo profesional; tecnología educativa; género

diferencias de género en la CDD global y en seis áreas competenciales. Asimismo, se emplearon Modelos Lineales Generales factoriales para evaluar si las diferencias de género variaban según variables contextuales y profesionales. **Resultados:** El estudio encontró un patrón general de paridad de género en la autopercepción de la CDD. No se observaron diferencias estadísticamente significativas en la puntuación global ni en cinco de las seis áreas de DigCompEdu, y los tamaños del efecto observados fueron triviales. La única diferencia destacable fue una pequeña ventaja de las mujeres en Facilitación de la Competencia Digital del Estudiantado (d = −0.15), concentrada entre docentes con menor experiencia. El tipo de institución mostró asociaciones modestas con los niveles de CDD, lo que sugiere que el contexto institucional puede ser relevante para comprender la variación en la autopercepción de la CDD. **Conclusiones:** Estos hallazgos cuestionan los supuestos de brechas de género inherentes en la CDD. Dentro del contexto universitario acreditado analizado, el género mostró una asociación mínima con la autopercepción de la CDD. Las estrategias de desarrollo profesoral deberían priorizar la etapa de la carrera académica y las condiciones institucionales por encima de los enfoques basados en género, considerando también las diferencias estructurales entre instituciones públicas y privadas.

1. Introduction

Teacher Digital Competence (TDC) has become increasingly recognized as a component of educational quality in digitalized university contexts. In recent decades, digital technologies have ceased to be peripheral educational resources and have become central tools of contemporary teaching professional practices. However, this process of teaching digitalization is not a neutral process. When the integration of digital technologies occurs without deliberate attention to equity, it may reinforce pre-existing inequalities in training opportunities (United Nations, 2023; van Dijk, 2020; Warschauer, 2004). In this scenario, teachers' TDC acquires relevance both because of its role in the current quality of teaching and because of the possible variability in its development and perception among different groups of teachers.

TDC has emerged as a useful construct for analyzing differences in how teachers perceive and develop their pedagogical use of digital technologies. Beyond a general digital capacity, TDC encompasses an integrated set of knowledge, skills, and professional dispositions oriented toward the pedagogical use of digital technologies centered on students' learning needs and interests (Caena & Redecker, 2019; Redecker, 2017). Within the DigCompEdu, relevant competences and areas include Differentiation and Personalisation, Self-Regulated Learning, and Facilitating Learners' Digital Competence, among others (Inamorato dos Santos et al., 2023; Redecker, 2017). While the broader discourse on digital education increasingly references advanced applications such as learning analytics, adaptive platforms, and artificial intelligence (Mhlongo et al., 2023; OECD, 2021; UNESCO, 2023), this study focuses on foundational dimensions of TDC as operationalized through the DigCompEdu framework. This focus allows for examination of core pedagogical digital practices that precede and underlie more specialized technological applications.

Although there are various frameworks that guide the development of TDC, the DigCompEdu conceptual framework has consolidated itself as a reliable standard to conceptualize and evaluate TDC at different educational levels. Instruments aligned with this framework such as SELFIE for Teachers have been widely used to collect self-reported data on digital practices and perceptions of teachers' TDC (Caena & Redecker, 2019; Economou, 2023). Self-report measures present limitations, for example, the lack of correspondence between perceived TDC and demonstrated TDC, and inflation or underestimation in personal evaluations of self-efficacy (Adewale, 2025). Even so, self-perceived TDC has relevant informative value. Beliefs about one's own competence are strongly associated with the way teachers use digital tools, maintain effort in the face of difficulties of use, and decide whether to experiment with new practices (Bandura, 1997). Therefore, in this study self-perceived TDC is assumed not as a substitute for the real performance of TDC, but as a significant indicator of disposition and professional orientation toward training digitalization.

Gender has been one of the most studied variables in the field of TDC, although the empirical evidence remains inconsistent. Some studies identify gaps in favor of male teachers, especially in competence domains with a technical emphasis; other studies find parity or even female advantages in digital practices of a pedagogical nature and in supporting students (Ancheta-Arrabal et al., 2021; Guillén-Gámez et al., 2021; Mercader & Duran-Bellonch, 2021; Singh et al., 2025). This heterogeneity is itself informative, since it suggests that gender differences in self-perceived TDC are not fixed traits, but are contextually produced results, determined by opportunities for recognition and feedback in specific professional environments. Sociocognitive theory holds that the perception of one's own capacity develops from mastery experiences and social feedback, not from aptitudes exclusively inherent to the person (Bandura, 1997). When opportunities to experiment and receive recognition for digital work performed are distributed unequally according to teachers' gender, it is likely that self-perceived TDC reflects those differences (Järvinen & Mik-Meyer, 2025; Sümer & Eslen-Ziya, 2023; van Dijk, 2020).

Years of teaching experience, that is, the stage of the academic career, together with the institutional context add nuances in these digitalized scenarios. Age and years of teaching experience may also reflect generational effects and different levels of exposure to faculty development, associated with different phases of the academic life cycle of teachers (Day & Gu, 2007; Huberman, 1989). As teachers' academic careers progress, changes in roles and responsibilities—toward teaching coordination functions or administrative management—modify incentives and the time available to develop digital teaching practices. The type of institution introduces another source of nuance in the analysis: systematic differences in university infrastructure, type of governance, and organizational expectations may facilitate or hinder the sustained pedagogical adoption of digital technologies (OECD, 2021; Tungpantong et al., 2022). When professional roles and distribution of workload present gender dimensions, apparently similar institutional conditions may give rise to differences in professional development trajectories for women and men.

The accreditation of universities is relevant in this analysis both because of the credibility of the high-quality seal by the state body responsible for regulation and supervision and because of the context of university governance. Quality assurance systems may influence investment in the

pedagogical use of digital technologies, in the structure of faculty development, and in expectations of improvement of teachers based on evidence (Consejo Nacional de Acreditación, 2019a, 2019b; OECD, 2021; Sistema Nacional de Información para la Educación Superior en Colombia, 2024). A priori, higher education institutions with High-Quality Accreditation constitute a relevant context in which more favorable conditions for TDC development may be expected. If the gaps remain in this segment, the implications for policies oriented toward equity are even more relevant.

Evidence on TDC in Latin America, and particularly in Colombia, remains limited. Studies in the region are carried out in training contexts with heterogeneous infrastructural conditions and face persistent inequalities in access to opportunities for structured professional development (Lustosa Rosario et al., 2021; Melo et al., 2020; Sabzalieva et al., 2024; UNESCO & JET Education Services, 2022; Wöbbekind et al., 2025). Colombia constitutes a particularly relevant case because its higher education system is characterized, on the one hand, by institutional differentiation (public, private, and mixed institutions), and, on the other hand, by the national system of High-Quality Accreditation for higher education institutions, granted by the Consejo Nacional de Acreditación (CNA) under the supervision of the Ministerio de Educación Nacional (MEN), which provides a clearly defined institutional framework for this type of analysis (Consejo Nacional de Acreditación, 2019a, 2019b). The focus on accredited universities does not seek to represent the entire Colombian higher education system, but rather to examine variations within a segment where institutional supports for the pedagogical integration of digital technologies may be more likely, allowing for analysis of whether gender differences remain relevant even under relatively favorable conditions for the development of TDC.

To address these questions, two research questions were formulated:

RQ1. Are there gender differences in the self-perception of teachers' TDC in Colombian universities with High-Quality Accreditation?

RQ2. Do these differences vary according to (a) age, (b) years of teaching experience, or (c) type of institution (public/private)?

While previous studies have widely applied the DigCompEdu framework (Caena & Redecker, 2019) and examined gender-related differences in TDC (Ancheta-Arrabal et al., 2021; Guillén-Gámez et al., 2021; Singh et al., 2025), much of this work has focused on European contexts or has given limited attention to how gender intersects with institutional characteristics. In this regard, evidence of lower self-perceived TDC among women teachers has been reported in prior European research (Mercader & Duran-Bellonch, 2021), but less is known about whether similar patterns persist in Latin American higher education systems with formal quality-assurance processes.

This study addresses that gap by examining gender differences in self-perceived TDC among teachers from high-quality accredited universities in Colombia, distinguishing between public and private institutions. The study contributes to the literature in three ways. First, it provides empirical evidence from a Latin American context on whether gender gaps in self-perceived TDC are observed in institutions with recognized quality-accreditation status. Second, it examines whether gender differences in self-perceived TDC vary between public and private institutions within the context of high-quality accredited universities. Third, it offers evidence that may inform faculty

development and digital transformation policies by identifying whether patterns of self-perceived TDC differ across gender and institutional type.

2. Method

2.1. Study Design

A non-experimental, cross-sectional, and comparative quantitative design was used to examine gender differences in the self-perception of university teachers' TDC in Colombian higher education institutions with High-Quality Accreditation granted by the MEN. Cross-sectional research designs are appropriate for this type of study since they allow systematic comparisons between diverse demographic and institutional groups at a single point in time, maintaining ecological validity in a training context where experimental manipulation is neither viable nor ethically appropriate (Creswell & Creswell, 2023).

The analytical strategy progressed from descriptive comparisons toward a multifactorial approach to capture the effects of interaction with the selected variables. Instead of analyzing the effects of gender in isolation, the possible interactions between gender, age, teaching experience, and type of institution (public or private) were modeled, recognizing that these variables almost never operate independently in real professional contexts (Field, 2024).

2.2. Population

The target population of the study was composed of 87,252 full-time professors affiliated with higher education institutions in Colombia with High-Quality Accreditation in 2023 (Ministerio de Educación Nacional, 2023). The methodological decision to focus on this institutional population segment was analytical. These institutions, by operating under consolidated governance structures, constitute an analytically relevant context in which more structured quality assurance conditions and institutional supports for TDC development may be expected. If gender differences in the self-perception of TDC persist in this educational context, this would suggest the need to examine how such differences may operate in institutions with fewer resources and supports.

This population is highly heterogeneous in the study dimensions since it includes both genders, a wide age range (from teachers under 25 years old to teachers over 60 years old), different levels of teaching experience (from 1 to more than 20 years), and both types of institution (public and private). At the geographic level, the study considered six Colombian macro-regions: Andean, Caribbean, Pacific, Orinoquía, Amazonía, and Insular. However, during the study period, the Insular region did not have higher education institutions with High-Quality Accreditation.

2.3. Sampling Strategy and Participants

Obtaining a nationally representative sample in Colombia presented an important methodological challenge due to the absence of a centralized database with all contact information of university teachers. To overcome this, a geographically stratified outreach strategy was implemented. This strategy was oriented toward maximizing territorial coverage while respecting the voluntary nature of participation in the study.

The sample was constructed by stratifying accredited higher education institutions first by macro-region and then by type of institution (public or private). Within each stratum, institutions were ordered alphabetically and were randomly selected. A practical eligibility criterion was applied which consisted of including only universities with public and accessible university faculty directories since otherwise it was not possible to establish direct contact with potential participants. Teachers from the selected institutions received personalized invitations sent to their institutional email addresses. As data collection progressed, and some strata reached their expected participation quotas, invitations were redirected toward underrepresented regions and institutional types with the objective of maintaining sample balance.

The final sample was composed of 765 full-time professors, which represents approximately 0.87% of the national reference population. Regarding gender composition, 55.9% of the teachers identified as male, 43.8% as female, and 0.3% (n = 2) as non-binary or another category. This latter group was retained in descriptive analyses but was excluded from inferential analyses due to representing an insufficient size for the planned comparisons.

The distribution of participants by age was moderately concentrated in intermediate ranges since 14.4% of the teachers were under 35 years old, 39.5% between 36 and 45, 31.2% between 46 and 55, and 14.9% 56 years old or older. Teaching experience showed a similar pattern, with 19.4% of the teachers reported up to 10 years, 37.6% between 11 and 20 years, and 42.9% more than 20 years of teaching experience. Teachers' institutional affiliation was practically balanced since 50.7% of the teachers worked in private universities and 48.8% in public institutions, with 0.5% non-response.

In geographic terms, the final sample covered four of the six macro-regions considered in the study: Andean, Caribbean, Pacific, and Orinoquía. The Insular region did not have accredited institutions during the study period, and no valid responses were obtained from the Amazonía region despite additional contact efforts.

The sampling procedure combined stratified random selection at the institutional level with voluntary participation at the individual level. This design supports comparative analyses between the study groups of interest, particularly by gender, age, teaching experience, and type of institution. However, because individual participation was voluntary and depended on accessible institutional faculty directories, the sample should not be considered strictly probabilistic and does not allow direct statistical generalization to the entire national population of university teachers (Creswell & Creswell, 2023; Vehovar et al., 2016).

2.4. Instrument

The self-perception of TDC was assessed using an adapted version of the SELFIE for Teachers questionnaire, based on the DigCompEdu framework (Redecker, 2017). The selection of this instrument was supported by its broad empirical use and prior psychometric evidence derived from its application to more than 60,000 teachers from European educational systems (Economou, 2023). In this study, SELFIE for Teachers was used to measure self-perceived digital

competence rather than observed digital teaching performance or objective mastery of advanced technologies.

Although the instrument has been previously validated, its application in a different cultural and institutional context required contextual adaptation following established guidelines for cross-cultural instrument adaptation (Beaton et al., 2000; Muñiz et al., 2013). Because the study used the official Spanish-language version of the *SELFIE for Teachers* questionnaire, a translation/back-translation procedure was not required. Instead, the adaptation process focused on semantic, contextual, and disciplinary equivalence between the official Spanish version and the Colombian university teaching context.

In the first phase, a panel of five full-time university professors (with 8–15 years of teaching experience across diverse disciplinary areas) reviewed the items to determine whether the wording was clear, culturally appropriate, and relevant to Colombian higher education. The review focused on identifying expressions that could generate ambiguity, terms that were uncommon in the Colombian academic context, and references that required contextual adjustment without altering the substantive meaning of the original items. Suggested modifications were discussed until consensus was reached, prioritizing semantic fidelity to the official Spanish version and conceptual alignment with the DigCompEdu framework.

In the second phase, a cognitive pretest was conducted with 10 university teachers (selected to represent diversity in teaching experience, disciplinary areas, and institutional type). The cognitive pretest was not intended to provide statistical evidence of item functioning, but rather to assess item comprehension, linguistic clarity, response format usability, completion time, and the adequacy of the questionnaire under real administration conditions. Participants were asked to indicate whether any item was confusing, difficult to interpret, culturally inappropriate, or misaligned with their teaching experience. The feedback obtained did not indicate major comprehension problems, although minor wording adjustments were made to improve clarity and contextual fit.

The psychometric component of the instrument included 30 Likert-type items organized according to the six DigCompEdu areas. Additional multiple-choice and open-ended questions were included only for contextual and descriptive purposes and were not analyzed psychometrically. All Likert-type items used a five-point scale, where higher values indicate higher self-perceived TDC. Self-reported composite scores were calculated, the overall TDC index and sub-indices by area, as averages of the corresponding items. Psychometric analyses were conducted using the main study sample (N = 765) rather than the cognitive pretest sample. The results showed high internal consistency, with an overall Cronbach's alpha of .96 and area-level values ranging from .72 to .90 across the six DigCompEdu areas, meeting commonly recommended standards (Nunnally & Bernstein, 1994).

Construct validity was examined through Confirmatory Factor Analysis (CFA), specifying a six-factor model corresponding to the DigCompEdu areas. Given the ordinal five-point response format, the use of ML estimation is acknowledged as a limitation, although the large sample size (N = 765) reduces the severity of this concern (Rhemtulla et al., 2012). The model showed an interpretable but imperfect fit to the data, $\chi^2(385) = 2343$, $p < .001$, CFI = .855, TLI = .837, RMSEA = .082 [90% CI: .078, .085], SRMR = .076. Although RMSEA and SRMR suggested reasonable absolute fit, the CFI and TLI values were below conventional thresholds, indicating

that the factorial structure should be interpreted with caution. Based on theoretical similarity among items, and supported by inspection of modification indices, a limited number of residual covariances were specified between items with closely related wording or pedagogical content (e.g., institutional communication items and digital feedback items). These covariances were theoretically justified rather than purely data-driven, and their number was kept minimal to reduce the risk of overfitting. Standardized factor loadings ranged from .27 to .85, with all items loading significantly on their intended factors ($p < .001$).

Reliability and convergent validity were further assessed using Cronbach's alpha, McDonald's omega, Composite Reliability (CR), and Average Variance Extracted (AVE). Omega values exceeded the .70 threshold across all six areas, whereas CR values exceeded .70 in five areas, with Area 2 (Digital Resources) falling slightly below this criterion (.63). Evidence of convergent validity was mixed: AVE values exceeded .50 for Areas 4, 5, and 6, but were below the recommended threshold for Areas 1, 2, and 3. These results suggest adequate internal consistency but only partial evidence of convergent validity, particularly for dimensions with fewer items or greater item heterogeneity.

Table 1. *Reliability and Convergent Validity Indices for DigCompEdu Areas (N = 765)*

DigCompEdu Area	Items (n)	Cronbach's α	McDonald's ω	Composite Reliability (CR)	Average Variance Extracted (AVE)
A1. Professional Engagement	8	.86	.87	.86	.46
A2. Digital Resources	3	.72	.74	.63	.37
A3. Teaching and Learning	5	.78	.79	.74	.38
A4. Assessment	4	.82	.83	.81	.53
A5. Empowering Learners	4	.87	.88	.86	.61
A6. Facilitating Learners' Digital Competence	6	.90	.91	.89	.58

Note. A value of .70 was used as the interpretive benchmark for reliability coefficients (Nunnally & Bernstein, 1994), and AVE ≥ .50 was used as the benchmark for convergent validity (Fornell & Larcker, 1981).

Discriminant validity was also examined using the Fornell-Larcker criterion and latent factor correlations. The results provided only partial support for discriminant validity. Several DigCompEdu areas, particularly Areas 2, 3, 4, and 5, showed high inter-factor correlations. Most high correlations ranged from .79 to .89; additionally, one latent correlation approached or slightly exceeded unity, suggesting a possible Heywood case and indicating that some dimensions may be empirically difficult to distinguish in this sample. This result may reflect the conceptual proximity between instructional practices and learner empowerment in self-report measures. Therefore, although the six-factor structure was retained because of its theoretical alignment with the DigCompEdu framework, the dimensions should be interpreted as closely related components of a broader digital competence construct rather than as fully independent latent variables.

Measurement invariance across gender and institution type was assessed through multigroup CFA by comparing configural, metric, and scalar models. The smaller analytic samples used in the invariance analyses ($N = 723$ for gender; $N = 722$ for institution type) reflect the exclusion of cases with missing information on the grouping variables. Changes in fit indices between nested models were below commonly recommended thresholds ($\Delta CFI < .010$; $\Delta RMSEA < .015$). For gender, the pattern of changes in CFI and RMSEA was consistent with approximate scalar

invariance. A similar pattern was observed for institution type, where configural, metric, and scalar models also showed negligible changes in CFI and RMSEA. However, because the configural models showed only marginal global fit and the overall CFA indicated concerns regarding the latent covariance structure, these invariance results should be interpreted cautiously and understood as approximate evidence rather than definitive proof of measurement equivalence. Detailed results are presented in Table 2.

Table 2. *Measurement Invariance Testing Across Gender and Institution Type*

Model	χ^2	df	CFI	RMSEA	ΔCFI	ΔRMSEA
Gender Invariance (N = 723)						
1. Configural	3105	780	.820	.091	—	—
2. Metric	3130	804	.820	.089	.000	-.002
3. Scalar	3169	828	.819	.088	-.001	-.001
Institution Type Invariance (N = 722)						
1. Configural	2995	780	.816	.089	—	—
2. Metric	3031	804	.815	.088	-.001	-.001
3. Scalar	3062	828	.814	.086	-.001	-.002

Note. ΔCFI and ΔRMSEA represent changes from the previous model. Changes of no more than .010 in CFI and .015 in RMSEA were considered indicative that the additional equality constraints did not substantially worsen model fit (Cheung & Rensvold, 2002; Putnick & Bornstein, 2016). Given the sensitivity of χ^2 to large samples, invariance decisions were based primarily on changes in CFI and RMSEA rather than χ^2 difference tests (Milfont & Fischer, 2010).

2.5. Data Collection

Data collection was carried out over three months through an online questionnaire distributed via institutional email addresses. The initial invitation explained the context and purpose of the study, emphasizing the voluntary nature of participation together with confidentiality protocols.

Participants were asked to provide their name and institutional email within the form solely to verify that each teacher responded only once. Responses were therefore not anonymous at the point of data collection. However, identifiable information was stored in a separate file and permanently dissociated from the analytical database before statistical processing. The dataset used in the analyses did not contain any personally identifiable information.

The response hosting platform was configured to prevent duplicate submissions and require completion of mandatory questionnaire items, thereby reducing missing data and simplifying data cleaning. The online format of the instrument was adequate for the geographic scope of the study, allowing participation from different regions and types of institution in Colombia without the logistical limitations of face-to-face or paper-based methods.

2.6. Variable Recoding

Before data analysis, the variables age, teaching experience, and type of institution were recoded with the objective of ensuring conceptual coherence together with statistical adequacy.

Age: It was collected in predefined ranges, which prevents continuous analyses. To ensure that cell sizes were adequate in factorial models, low-frequency categories were grouped following methodological recommendations (Field, 2024; Tabachnick & Fidell, 2019). Three age groups were defined, namely: early career (≤ 39 years, 21.7%), mid-career (40–59 years, 61.8%), and advanced stage (≥ 60 years, 16.5%). The original categorization was retained for descriptive analyses. Sensitivity analyses confirmed the stability of the results.

Teaching experience. Years of teaching experience were initially collected in seven categories (from "1–2 years" to "more than 20 years"), which were organized into three levels, namely: initial experience (≤ 10 years, 19.4%), intermediate experience (11–20 years, 37.6%), and advanced experience (> 20 years, 42.9%). Minor inconsistencies were resolved case by case, for example, a double selection of adjacent categories was assigned to the intermediate group. One response "Prefer not to answer" was treated as missing data.

Type of institution was coded as a dichotomous variable, namely: 1 = public, 2 = private. The distribution was balanced (48.8% public; 50.7% private). Four cases (0.5%) without response were excluded from the corresponding analyses.

2.7. Data Analysis

The data analysis procedure followed a sequential analytical strategy from description toward inference. Descriptive statistics were calculated for overall TDC and its six areas of the DigCompEdu framework (means, standard deviations, and distributions), disaggregated by demographic variables and professional variables. These made it possible to evaluate the assumptions required for subsequent analyses.

Inferential analyses were conducted through General Linear Models (GLM) with factorial design. This analytical approach made it possible to estimate both main effects (gender, age, teaching experience, and type of institution) and interactions between variables, considering their interdependence in real contexts (Field, 2024; Tabachnick & Fidell, 2019).

First, independent samples t-tests were applied to the overall TDC. When the assumption of homogeneity of variances was violated, the Welch correction was used. As an additional verification, nonparametric Mann–Whitney tests were applied.

Subsequently, factorial GLM models were estimated for the overall score and for each of the six areas. Given the unbalanced nature of the data, Type III sums of squares were used. When assumptions were not fully met, robust HC3 standard errors (Hayes & Cai, 2007; Long & Ervin, 2000) and 95% bootstrap confidence intervals (Efron & Tibshirani, 1993) were used as robustness checks. These checks generally confirmed the substantive pattern of results, although some marginally significant effects became non-significant. Therefore, statistically significant results with very small effect sizes were interpreted cautiously. The level of statistical significance was established at $p < .05$. Data analyses were conducted in IBM SPSS Statistics version 25.

2.8. Ethical Considerations

The study was based on three ethical principles, namely: voluntary participation, informed consent, and protection of participants' data.

Before responding, participants accessed the informed consent that explained the context, the purpose of the study, the use of the data, and their right to withdraw at any time without any consequence. No incentives were offered to participants.

Data protection followed a two-phase anonymization process. In the first phase, pseudonymization was carried out during data collection. Then, in the second phase, the link between identity and data was permanently removed before analysis. The analytical dataset did not contain identifiable participant information.

The data are stored on an institutional server with access restricted to the research team. The retention period will not exceed three years. The study was conducted as part of a doctoral research project that received ethical approval on January 17, 2024, from the Institutional Review Board (IRB00003099), under protocol CER 012401.

3. Results and Discussion

The results are organized based on the two guiding research questions of the study. First, the analyses of descriptive statistics of TDC are presented at the overall level and for each of the six DigCompEdu areas. Second, the inferential analyses on gender differences (RQ1) and their possible interactions with the variables age, years of teaching experience, and type of institution (RQ2) are presented.

3.1. Gender Differences in TDC (RQ1)

To examine whether differences existed between male teachers and female teachers in the self-perception of TDC, independent samples t-tests were conducted on the overall TDC score and the six DigCompEdu areas. The results are presented in Table 3.

Table 3. *Gender differences in self-perceived TDC (overall and by DigCompEdu area)*

DigCompEdu Dimension	Men (M, SD)	Women (M, SD)	t(df)	p	Cohen's d	95% CI [LL, UL]
Overall TDC	3.76 (0.64)	3.80 (0.65)	–0.69 (721)	.490	–0.05	[–0.20, 0.10]
Professional Engagement	3.69 (0.76)	3.75 (0.78)	–0.91 (725)	.360	–0.07	[–0.21, 0.08]
Digital Resources	4.09 (0.75)	4.16 (0.69)	–1.21 (752)	.220	–0.09	[–0.23, 0.06]
Teaching and Learning	3.84 (0.66)	3.81 (0.64)	0.59 (752)	.550	0.04	[–0.10, 0.19]
Assessment	3.65 (0.90)	3.65 (0.94)	–0.14 (757)	.890	–0.01	[–0.15, 0.13]
Empowering Learners	3.92 (0.87)	3.90 (0.89)	0.26 (758)	.800	0.02	[–0.12, 0.16]
Learners' Digital Competence	3.66 (0.87)	3.80 (0.84)	–2.11 (756)	.035	–0.15	[–0.30, –0.01]

Note. M = mean; SD = standard deviation; t(df) = Student's t with associated degrees of freedom; p = two-tailed probability; d = Cohen's effect size; CI = confidence interval; LL = lower limit; UL = upper limit. All comparisons are based on independent-samples t-tests with equal variances assumed unless otherwise indicated. Sample sizes ranged from 403 to 425 for men and from 320 to 335 for women. Data compiled by the authors.

At the descriptive level, the sample showed moderate to moderately high levels of TDC in both groups, with means between 3.6 and 4.2 on a five-point Likert scale. These figures suggest that

teachers in accredited Colombian High-Quality universities self-perceive their TDC as competent in the use of digital technologies, not at superior levels, but clearly above the midpoint of the Likert scale. More importantly for RQ1, the differences between groups were systematically smaller than the variability within them. In each DigCompEdu area, the difference in means between genders was lower than 0.13 points, while standard deviations ranged between 0.64 and 0.94, a pattern that already anticipated what the inferential analyses would confirm.

For the overall score in the self-perception of TDC, male teachers and female teachers reported practically equal means ($M = 3.76$, $SD = 0.64$ versus $M = 3.80$, $SD = 0.65$), with a non-significant difference of negligible magnitude, $t(721) = –0.69$, $p = .49$, $d = –0.05$, 95% CI [–0.20, 0.10]. The pattern was similar across the DigCompEdu areas since no statistically significant differences emerged in five of the six dimensions ($|d| \leq .15$), and the confidence intervals showed substantial overlap in all cases.

The only exception was the area Facilitating learners' digital competence, where female teachers obtained slightly higher scores than male teachers ($M = 3.80$, $SD = 0.84$ versus $M = 3.66$, $SD = 0.87$), $t(756) = –2.11$, $p = .035$, $d = –0.15$, 95% CI [–0.30, –0.01]. This difference, although statistically significant according to the conventional threshold, is small in practical terms and lies at the limit of detectability. Given that seven simultaneous comparisons were conducted, the probability of obtaining at least one spurious significant result is not trivial; therefore, this finding should be interpreted with caution rather than with strong inferential weight.

The overall picture in the self-perception of TDC is one of notable parity. Gender-related differences accounted for only a minimal proportion of the observed variation in the self-perception of TDC, with differences at the individual level being much greater. The data are consistent with findings from institutional contexts where sustained support structures and inclusive professional cultures reduce gender gaps in TDC frequently documented in previous studies (Guillén-Gámez et al., 2021; Inamorato dos Santos et al., 2023).

Previous gender gaps in digital competence have often been interpreted in relation to gendered socialization processes that may increase technological confidence among male teachers and reduce it among female teachers, including mechanisms similar to the well-known impostor phenomenon (Clance & Imes, 1978; Mercader & Duran-Bellonch, 2021; Teo, 2011; Wajcman, 2004). The fact that these patterns were not clearly reproduced in the present study is theoretically relevant, although it should be interpreted within the limits of a cross-sectional self-report design. Self-perceived TDC is not a fixed individual trait; rather, it may be shaped by mastery experiences, institutional feedback, and opportunities for digital experimentation (Bandura, 1997). In this sample, gender showed limited predictive relevance for self-perceived TDC, suggesting that other professional and institutional conditions may be more informative for understanding variation in teachers' digital competence perceptions. In this interpretation, High-Quality Accreditation should be understood as part of the institutional context in which self-perceived TDC is examined, rather than as a directly measured causal mechanism. The present data do not allow us to identify which specific accreditation-related processes, institutional supports, or governance practices may explain the observed pattern (Alhashem et al., 2022; Consejo Nacinal de Acreditación, 2019b; Pettersson et al., 2024).

3.2. Contextual Interactions of Gender Effects in Overall and Area-Specific TDC (RQ2)

To analyze whether gender differences in the self-perception of TDC were conditioned by contextual variables, factorial GLM models were estimated that included gender, age group, years of teaching experience, and type of institution as factors. The GLM models used Type III sums of squares in order to handle unequal cell sizes, and effect sizes are reported through partial eta squared (ηp^2). Considering that the question refers to gender patterns, Table 4 presents the p-values and ranges of ηp^2 specifically for main effects of gender and interactions involving gender.

Table 4. *Gender-related main and interaction effects from factorial GLM models (overall and by DigCompEdu area)*

DigCompEdu Dimension	Gender (p)	Gender × age group (p)	Gender × teaching experience (p)	Gender × institutional type (p)	Gender × age group × experience × institution (p)	ηp^2 range
Overall TDC	.088	.124	.131	.094	.024	.004–.007
Professional Engagement	.128	.252	.071	.068	.016	.003–.008
Digital Resources	.844	.525	.859	.679	.261	.000–.002
Teaching and Learning	.102	.143	.246	.052	.135	.003–.005
Assessment	.037	.139	.354	.117	.444	.001–.006
Empowering Learners	.822	.379	.974	.268	.151	.000–.003
Learners' Digital Competence	.425	.149	.014	.318	.026	.001–.012

Note. Values are p-values from univariate GLM tests with Type III sums of squares. ηp^2 = partial eta squared; the ηp^2 range refers to the minimum and maximum effect sizes for the gender main effect and its interactions (Gender × Age group, Gender × Teaching experience, Gender × Institutional type, and the four-way interaction) within each model. Data compiled by the authors.

The results confirmed the general pattern observed in the previous descriptive analyses. Mean scores of the self-perception of TDC remained at moderate to high levels (approximately between 3.7 and 4.1 points), with minimal differences between male teachers and female teachers and considerably greater internal variability than differences between groups.

Main effects of gender were not significant in five of the six DigCompEdu areas, confirming the general pattern of parity observed in RQ1. The only exception was the area Assessment, where male teachers showed slightly higher scores ($p = .037$, $\eta p^2 = .006$), with a very small effect size that would not withstand conservative corrections for multiple comparisons. Given its very small magnitude, this result should be interpreted as exploratory. One possible interpretation is that it may reflect relatively greater confidence in digitally structured tasks associated with the technical management of learning assessment processes. This is consistent with some studies indicating that there is a differential distribution between technical dimensions and relational dimensions of academic work in university contexts (Staudt & He, 2024; Sümer & Eslen-Ziya, 2023).

An interaction between gender and teaching experience emerged in facilitating learners' digital competence ($p = .014$, $\eta p^2 = .012$). Although statistically significant, this effect size is trivial by conventional standards ($\eta p^2 < .06$; Richardson, 2011). The pattern suggests that any gender differences in this area may be more pronounced among less experienced teachers, though the practical significance of this finding is limited given the small effect magnitude. This pattern is consistent with the greater involvement of teachers in early career stages in digital pedagogical dimensions centered on direct support for students. These differences tend to attenuate as professional trajectories diversify and academic responsibilities change (European Commission, 2019; Järvinen & Mik-Meyer, 2025).

Some higher-order interactions (gender × age group × experience × type of institution) were also identified. Their interpretation is necessarily limited due to the reduced size of the subgroups. In exploratory terms, the results suggest that when gender differences appear, they are modulated by the intersection between professional trajectory and institutional context.

Regarding type of institution, it was observed that teachers from private universities reported slightly higher levels of self-perceived TDC in several DigCompEdu areas and in the overall score. This result suggests that structural conditions associated with institutional resources, technological infrastructure, and the organization of pedagogical support may have greater weight than gender in the development of TDC. This interpretation is consistent with previous evidence indicating that private institutions tend to adopt digital initiatives more rapidly and operate with more agile support structures, while public universities face greater organizational and resource constraints (Looi, 2022; Tungpantong et al., 2022).

From a practical perspective, the consistently negligible effect sizes observed across the analyses suggest that gender alone does not appear to be a substantively relevant factor in explaining self-perceived TDC in this context. Even where statistically significant differences were identified, their magnitude was too small to support strong practical implications for educational decision-making. Instead, the institutional context—shaped by access to resources, governance arrangements, and structured pedagogical support—appears more closely associated with variation in TDC than demographic variables alone.

Accordingly, faculty professional-development policies should avoid relying primarily on broad gender-based assumptions. Support could be better differentiated by career stage and competence domain, while also recognising the digital work involved in supporting students, regardless of who performs it (Alhashem et al., 2022; Looi, 2022). At the same time, structural inequalities between public and private institutions should be addressed through sustained investment in infrastructure and training. Expectations of digital innovation in institutions with higher technological demands should also be managed carefully so that they do not translate into technostress or excessive faculty workload (Dahabiyeh et al., 2022).

Several limitations warrant consideration. First, the study relies on self-report measures of TDC, which may not correspond to demonstrated digital competence or actual classroom practices (Adewale, 2025; Tondeur et al., 2018). Second, the SELFIE for Teachers instrument assesses foundational dimensions of digital competence aligned with DigCompEdu but does not capture more advanced applications such as artificial intelligence integration, learning analytics, or adaptive platform use. Therefore, findings reflect teachers' self-perceptions of core digital pedagogical practices rather than their capacity to engage with emerging educational technologies. Third, voluntary participation may introduce self-selection bias, as teachers with greater interest in digital competence may be more likely to respond. Finally, the GLM models did not incorporate potentially relevant variables such as disciplinary field, organizational roles, or direct access to institutional supports.

4. Conclusions

The findings of this study suggest a contextual reading of TDC in higher education. In the context of accredited Colombian universities, gender differences in self-perceived digital competence were

small, whereas variation appeared more closely associated with institutional characteristics and specific competence domains. The structural conditions linked to High-Quality Accreditation—such as access to technological infrastructure, organised pedagogical support, and clearer governance expectations—may help create environments in which gender-based differences in self-perceived TDC are less pronounced. Rather than indicating that gender is irrelevant, these findings suggest that its role should be interpreted in relation to the institutional conditions under which digital teaching practices are developed and supported.

This interpretation has implications for faculty development and institutional digital transformation. From a policy perspective, universities should avoid relying primarily on broad remedial or gender-targeted digital training strategies when the evidence points to stronger variation by institutional context and competence domain. Faculty development may be more effective when it is transversal, differentiated by professional trajectory and pedagogical area, and attentive to the digital work involved in supporting students, regardless of who performs it. Digital transformation policies should also address structural inequalities between public and private institutions. More equitable development of TDC requires sustained investment in technological infrastructure and pedagogical support systems, particularly in public universities, rather than placing responsibility for digital adaptation mainly on individual teachers.

Future research should build on these findings by using longitudinal designs and performance-based measures of TDC to complement self-reported evidence. It would also be useful to extend the analysis to non-accredited institutions, where formal support structures may be less developed. In this sense, advancing teacher digital competence requires attention not only to individual characteristics, but also to the institutional ecosystems that enable, constrain, and give meaning to digital teaching practices.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

Ethical Implications

The study was conducted as part of a doctoral research project that received ethical approval on January 17, 2024, from the Institutional Review Board (IRB00003099), under protocol CER 012401. The study also received approval from a local ad hoc committee.

Authors' Contribution

Diego Fernando Ávila Clavijo: Conceptualization, methodology, investigation, data curation, formal analysis, visualization, and writing—original draft.

Cristina Mercader Juan: Methodology, formal analysis, supervision, and writing—review and editing.

Both authors reviewed and approved the final version of the article.

Declaration of Generative AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used a language model (LLM) tool for linguistic editing and structural improvement of the document. All content was subsequently reviewed, corrected, and validated by each of the authors, who assume full responsibility for the accuracy, integrity, and conclusions of the present work.

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