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Teacher digital competence in business schools: Challenges from the student's perception

Competencia digital docente en las escuelas de negocios: Retos desde la percepción del estudiante

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ABSTRACT

The increasing demand for digital talent in the job market has driven business schools to integrate digital business education into their curricula. However, ensuring that faculty members

possess sufficient Teacher Digital Competence (TDC) is essential for effectively training future professionals. This study evaluates whether business school faculty have the appropriate TDC to meet industry expectations, focusing on students' perceptions at ESIC Business & Marketing School in Barcelona. Using a validated adaptation of the COMDID-A test, combined with ad hoc questions, to assess TDC from students' perceptions, this research evaluates faculty TDC levels and explores the factors influencing students' assessments. Findings indicate that faculty digital competencies (DC) are primarily centred on teaching-learning processes, with higher scores in the didactic dimension. However, information and communication technologies (ICT) integration, responsible digital use, and personal and professional development received lower ratings, revealing key areas for improvement. Students highlighted limited innovation in ICT implementation, with faculty relying mainly on basic tools such as slides presentations and the learning management system (LMS) for one-way communication. Additionally, resistance to change, particularly among older faculty members, emerged as a potential barrier, while gender was not found to be a determining factor in TDC levels. These insights underscore the need for enhanced faculty training programs to foster a more interactive and pedagogically meaningful use of ICT. Given the study's case-based approach, future research should explore faculty self-perception vs. student assessments and conduct comparative analyses across business schools to determine whether these trends are consistent in different educational contexts.

Keywords. Teacher digital competence, COMDID-A, ICT integration, business schools, digital business education.

RESUMEN

La creciente demanda de talento digital en el mercado laboral ha llevado a las escuelas de negocios a integrar la educación empresarial digital en sus planes de estudio. No obstante, garantizar que el profesorado cuente con una Competencia Digital Docente (CDD) adecuada es fundamental para formar eficazmente a los profesionales del futuro. Este estudio evalúa si el profesorado de escuelas de negocios posee la CDD apropiada para satisfacer las expectativas del sector, centrándose en la percepción de los estudiantes de la ESIC Business & Marketing School en Barcelona. Utilizando una adaptación validada del test COMDID-A, junto con preguntas ad hoc, se analiza la CDD del profesorado desde la perspectiva estudiantil, evaluando los niveles de competencia digital y los factores que influyen en dicha valoración. Los resultados indican que las competencias digitales del profesorado se concentran principalmente en los procesos de enseñanza-aprendizaje, obteniendo puntuaciones más altas en la dimensión didáctica. Sin embargo, la integración de las tecnologías de la información y de la comunicación (TIC), el uso responsable de las tecnologías y el desarrollo personal y profesional recibieron valoraciones más bajas, lo que revela áreas clave de mejora. Los estudiantes destacaron una escasa innovación en la implementación de las TIC, señalando que el profesorado se limita mayormente al uso de herramientas básicas como presentaciones en diapositivas y el sistema de gestión del aprendizaje (LMS) para una comunicación unidireccional. Además, se identificó la resistencia al cambio, especialmente entre docentes de mayor edad, como una posible barrera, mientras que el género no resultó ser un factor determinante en los niveles de CDD. Estas conclusiones subrayan la necesidad de fortalecer los programas de formación docente para promover un uso más interactivo y pedagógicamente significativo de las TIC. Dado el enfoque de estudio de caso, se sugiere que futuras investigaciones exploren la autopercepción del profesorado frente a la evaluación de los estudiantes y realicen análisis comparativos entre escuelas de negocios para determinar si estas tendencias se replican en otros contextos educativos.

Palabras clave. *Competencia digital docente, COMDID-A, integración de las TIC, escuelas de negocios, educación empresarial digital.*

INTRODUCTION

The emergence of artificial intelligence and digitalization has intensified the search for digital talent by companies, which seek professionals capable of leading and adapting to a highly competitive market (Montero Guerra & Danvila-Del Valle, 2024).

Information and Communication Technologies (ICT) are a set of tools that enable the acquisition, storage, processing, transmission, and presentation of information electronically in all areas, including education, where they can facilitate knowledge acquisition (Majee, 2019; Mishra et al., 2010). ICT encompasses the digital tools and systems that facilitate communication, information processing, and technological innovation. According to Eurostat (2024), the demand for ICT professionals has grown substantially, reporting a 59% increase in ICT-related employment, far outpacing general employment growth (10,7%). This trend underscores the rising need for digital talent in various industries, prompting businesses to intensify their efforts to attract and retain skilled professionals.

Barcelona has emerged as a significant hub for digital employment, with companies actively seeking specialized talent to sustain their competitiveness. According to the latest report from Mobile World Capital Barcelona (2024), the city now hosts 122,185 digital professionals, marking a 12.4% increase in digital talent supply compared to the previous year and almost a 70% increase since 2018. The demand for digital professionals has doubled in the last five years, highlighting the growing importance of digital expertise. The overall trend reflects an increasing reliance on digital talent. This dynamic job market has driven business schools and universities to progressively adapt their academic offerings, introducing degree programs focused on digital business, technology, and innovation. In this regard, academic training plays a fundamental role in preparing future professionals, as 83,8% of the ICT professionals in Spain have tertiary education (Eurostat, 2024).

Given the increasing reliance on digital skills across industries, it has become crucial to establish frameworks for assessing and improving Digital Competencies (DC). DC is a multifaceted concept that encompasses a range of skills and competencies, such as technical proficiency, critical evaluation of digital technologies, and the motivation to engage in digital culture (Ilomäki et al., 2014). These competencies encompass a broad range of abilities, including information literacy, digital communication, content creation, cybersecurity, and problem-solving in digital environments. Various international organizations, such as the European Commission with its DigComp framework (Joint Research Centre, 2022), have developed structured methodologies to measure DC at different proficiency levels. DC is based on the responsible use of ICT, moving from the simple accumulation of data to its transformation into information to build knowledge. However, Tondeur et al. (2023) proposed the HeDiCom as a specific framework for Higher Education teachers' digital competencies, including four dimensions: teaching practice, empowering students for a digital society, teachers' digital literacy, and teachers' professional development.

Business schools are the primary providers of degrees in the digital-business domain that is, programs whose core curriculum targets the creation, scaling, and governance of digital business models and operations (e.g., platforms and ecosystems, data/analytics for value capture, e-commerce, martech, AI-enabled processes). In Barcelona's 2025 landscape, our scan identified 40 such business-related degrees; all but one are delivered by private business schools. This pattern underscores the central role of business schools in structuring and expanding the digital business education offer (Table 1).

Table 1. Digital business-related degrees by public and private educational institutions in Barcelona, 2025

#	Degree	Institution
1	Programs in Web Development and UX/UI Design	CEI Escuela de Diseño
2	Bachelor's Degree in Digital Business and Tourism Innovation	CETT-UB (affiliated with Universitat de Barcelona)
3	Postgraduate in Data Analytics	EADA Business School
4	Postgraduate in Digital Transformation for SME Executives	EADA Business School
5	Postgraduate in Digital Marketing Management	EADA Business School
6	Postgraduate in HR Innovation	EADA Business School
7	Digital Accelerator Program	EAE Business School
8	Master's Degree in Innovation and Entrepreneurship	EAE Business School
9	Master's Degree in Marketing Management and Commercial Strategy	EAE Business School
10	Bachelor's and Master's Degree in Digital Management	Epitech
11	Executive Master in Business Analytics (EMIBA)	ESADE Business School
12	Executive Master in Digital Business, Innovation & Entrepreneurship	ESADE Business School
13	Executive Diploma in Business Analytics	ESADE Business School
14	Executive Diploma in Digital Business, Innovation & Entrepreneurship	ESADE Business School
15	Digital Transformation Program	ESADE Business School
16	Master's Degree in Innovation and Entrepreneurship	ESEI International Business School
17	Bachelor's Degree in Digital Business	ESIC Business & Marketing School
18	Higher Degree in Digital Business	ESIC Business & Marketing School
19	Higher Degree in Innovation and Entrepreneurship	ESIC Business & Marketing School
20	Bachelor of Arts in Digital Business, Design & Innovation	EU Business School Barcelona
21	Master in Digital Business	EU Business School Barcelona
22	MBA in Digital Business	EU Business School Barcelona
23	Bachelor's Degree in Sports Management and Digitalization	Euncet Business School
24	Bachelor's Degree in Business, Innovation, and Technology	Euncet Business School
25	Bachelor's Degree in Marketing, Innovation, and Technology	Euncet Business School
26	Master's Degree in Marketing and Digital Communication Management	Euncet Business School
27	Programs in Digital Transformation and Entrepreneurship	IEBS Business School
28	Master's Degree in Innovation Management (MBI)	IL3 - Universitat de Barcelona
29	Programs in Digital Marketing and Business Management	IM Digital Business School
30	Programs in Digital Innovation and Artificial Intelligence	INESDI Business Techschool
31	Bachelor's Degree in Digital Business Design and Innovation	La Salle Campus Barcelona

32	Master's Degree in Technology Management and Digital Innovation	La Salle Campus Barcelona
33	Master's Degree in Digital Product Management	Nuclio Digital School
34	Master's Degree in AI: Business & Innovation	Nuclio Digital School
35	Master's Degree in Digital Marketing: Analytics, SEO/SEM & Paid Social	Nuclio Digital School
36	Master's Degree in Human Resources: Innovation, Strategy, and Leadership	Nuclio Digital School
37	Master's Degree in Data Analytics	Nuclio Digital School
38	Master's Degree in Digital Transformation	OBS Business School
39	Master's Degree in Digital Marketing, Growth Hacking, and eCommerce	OBS Business School
40	Master's Degree in Digital Business Administration	Universitat de Barcelona (UB)

This digital business education offering includes undergraduate degrees, master's programs, and higher-level qualifications aimed at training digital talent to meet the needs of the labour market. This shift aligns with the dual demand: businesses require professionals with digital skills, and students seek education tailored to the evolving digital economy. Business schools, particularly private ones, have responded with agility, reshaping their curricula to meet market needs by integrating digital business concepts and technological innovation into their programs.

However, equipping future business professionals with DC requires that the faculty responsible for delivering these programs also possess the necessary DC. This brings to light the concept of Teacher Digital Competence (TDC). The first references to TDC emerged in 2008, linked to the "ICT Competency Framework for Teachers" proposed by (UNESCO, 2008). Another key moment in the development of the TDC concept dates back to 2013, associated with a communication from the European Commission titled "Opening up Education: Innovative Teaching and Learning for All through New Technologies and Open Educational Resources" (Pérez-Escoda & Rodríguez-Conde, 2015).

We adopt a conceptualization of TDC that goes beyond basic proficiency in using digital tools for instructional purposes (such as managing virtual classrooms, using learning management systems, and handling digital content), to their application and pedagogical integration in authentic learning contexts (Ilomäki et al., 2014), consistent with the DigCompEdu and HeDiCom frameworks.

To connect classroom practice with firm-level demands, we interpret TDC through the lens of digital (dynamic) capabilities—the ability to sense digital opportunities, seize them via learning design and assessment, and reconfigure routines through continuous professional development (Teece, 2007). This framing links teachers' digital practice in business schools with the skill profiles required in digital-business contexts (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Vial, 2019; Warner & Wäger, 2019).

Through the adaptation of the COMDID-A test (Lázaro-Cantabrana & Gisbert Cervera, 2015), originally designed as a self-perception test for TDC, this study examines the perceptions of students in the Degree Area at ESIC Business & Marketing School in Barcelona regarding their faculty TDC. As a private business school that has actively adapted its educational offerings to align with market demands, ESIC provides a relevant case study for evaluating the impact of digital competencies among faculty in contrast to the student's expectations. In this specific context, TDC involves a deeper understanding of how to effectively teach digital business concepts and prepare students for the demands of the digital economy (Tondeur et al. 2023).

While Teacher Digital Competence (TDC) in higher education is well framed by established models (e.g., DigCompEdu, HeDiCom, COMDID), most evidence relies on teacher self-reports and seldom focuses on business schools and the digital-business domain. Moreover, when self-

assessment tools such as COMDID-A are adapted to third-party (student) evaluation, psychometric properties cannot be assumed. These gaps limit how findings can inform programme-level decisions in business schools. Our study addresses this by adapting COMDID-A to student perceptions, reporting reliability/CFA evidence, and integrating qualitative insights to connect results with digital-business needs.

Adopting DigCompEdu and HeDiCom as reference, the general objective of this study is to evaluate whether faculty members at business schools possess sufficient TDC to effectively train future professionals in the digital business sector within the current context of rapid technological and educational change.

To achieve this goal, the study is guided by the following specific research objectives:

1. To evaluate faculty TDC from the perspective of the students.
2. To explore the factors influencing the perceptions of the students.

The insights derived from this research will contribute to a better understanding of the impact of faculty digital competencies on the perceived quality of education by students in business schools, identify key areas for improvement in faculty digital competencies, and inform future faculty training initiatives to ensure alignment with both industry needs and student expectations.

LITERATURE REVIEW

Digital transformation has radically changed the way businesses operate, generating an increasing demand for professionals with digital skills. Various studies have analysed this phenomenon and identified how automation, artificial intelligence, and process digitalization have transformed the professional profiles required in the job market. Kuznetsova A. et al., (2021) analysed how the development of the digital economy is transforming the labour market structure by reducing part of the workforce and increasing demand in the information technology sector in Russia and the European Union. In turn, Hubschmid-Vierheilig et al. (2020), focused on the UK and Switzerland, emphasize the need to enhance workforce digital competencies for business competitiveness and highlight that while some organizations hesitate to invest in digital upskilling, others leverage digitalization to strengthen employees' skills with company-specific competencies, supported by tailored human resource development programs from educational institutions. Also, Brown et al. (2021) highlight how digitalization has driven the emergence of micro-credentials to develop specific digital competencies in response to market demand. Batić et al., (2021) spotlight that governments and companies play a crucial role in this process, particularly through higher education initiatives that adapt curricula to develop a digitally skilled workforce. Taken together, these studies map demand-side shifts and heterogeneous upskilling responses, yet they largely remain at the macro/meso level and leave underexplored the micro-level teaching practices through which business schools cultivate students' readiness for digital business.

In response to this demand, higher education institutions have had to transform their academic offerings to align with market needs. This has led to the introduction of new degrees and programs focused on digital business and technology. Kaputa et al. (2022) report that digital transformation in higher education has prompted the redesign of academic programs in technology and digital business fields. Vicente et al., (2020), centred on Portuguese universities and polytechnic institutes, point out that strategic planning and faculty perceptions regarding digital innovation remains limited.

While this literature explains why programmes are being redesigned and why digital-business degrees have proliferated, it often remains at the institutional or labour-market level. To connect this macro/meso evidence with what happens inside courses, we adopt a digital dynamic capabilities (DDC) perspective. DDC explains how organisations respond to digital change through mechanisms of sensing, seizing, and reconfiguring (Teece, 2007; Vial, 2019; Warner & Wäger, 2019). In our context, these mechanisms provide a concise vocabulary to interpret how teachers'

digitally mediated practices can translate digital pressures into learning value and, ultimately, into programme-level readiness for digital business.

Accordingly, throughout the paper we use sensing-seizing-reconfiguring not as an additional competence framework, but as an interpretative lens to connect observed TDC profiles with the capability-building work that business schools are expected to perform in the digital economy.

The COVID-19 pandemic marked a turning point in the digitalization of higher education. This is confirmed by various studies, emphasizing that while digitalization was already underway, the health crisis triggered emergency online teaching and rapid shifts in teaching/assessment models (García-Peñalvo & Corell, 2020; Kaqinari et al., 2021). Beyond infrastructure, studies identify teacher- and student-level factors shaping digital learning success (Engel et al., 2023). At an institutional level, digital transformation is framed as a driver of change—extending to program redesign and social-innovation goals—based on students' post-lockdown experiences (Kaputa et al., 2022). Beyond the impact of COVID-19, several studies have highlighted the importance of assessing and developing digital competencies among higher education faculty. This is not only about adapting teaching to the digital environment but also about ensuring that educators have the necessary skills to train professionals in the digital field. Kaqinari et al. (2021) investigate the adaptation process of university faculty to digitalization, identifying heterogeneous adaptations to online teaching and challenges and opportunities in faculty training. Cesco et al. (2021) analyse job market skill demands and enrolment trends in technical-scientific higher education programs in Europe. The study evaluates how digital teaching tools and methods can enhance student training. It also identifies different higher education program models that can address future educational challenges.

As a foundational view, DC has been described as a universal competency essential for functioning in contemporary society (Krasna, 2010). Early accounts also encompass ethical digital literacy, technological literacy, digital literacy in reading and writing, informational literacy, digital visual literacy, new media literacy, communication and collaboration literacy, and social media literacy (Avni & Rotem, 2019). In this context, DC is established as fundamental for addressing the challenges posed by digitalization, and education is seen as the key to promoting its development (Ilomäki et al., 2016).

TDC is a multifaceted concept that combines technical and pedagogical skills. While Instefjord (2014) warned about challenges in integrating technology into teacher education—highlighting the tension between mastery and appropriation, as well as resistance to technology—other studies, such as Esteve-Mon et al. (2020), highlight that university faculty should reach high levels of digital competence, particularly in the pedagogical use of technology based on a systematic review of studies indexed in WoS and Scopus. Read through the DDC lens, this multifaceted nature of TDC can be interpreted as a set of micro-foundations for capability building: sensing (e.g., information literacy and responsible/ethical use), seizing (learning design, assessment, and ICT integration beyond slides/LMS), and reconfiguring (ongoing professional development and iterative course redesign) (Teece, 2007; Vial, 2019; Warner & Wäger, 2019). This framing helps link teacher competence profiles to the mechanisms through which business schools can cultivate digital-business readiness.

In this context, adequate teacher preparation is not optional. Building on a systematic review of research (2008–2018), Starkey (2020) shows that teacher preparation is increasingly organised around digital competencies—framed as generic digital competence, digital teaching competence, and professional digital competence—as schooling evolves with deeper technology integration; thus, current and future educators must align their competences with this digital landscape.

The development of TDC is crucial for educators, as it not only enhances their ability to effectively use digital media and content (Seufert et al., 2019) but also fosters teaching innovation (Garzón Artacho et al., 2020). However, there is a significant deficit in these competencies among

teachers, particularly in digital content creation (Garzón Artacho et al., 2020; Napal Fraile et al., 2018). This highlights the urgent need for specific training and support in this area.

A series of studies have explored the development of TDC. Reisoğlu & Çebi (2020) emphasize the need for training programs that cover information and data literacy, communication and collaboration, digital content creation, security, and problem-solving. Similarly, Seufert et al. (2019) highlight the importance of online professional learning communities in fostering these competencies, focusing on content knowledge, pedagogical content knowledge, and pedagogical knowledge. Napal Fraile et al., (2018) underscore the need to deliberately incorporate the relational and didactic aspects of ICT integration into teacher training. Collectively, these studies suggest that a combination of training programs, online communities, and intentional ICT integration can effectively develop Teacher Digital Competence.

Since the emergence of the TDC concept (UNESCO, 2008), interest and research on this topic have continuously grown. Punie y Redecker (2017) proposed the DigCompEdu framework, which serves as the European Commission's reference for the development of TDC. A recent systematic review of TDC in higher education reports a predominance of teacher self-report (Basilotta-Gómez-Pablos et al., 2022). As an example of faculty self-perception designs, Viñoles-Cosentino et al. (2022) surveyed university TDC, reporting overall intermediate levels and sharper strengths in technical/professional aspects than in pedagogical integration.

Although research on TDC in higher education is sizeable, comparative business-school evidence remains limited. Where international comparisons within business schools exist, they typically emphasise broader teaching-effectiveness dimensions and reveal contextual variation (Simendinger et al., 2017), while regional analyses report between-site differences in perceived digital teaching skills (Torres Molina, 2021). This scarcity and heterogeneity both motivate our case-study focus and, crucially, call for a common measurement yardstick to enable cumulative, multi-institution comparisons. We therefore rely on COMDID-A—a higher-education instrument with a transparent operationalisation of TDC—and adapt its items for student perception to capture enacted practice (i.e., the teaching routines through which sensing–seizing–reconfiguring may or may not materialise in the classroom), while testing reliability and factorial structure to ensure the adapted use is psychometrically sound.

Given the scarcity and heterogeneity of comparative evidence in business-school settings, a standardised instrument is needed to support valid multi-institution comparisons. In this sense, other studies highlight the necessity and importance of TDC (Palau & Mogas, 2022) and, consequently, the need to assess it (Palau et al., 2019), which has led to the development of evaluation tools for different educational levels. Among these, the COMDID-A (Lázaro-Cantabrana & Gisbert Cervera, 2015) stands out as a peer-reviewed instrument specifically designed to assess TDC in the university context through self-perception. Their article reports the development and validation of the scale, grounded in expert review and structured process to define dimensions, indicators and developmental levels, providing a transparent operationalisation of TDC for higher education. COMDID-A provides a structured framework based on a hierarchy of four dimensions: that encompass indicators through which teachers indicate their level of competence: (D1) didactic, curricular and methodological; (D2) planning, organisation and management of spaces and digital technological resources; (D3) relational, ethical and security; and (D4) personal and professional development.

Lázaro-Cantabrana & Gisbert Cervera (2015), based their definition on reports from international organizations such as UNESCO (2008, 2014) and the European Commission (2013), as well as the International Society for Technology in Education (ISTE, 2008). They also drew on the process described by Larraz (2013), based on Mertler's (2000) work, for defining dimensions, the 22 indicators, and four levels of development (Churches, 2007) related to TDC: beginner, intermediate, expert and transformational levels. Other significant contributions include the Enlaces report (2011) from the Chilean Ministry of Education, which proposes dimensions and indicators

for TDC; Fraser et al. (2013), who offer a structural perspective on the dimensions; and the Generalitat de Catalunya (2013, 2022), which defines four areas of TDC: the classroom, the school, the environment and the educational community, as well as the professional development. This theoretical foundation ensures that COMDID-A is structured based on widely recognized criteria for assessing TDC.

A related tool, the COMDID-C (Lázaro-Cantabrana et al., 2019), extends this approach by incorporating concrete evidence of use and application in the classroom. Both instruments, along with other existing assessment tools, primarily rely on knowledge tests or self-perception questionnaires, which have been validated and proven useful.

However, these approaches do not incorporate students' perspectives, despite their role as key stakeholders in the development of TDC. To address this limitation, we adapt COMDID-A—originally designed for university educators' self-assessment—to a student-perception format, shifting the focus from self-perceived competence to students' observations of teachers' digital practice. This provides a complementary, practice-proximal view of TDC in higher education and sets the stage for the instrument adaptation and validation reported in the next section.

METHODOLOGY

Research design

For the development of this research, an adapted version of COMDID-A was used to assess TDC from the students' perspective. As described in the theoretical framework, this solution has been validated in various contexts (Lázaro-Cantabrana et al., 2018; Lázaro-Cantabrana & Gisbert Cervera, 2015). Its specific focus on university-level assessment made it particularly suitable for the research objectives.

The adaptation of COMDID-A for measuring digital competence retained its original structure while adjusting the wording for third-party use and including precise instructions to facilitate collective rather than individual assessment. Prior to the analysis of results, this adapted version of COMDID-A underwent a pilot phase using a mixed-methods approach with a sample of 24 students. The results from this preliminary stage were excluded from the final analysis, as enough areas for improvement were identified to justify discarding its initial use.

Subsequently, the revised version of the questionnaire was statistically validated using confirmatory factor analysis (CFA) with the Diagonally Weighted Least Squares (DWLS) estimator, selected according to sample size and the ordinal nature of the variables. The sampling adequacy analysis yielded an overall KMO of 0.471. Although this value falls below the conventional 0.50 criterion, it may be considered marginally acceptable given the exploratory and preliminary nature of the study and the sample size limitations (n = 79). Bartlett's test of sphericity was significant ($p < 0.001$), confirming the presence of sufficient correlations among the variables to proceed with factor analysis.

Although the chi-square test was significant, which is common in models with moderate sample sizes, other fit indices suggested an overall satisfactory model fit. Specifically, GFI = 0.929 and CFI = 1.000 exceeded recommended thresholds, while TLI (≈ 1.00) and RMSEA = 0.000 indicated excellent fit (Hooper et al., 2008; Hair et al., 2019). The SRMR (0.098) and NFI (0.766) were slightly below recommended values; however, such deviations alone are not sufficient to reject model adequacy, particularly in samples smaller than 100 cases (Hair et al., 2019).

Factor loadings were examined, with most exceeding the commonly accepted minimum threshold of 0.30, indicating acceptable convergence between items and their latent constructs (Tavakol & Wetzel, 2020). Nevertheless, some loadings were close to or slightly below this reference value, which may have contributed to the moderate McDonald's omega coefficients observed across dimensions (D1 = 0.560; D2 = 0.529; D3 = 0.478; D4 = 0.594). Because reliability estimates are directly influenced by the magnitude of factor loadings and are sensitive to both

sample size and the number of items per construct, lower omega values are not unexpected in small-sample preliminary validation studies (McNeish, 2018). Moreover, reliability thresholds should not be interpreted rigidly, as their adequacy depends on the research context, instrument purpose, and stage of development (Taber, 2018).

It is important to clarify that this study does not involve the construction or full psychometric validation of a new instrument. Rather, it is based on an adaptation of the already validated COMDID-A questionnaire, which served as the conceptual and structural foundation for the present measurement approach. The decision to use COMDID-A as a starting point was grounded in its prior validation and theoretical robustness. The present study therefore aimed to examine the applicability and structural coherence of this established framework when adapted to a different stakeholder group—students—thus providing an external assessment distinct from the original self-assessment design. In this sense, the CFA results should be interpreted as preliminary evidence supporting the transferability of the original factorial structure to an external evaluative context, rather than as a de novo validation process.

In this adapted version, two additional questions were included at the end of the questionnaire, ensuring they did not influence the evaluation of the indicators for measuring TDC. In line with the first specific research objective an overall evaluation using a five-point Likert scale was added. Additionally, according to the second specific research objective an open-ended question was included to explore the reasons behind the given rating. This addition provided a more comprehensive perspective on digital competence assessment, incorporating a qualitative dimension that enhanced the understanding of the phenomenon and allowed for the identification of key aspects highlighted by students, potential barriers to the adoption and implementation of TDC and relationships between specific aspects and the overall assessment of digital competence.

The questionnaire also included sociodemographic variables—gender, age, and nationality—and academic variables such as year of study and prior educational background. These variables were used to monitor sample composition to ensure representativeness and served as potential factors for subgroup analysis. We use student perceptions as a third-party indicator because they capture enacted practice in day-to-day teaching, complementing teacher self-reports. However, student ratings can be affected by non-instructional biases (e.g., halo/leniency, course difficulty/grades, gender/ethnicity effects) and do not automatically index learning. Prior syntheses and meta-analyses document these concerns and caution against using student ratings as a sole measure (Benton & Cashin, 2014; Spooren, Brockx, & Mortelmans, 2013; Uttl, White, & Wong Gonzalez, 2017), with more recent reviews reiterating validity and rater-bias issues (Stroebe, 2020; Stoesz, De Jaeger, Quesnel, Bhojwani, & Los, 2022; Quansah, Cobbinah, Asamoah-Gyimah, & Hagan, 2024). We mitigated these risks by rewording items for third-party use, giving clear instructions to rate typical practices rather than individual teachers, combining the scale with an open-ended prompt for context, and by testing reliability and factorial structure before interpretation.

Target

For this study, the target population was defined as students enrolled in the official Marketing degree program taught in Spanish at the ESIC Business & Marketing School campus in Barcelona. The institution is affiliated with the Universitat Rovira i Virgili in Catalonia and, at the time of fieldwork, had 56 professors, including full-time and part-time professors, with a distribution of hours among teachers such that 48% of them delivered 73% of the total teaching hours.

Additionally, the course and reference period for responses were considered. Since some participants had been at the institution for several years, it was necessary to limit their opinions to the period from the beginning of the 2022-2023 academic year until the fieldwork date (November and December 2024). This approach also avoided the potential influence of the exceptional measures implemented during the most restrictive phases of the COVID-19 pandemic. Under this criterion, first-year students were excluded from participation, as they would not have had sufficient

experience to form a well-rounded opinion given their recent enrolment and their comparatively limited qualitative and quantitative knowledge.

Given the single-site design in a private Spanish business school, generalizability is inherently limited, and findings should be interpreted as analytically rather than statistically generalisable.

Data collection

Regarding the tool used for data collection, Microsoft Forms was chosen for its advantages in managing fieldwork and data cleaning. Its integration with the institution's credential system ensured controlled access to the questionnaire, allowing only institutional members to participate and ensuring they could do so only once. Authentication through institutional credentials allowed the system to register responses linked to student enrolment numbers; however, no personal identifiable information was collected, and access to raw data was limited to a single member of the research team. Participation was entirely voluntary, and respondents were informed of this condition, the applicable ethical and privacy standards, and their consent was obtained prior to data collection. A dedicated email address was provided to enable participants to exercise their rights under the GDPR and ethical standards. All data were anonymized during the transfer to the research team's local devices. Additionally, the platform enabled the collection of information regarding the time and duration of the questionnaire completion process to detect anormal completing time during data cleaning.

For the fieldwork, a self-administered approach was adopted to complete the questionnaire. Following the experience gained during the pilot phase, the fieldwork was conducted in person, allowing for an emphasis on evaluating competence rather than use, as well as focusing on the collective assessment of the teaching staff.

Data analysis

Given that the aim was diagnostic, we report both means, to summarise central tendency, and frequency distributions, to make multimodality visible, improving interpretability of item-level patterns. The indicators retained their original five-point scale, represented by values ranging from 0 to 4, where 0 indicated a lack of competence, allowing for more intuitive interpretation. The same approach was applied to the overall evaluation.

For the numerical assessment of each of the four dimensions, the average score of the corresponding items was calculated, as the original COMDID-A questionnaire authors did not propose specific weightings in their publication (Lázaro-Cantabrana et al., 2018; Lázaro-Cantabrana & Gisbert Cervera, 2015).

Regarding the open-ended question on the reasons underlying the overall competence evaluation, responses were qualitatively examined through discourse analysis, focusing on interpretative patterns and the meanings conveyed in participants' narratives rather than on mere textual features. Subsequently, open-ended responses were first categorized based on sentiment polarity (positive, negative, neutral). Within each sentiment category, thematic coding was conducted to identify recurring patterns and concepts. All three researchers independently reviewed the responses and developed initial codes. Coding discrepancies were minimal, affecting less than 10% of the total coded segments, and were addressed through a negotiated agreement process. During this process, all differences were resolved through discussion reaching a full consensus on the final themes, following established recommendations that emphasize consensus-building and interactive discussion over sole reliance on statistical indices of inter-coder reliability for ensuring rigor in qualitative coding (Olson et al., 2016; Hemmler et al., 2020). Consequently, given this high level of initial convergence, no formal inter-coder reliability statistics were considered necessary.

Differences in TDC assessment results were examined across gender, year of study, age, prior education, and nationality. Additionally, the reasons provided for the overall TDC evaluation were

analysed across categories of the global rating. Pairwise comparisons were performed using Z-tests for proportions with Holm adjustment to control the familywise error rate. Omnibus differences were assessed using chi-square tests, and exact Monte Carlo p-values were computed to address small expected cell counts when possible. Given the small sample sizes and presence of extreme values in some contingency table cells, exact tests such as Fisher's exact test were considered; however, these tests are often overly conservative and have lower power to detect true differences. Therefore, Z-tests for proportions and chi-square tests were preferred as they generally maintain better control of Type I error rates and offer higher statistical power in small-sample contexts, except when sample sizes are extremely small (Collins & Morris, 2008; Cheng & He, 2021). To address concerns about small expected counts, exact Monte Carlo p-values were computed when possible, providing a computationally intensive but more accurate alternative to traditional asymptotic approximations (Campbell, 2007). The Holm adjustment was applied to pairwise comparisons to control the familywise error rate, ensuring robust inference despite multiple testing. This approach balances the need for sensitivity in detecting meaningful differences with appropriate error control under challenging data conditions (Collins & Morris, 2008; Campbell, 2007; Cheng & He, 2021).

Confirmatory Factor Analysis (CFA) was conducted using JASP (version 19), whereas the assessment of Technological Digital Competence (TDC) was performed with IBM SPSS Statistics (version 26).

Sample description

The total sample obtained was 124 out of 187 potential participants, representing approximately 66% participation, with non-attendance in class identified as the main reason for non-participation and no significant sociodemographic or academic differences were detected when comparing with total population composition.

Despite the considerable participation rate, the data cleaning process revealed exceptionally short and long completion times, which could be indicative of low response quality (Krosnick and Presser, 2010), as well as anomalous response patterns. To ensure the highest response quality, these records were removed, reducing the sample to 79 valid cases, representing 42% of the study population.

The following section presents the sample composition, detailing sociodemographic variables (Figure 1) and academic variables (Figure 2) as percentages:

Figure 1. Sample composition by sociodemographic variables.

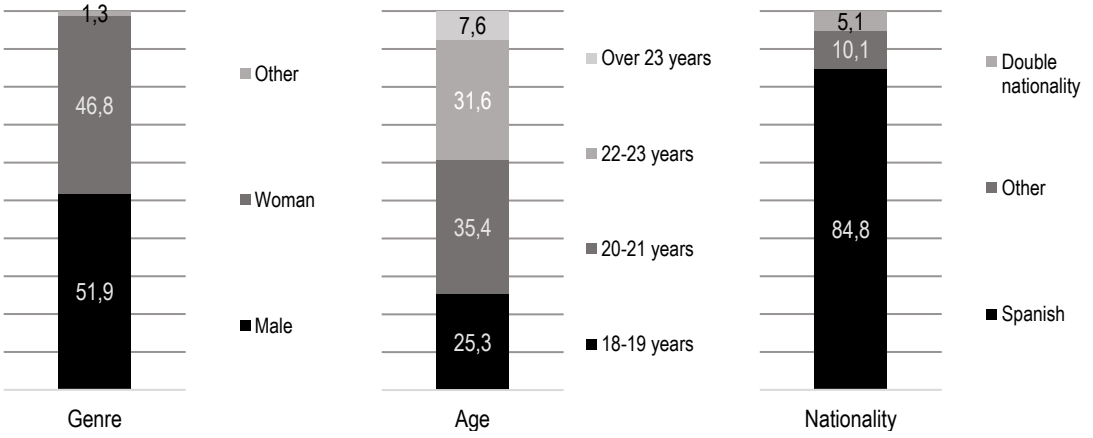
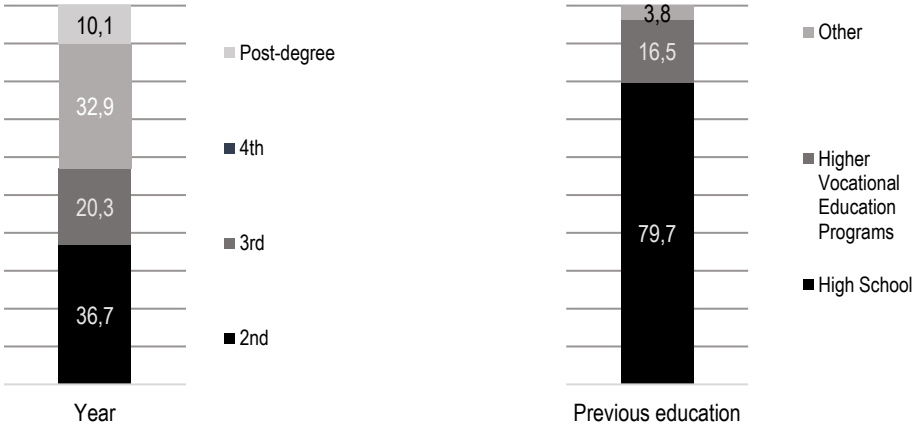


Figure 2. Sample composition by academic variables



RESULTS

The findings of the study are structured around the two specific research objectives. First, the results provide an assessment of faculty Teacher Digital Competence from the students' perspective (OBJ 1), based on the 22 indicators across the four dimensions of TDC including rank by average, average score and detailed through frequency counts (Table 2).

Table 2. Classification of indicators, dimensions, and overall evaluation according to the average score

			Frequency count (%)				
	Rank	Average	0	1	2	3	4
Indicators							
11 - Digital technologies as learning enablers	6	2,70	0	21,5	17,7	30,4	30,4
12 – Teacher's Digital Competence in teaching planning	1	3,14	0	12,7	13,9	20,3	53,2
13 - The treatment of information and creation of knowledge	3	2,76	1,3	13,9	17,7	41,8	25,3
14 - Attention to diversity	20	1,97	15,2	17,7	30,4	27,8	8,9
15 - The methodological line of the center	15	2,38	1,3	16,5	34,2	39,2	8,9
16 - Evaluation, tutoring and monitoring of students	5	2,71	1,3	25,3	15,2	17,7	40,5
21 - Management of digital technologies and software	4	2,72	0	11,4	25,3	43	20,3
22 - Learning environments	18	2,27	5,1	21,5	32,9	22,8	17,7
23 - Spaces with digital technologies of center	7	2,68	1,3	5,1	32,9	45,6	15,2
24 - Projects of incorporation of digital technologies	19	1,99	3,8	25,3	45,6	19	6,3
25 - Digital technology infrastructures	9	2,52	1,3	26,6	19	25,3	27,8
31 - Ethics and security	21	1,96	1,3	51,9	12,7	17,7	16,5
32 - Digital inclusion	13	2,42	3,8	21,5	17,7	43	13,9
33 - Communication, diffusion and transfer of knowledge	8	2,66	1,3	26,6	10,1	29,1	32,9

34 - Digital identity of the center	16	2,30	0	38	20,3	15,2	26,6
35 - The educational community	11	2,47	2,5	17,7	25,3	39,2	15,2
41 - Personal Learning Environments (PLE)	22	1,85	0	36,7	45,6	13,9	3,8
42 - Digital identity and presence	10	2,49	2,5	27,8	20,3	16,5	32,9
43 - Leadership in the use of digital technologies	12	2,43	3,8	12,7	40,5	22,8	20,3
44 - Virtual learning communities: formal, non-formal and informal	2	2,78	1,3	21,5	13,9	24,1	39,2
45 - Lifelong learning	17	2,30	3,8	21,5	27,8	34,2	12,7
46 - Creation and dissemination of educational material with open licenses	14	2,41	3,8	10,1	38	38	10,1
Dimension							
D1 Aggregated Indicator - Didactic, curricular, and methodological dimension	1	2,61	-	-	-	-	-
D2 Aggregated Indicator - Planning, organization, and management of digital technological spaces and resources	2	2,44	-	-	-	-	-
D3 Aggregated Indicator - Relational, ethical, and safety	4	2,36	-	-	-	-	-
D4 Aggregated Indicator - Personal and professional	3	2,38	-	-	-	-	-

Overall Evaluation	-	2,16	0	12,7	62,0	21,5	3,8

Note. The indicators were numerically identified, with the first digit representing the dimension to which they belong and the second digit indicating the specific indicator within that dimension.

The results indicated that aspects related to the didactic, curricular, and methodological dimension (D1) were generally the highest rated. Notably, students' perception of teachers' digital competence in lesson planning stood out well above all other aspects analysed: approximately 75% of students rated the teachers' competence level as either expert or transformative. Following closely, but still highly relevant within a professional context, were information management and knowledge creation, with 67% of students considering the teachers to be at an expert or transformative level, and technologies as facilitators of learning, rated as expert or transformative by 61% of the students.

These results are highly significant, as they reflect complementary indicators within the context of a business school, where developing DC, utilizing ICT, and promoting responsible information use are key elements.

The evaluation, tutoring, and monitoring of students also received a high average score, although 25% of the students rated the competence level as beginner.

Among the aspects included in this dimension, it is worth highlighting that the knowledge of how to use ICT to support diversity was one of the lowest-rated indicators. Furthermore, this indicator showed a significantly higher value for the "incapable" level (0) compared to other items, making it the most notable competence gap among teachers.

Regarding the remaining dimensions, they obtained very similar average scores, around 2.4 out of 4. However, Dimension 2 stood out by placing three competencies among the ten highest-rated: the management of digital technologies and software, the use of digital spaces within the institution, and digital infrastructure. These competencies are highly relevant in the business context, as they address aspects related to the practical use of technology, which is essential in a digital business

environment. However, the integration of ICT into the development of the institution's educational project and the use of technology in the classroom ranked among the lowest-rated indicators.

Dimensions 3 and 4 only stood out for the use of ICT to access third-party educational content and as a communication tool.

Regarding areas with significant room for improvement, one of the most notable was the indicator related to ethics and safety in ICT use. This includes aspects such as responsible and secure use, respect for copyright, and the digital management of resources for self-learning or Personal Learning Environments (PLE).

Concerning the students' overall evaluation of TDC, approximately 90% considered that teachers had at least an intermediate or higher competence level. However, this result may not be as positive as it initially appears, as the majority opinion rated the level as intermediate (62%), while only 3.8% considered it to be very high.

These results were further analysed comparatively across gender, course, age, prior education, and nationality, without identifying any significant differences worth considering for the analysis. This finding suggests that the perception of digital competence was not related to students' characteristics, including the specific set of teachers who had taught each course and group during the analysed period.

Second, the analysis explores the factors shaping these perceptions (OBJ 2), drawing from qualitative insights to identify key themes influencing students' views. To gain a better understanding of how the teaching staff's digital competence level was perceived, an open-ended question was included to explore the reasons behind the overall evaluation to detect improvement areas.

The qualitative analysis of open-ended responses revealed a consistent perception among students that the faculty's overall level of digital competence was moderate, reflecting notable advances alongside persistent limitations. Participants frequently acknowledged that most lecturers were able to use standard digital tools—such as the institutional learning platform, presentation software, and online submission systems—yet their use remained largely functional rather than pedagogically innovative. Digital technologies were perceived as supporting instructional delivery and administrative management rather than transforming teaching and learning dynamics.

A central emergent pattern across responses was the heterogeneity of digital proficiency within the faculty. Students repeatedly highlighted a generational divide, suggesting that younger instructors or those with recent professional development demonstrated higher levels of digital fluency, whereas more senior faculty tended to rely on traditional methods and displayed resistance or insecurity when adopting new technologies. This generational difference was frequently cited as a primary reason for the perceived medium level of digital competence. As one student stated, "Older professors do not usually use technologies as much, while younger ones integrate them more effectively into their teaching."

Another salient theme concerned the perception that, although lecturers possessed sufficient technical skills to function in digital environments, they rarely employed these tools in innovative or interactive ways. Students noted that digital platforms were primarily used for file sharing, grading, or displaying slides, but seldom for fostering collaboration, creativity, or critical engagement. This limited scope of application was often interpreted as evidence that digitalization in higher education had been more procedural than transformative. One participant observed, "They know how to use digital tools, but not in an original or different way."

Despite these limitations, many participants recognized a positive trajectory of adaptation, especially in recent years following the increased reliance on digital teaching during and after the COVID-19 pandemic. Several students valued the effort made by lecturers to learn and integrate new technologies, even if inconsistently. Such comments suggest that the institutional context has fostered gradual normalization of digital practices, although pedagogical mastery and creativity remain uneven. As one respondent remarked, "In the last two years I have noticed a clear

improvement in the teachers' digital training; they have adapted quite well to the new university platforms."

Beyond individual attitudes, respondents also attributed the moderate level of digital competence to structural and contextual barriers. Limited time for training, scarce institutional incentives, and a lack of systematic professional development were frequently cited as factors constraining deeper digital integration. Consequently, the observed shortcomings were often interpreted not as resistance, but as a byproduct of insufficient organizational support. One participant explained, "Their digital level is medium because there is a lack of specific training and resources, and little time to learn new technologies."

A recurring subtheme reflected the distance between digitally native students and instructors who have had to adapt later in their careers. Students often described themselves as more fluent and confident with technology, while perceiving lecturers as competent but less assured. This generational asymmetry was generally portrayed as a natural outcome of different formative experiences rather than as a source of frustration. Nonetheless, it reinforced the impression that many professors were still in the process of "catching up" to students' technological expectations.

Finally, a notable number of participants expressed a desire for greater pedagogical innovation in the use of digital tools. Students emphasized the need for more dynamic, interactive, and experiential approaches to digital learning, arguing that technology should be leveraged not only for efficiency but also for creativity and engagement. They also underscored that digital competence among faculty should model the skills expected of students in contemporary professional contexts.

Additionally, to obtain a more precise answer to OBJ2, the responses were coded and analysed quantitatively.

The mentions were classified into three groups of codes or types of mentions, following a ternary sentiment or opinion analysis, categorizing them as positive, negative, or neutral. This process, along with the coding itself, was conducted independently from the general evaluation score, as many responses simultaneously included positive, neutral, and/or negative aspects.

The resulting code plan was as follows:

- Positive mentions:
    - *"They have professional experience"* – Highlighting professional experience as a distinguishing factor, reflecting applied knowledge within their field.
    - *"They have ease/knowledge in using technology"* – Referring to their ability to use technology effectively.
    - *"They teach how to use it"* – Emphasizing their ability to instruct others on technology usage.
    - *"They use it regularly"* – Referring to frequent use of ICT
    - *"Other positive"* – Encompassing minor positive mentions not classifiable under the previous categories.
- Negative mentions:
    - *"Basic use"* – Mentions highlighting a limited use of technology, such as slide presentations, virtual classrooms, or communication, without adding value to the learning process.
    - *"Lack of implementation/innovation"* – Including mentions that call for a more prominent role of ICT in teaching.
    - *"Resistance/Difficulty to change/Use of traditional methods"* – Emphasizing the difficulty in adopting ICT.
    - *"Limited knowledge/Should know more/Lack of training"* – Grouping responses that underline the need for increased knowledge and/or training among teachers.
    - *"Age"* – Associating low TDC levels with the age.

- *"Other negative"* – Including minor negative mentions not classifiable under the previous categories.

- Neutral mentions:
  - *"Variability"* – Referring to the lack of uniformity or disparity in digital competence levels.
  - *"Other"* – Including minor mentions whose interpretation cannot be classified as either positive or negative.

As an initial approach to the results, the volume of students making positive and negative mentions was analysed.

Table 3. Summary of the volume of positive and negative mentions on overall evaluation reasons

		Overall TDC evaluation		
	Total	Very low or low (A)	Medium (B)	Very high or high (C)
Sample size	(n=79)	(n=10)	(n=49)	(n=20)
% They mentioned positive aspects	**48,1%**	**0,0%**	**44,9% A**	**80,0% AB**
% They mentioned only positive aspects	**24,1%**	**0,0%**	**8,2%**	**75,0% AB**
Average of positive mentions (Base: They mentioned at least one positive response)	1,3	-	1,1	1,6 AB
% They mentioned negative aspects	**67,1%**	**90,0% C**	**83,7% C**	**15,0%**
% They mentioned only negative aspects	**43,0%**	**90,0% BC**	**46,9% C**	**10,0%**
Average of negative mentions (Base: They mentioned at least one negative response)	1,5	1,8	1,4	2,0
% They mentioned both positive and negative aspects	**24,1%**	**0,0%**	**36,7% AC**	**5,0%**

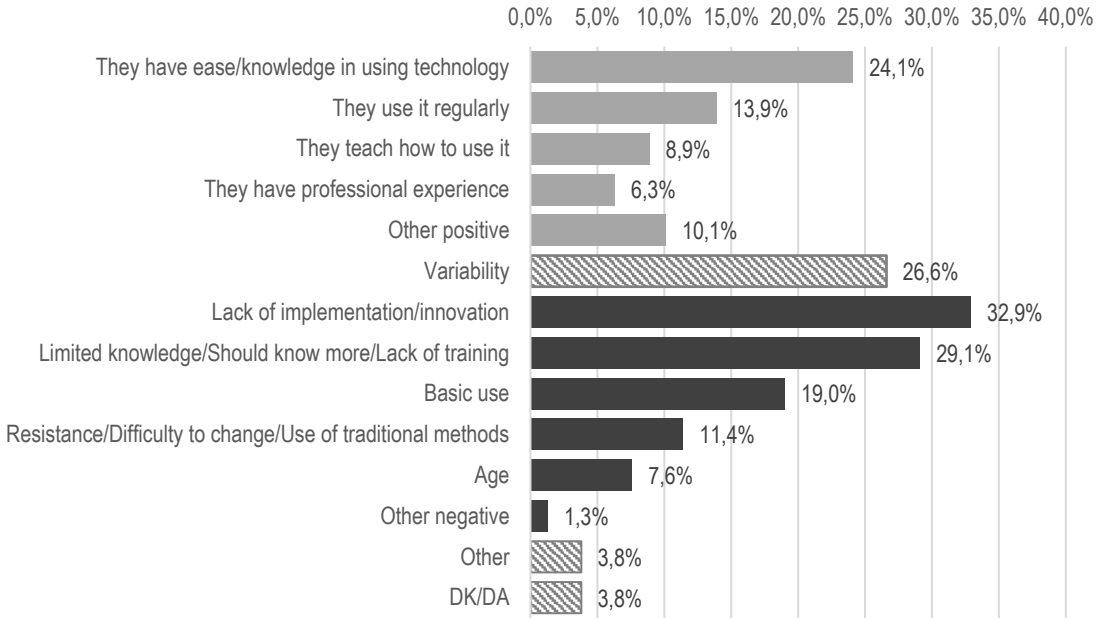
Notes. Letters indicate that the proportion in a given group is significantly higher than in the referenced group(s) at two-sided α = 0.05. To avoid a selective base restriction, averages of positive (negative) mentions are computed among respondents who provided at least one positive (negative) mention, respectively.

The first noteworthy finding was that, although the overall evaluation was mostly average or higher and the evaluation of the indicators was generally positive, the total volume of participants mentioning negative aspects reached 67.1%, approximately 20 percentage points more than the number of students highlighting any positive aspect. This imbalance was not only visible in the frequency of mentions but also in their intensity. While positive comments showed an average of 1.3 mentions among respondents who provided at least one positive comment, negative feedback was more detailed, reaching an average of 1.5. The share of respondents mentioning only negative aspects (43.0%) exceeded those mentioning only positive aspects (24.1%), and 24.1% mentioned both.

This situation was so prominent that it persisted even among students who rated the competency level as high or very high. In this group, although 80% mentioned positive aspects with an average of 1,6 mentions, the 15% who identified negative aspects did so with the highest level of detail in the entire study, reaching a notable average of 2,0 negative mentions per participant.

This suggests that while their overall assessment is favorable, their specific identified shortcomings are multifaceted and highly specific. Consequently, while the overall assessment cannot be considered negative based on the indicators, significant areas for improvement were identified.

Figure 3. Reasons on overall assessment



Note: Gray bar indicates positive aspect, Black bar indicates negative aspect, Striped bar indicates Neutral aspect

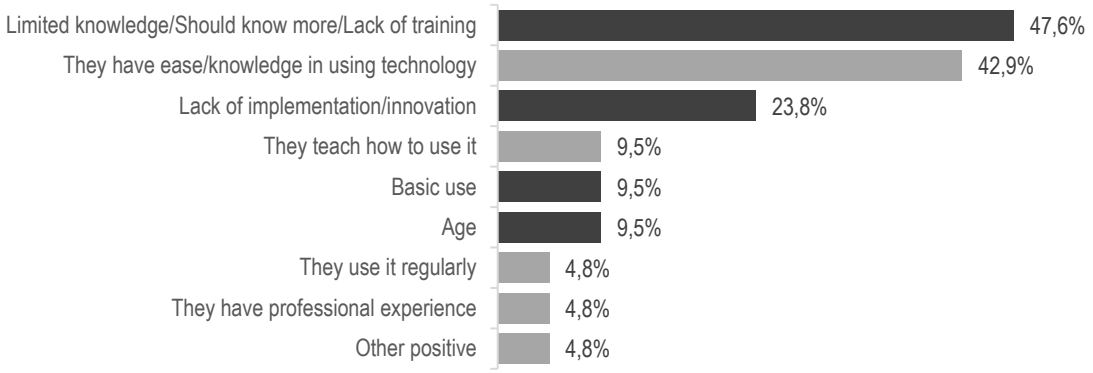
Upon detailed analysis, it was observed that the main criterion for evaluating the TDC by the students is their implementation, both explicitly under the code “Lack of implementation/innovation” and implicitly when referring to the basic use of ICT. This result had already been noted during the coding process, as students linked the TDC and ICT as tools for teaching and learning. Similarly to what was observed in the evaluation through COMDID-A, ICT appeared as a tool that was poorly implemented for faculty use. Related to this, the next most mentioned reason was the lack of knowledge and/or training, as about 3 out of 10 students stated this.

Variability emerged as another relevant aspect. However, it is not easy to make a direct analysis of this data, as it was generally accompanied by some qualification, which was also coded.

The only positive aspect that reached a relevant value was “ease and/or knowledge for use.” This finding, combined with the “lack of knowledge and/or training,” highlights that, beyond the assessment results, there is a population-wide need for improvement in TDC.

Among the other responses, it is worth noting that students reported perceiving some resistance to change or a tendency to maintain traditional methods, a result in line with what was observed earlier and largely related to the lack of implementation. Nearly 31% of students who mentioned the lack of implementation also mentioned this resistance.

Figure 4. Analysis of variability



Note: Gray bar indicates positive aspect, Black bar indicates negative aspect, Striped bar indicates Neutral aspect

Upon delving into variability, one of the expected results already observed when looking at frequency count of some COMDID-A indicators, it was noted how this was clearly linked to the level of knowledge, serving as an indicator of a significant polarization of it. In other words, the rating was generally average as a way of balancing their opinion, as a considerable number of students literally stated when responding with phrases such as, for example: “because I think there are teachers with a very high level of digital competencies, while there are others with a very low level. Therefore, it stays at an average level.”

DISCUSSION

Starting from our two objectives, we first interpret OBJ1 (competence levels) and then OBJ2 (reasons behind the ratings), before drawing broader contributions and implications.

Regarding OBJ 1, which focuses on the assessment of competency levels, most items received an average or above-average score, with the exception of PLEs, ethics and security, attention to diversity, and ICT integration projects. A critical analysis of the dimensions reveals that indicators related to the didactic dimension and the classroom context tend to rank higher, suggesting that faculty competencies are primarily centred on the teaching-learning process. Additionally, the didactic dimension showed the strongest relationship among the measured indicators, indicating greater numerical and competency-based consistency. This suggests that the higher ratings and the smaller variance among items—except for those related to diversity attention—may be linked to their greater impact and/or visibility in students’ daily academic experiences and classroom dynamics. In contrast, dimensions associated with ICT management, responsible and safe use, and personal and professional development rank lower. These areas present the greatest potential for improvement, as they show a higher proportion of individuals with either no competence or only basic competence, along with notable disparities in skill levels in some cases.

Turning to OBJ2, students frequently cite limited implementation/innovation—ICT reduced to slideware and an LMS-as-repository—and capacity barriers (knowledge/training), in line with prior work (Casillas Martín et al., 2020; Raposo et al., 2020; Fernández Márquez et al., 2018). Reports of resistance to change also appear, although evidence on age effects is mixed across studies (Basantes-Andrade et al., 2020; Guillén-Gámez & Mayorga-Fernández, 2020; Jorge-Vázquez et al., 2021; Basilotta-Gómez-Pablos et al., 2022). Likewise, gender differences do not emerge in our data, despite heterogeneous findings in the literature (Basantes-Andrade et al., 2020; Cabero-Almenara et al., 2021; Çebi & Reisoğlu, 2020; Parsons et al., 2019). Overall, positive didactic ratings co-exist with shallow digital integration, reinforcing the need to move from basic tool use to pedagogical application.

Beyond individual skill, several structural conditions documented in higher education help explain weaker performance in the advanced dimensions: (i) incentive misalignment (promotion/appraisal that privileges research over digital pedagogy and constrains institutional digital innovation; Vicente et al., 2020); (ii) time/workload models that leave little room for iterative course redesign during digital transitions (Kaqinari et al., 2021); (iii) limited access to instructional-design support and to effective uses of learning analytics, which hinders pedagogical integration beyond basic tool use (Engel et al., 2023; Cesco et al., 2021); (iv) tooling/governance that positions the LMS primarily as an administrative repository, echoing students' descriptions of "slides + LMS" and limiting interactive/assessment affordances (Casillas Martín et al., 2020; Raposo et al., 2020); and (v) risk/ethics/compliance pressures around assessment integrity, privacy and AI that can dampen experimentation—dimensions explicitly foregrounded in current competence frameworks (Punie & Redecker, 2017; Tondeur et al., 2023). Addressing these organisational and cultural conditions appears necessary for sustained TDC improvement.

Beyond OBJ1 and OBJ2, our results yield broader contributions for measurement, explanation, and theory building. Together, our findings make three contributions. First, we offer initial psychometric evidence (α, corrected item–total, CFA) for a student-perception adaptation of COMDID-A in a business-school context, extending who evaluates TDC beyond teacher self-reports and showing the measurement viability of this third-party lens. Second, we uncover a systematic visibility pattern: didactic items tend to score higher than advanced ICT integration, ethics/security, and PLEs, indicating that what students most readily observe is not necessarily what most supports digital-business capability building. Third, we theorise these results through a digital (dynamic) capabilities lens—mapping sensing (information/ethical literacy), seizing (learning design, assessment, ICT integration beyond slides/LMS) and reconfiguring (continuous professional development, iterative course redesign) as micro-foundations through which classroom practice can cultivate work-ready digital-business competencies.

Interpreting the results through DDC clarifies where capability building may stall. Lower performance in ethics/security and information-related indicators aligns with weaker sensing (how digital risks/opportunities are framed and modelled). Students' recurring "slides + LMS" accounts indicate limited seizing—i.e., translating digital possibilities into redesigned learning tasks, assessment, and feedback. Finally, comparatively weaker professional-development indicators point to limited reconfiguring (continuous renewal of teaching routines and iterative course redesign) (Teece, 2007; Vial, 2019; Warner & Wäger, 2019). This interpretation helps explain why our recommendations emphasise not only more technology use, but also redesigned learning tasks, responsible digital practice, and sustained faculty development.

Translating these insights into action, three layers of recommendations follow. Prioritise the low-scoring dimensions with targeted support—brief design sprints to advance ICT integration (data/AI-enabled tasks, authentic assessment, LMS-to-ecosystem practices), micro-modules on ethics & security (privacy-by-design, AI transparency, responsible data use), and short workshops to strengthen PLEs, with faculty modelling these practices in class. At curriculum level, introduce capstones/signature assignments that require students to operationalise digital-business capabilities (e.g., platform/ecosystem cases, analytics for value capture) and adopt transparent rubrics that make TDC-related design choices visible (collaboration tools, feedback cycles, evidence of iteration). Institutionally, align hiring and appraisal with TDC evidence (teaching portfolios, peer observation focused on integration beyond slides/LMS), offer micro-credentials tied to demonstrable practice change, foster peer-mentoring/learning communities with show-and-tell of redesigned activities, and monitor progress via programme-level dashboards on TDC dimensions.

Limitations

Given the fee-paying context, student ratings may reflect consumer expectations, smaller classes/resources, program branding, cohort/language differences, and workload/grade perceptions—hence our findings are context-bound and call for multi-site replications with appropriate controls and measurement invariance tests. Because our evidence rests on student perceptions, results may reflect perception biases and contextual factors beyond teachers' actual competence. Strategic decisions should therefore not be based on students' views alone. We position our approach as complementary to teacher self-assessment and to direct observation/performance-based evidence; future work should triangulate these sources to increase validity and estimate gaps between self- and third-party judgments (Benton & Cashin, 2014; Spooren et al., 2013; Uttl et al., 2017; Quansah et al., 2024). Institutions may also consider bias-mitigation practices in student surveys (e.g., brief intervention messages) alongside mixed-evidence systems (Kim et al., 2024).

Cross-national, business-school evidence on TDC remains scarce. Where international comparisons in business schools exist, they typically examine broader teaching-effectiveness attributes (class design, delivery, personal characteristics) and reveal cultural heterogeneity that can shape student ratings—implying that digital-competence judgements may not travel uniformly across contexts (Simendinger et al., 2017). Regional comparative work likewise finds site-level differences in perceived digital teaching skills within the same institution (Torres Molina, 2021). In parallel, a large body of students evaluation of teaching (SET) research cautions that student ratings show high internal consistency but low inter-rater agreement and are susceptible to biases (e.g., likability, expected grades, course difficulty), and that faculty and students often hold divergent criteria for "good teaching" (Clayson, 2018; Feistauer & Richter, 2018; Bhattacherjee & Ravishankar, 2016; Mukherji & Rustagi, 2008). Taken together, these patterns reinforce our stance: student-based TDC indicators should be interpreted as one evidence stream, warranting multi-country and multi-source replications in business-school settings before generalizing.

Regarding the external validity, this is a single-institution case study in a private business school (Barcelona, ESIC). As such, external validity is limited: findings are context-bound and should not be generalized to public institutions, other regions/countries, or different program levels without caution. To test robustness and transferability, future research should replicate the design across (i) private and public business schools, (ii) undergraduate and postgraduate programs, and (iii) diverse geographical contexts, using the same student-perception adaptation of COMDID-A. We also recommend testing measurement invariance and using multilevel designs to separate teacher- and institution-level variance before drawing sector-wide inferences.

Finally, it is important to consider the modest sample size and the fact that the instrument was adapted for external evaluation. Additionally, not all dimensions of TDC are equally observable by students. However, it is essential to emphasize that the primary objective of this research is descriptive and preliminary in nature. In this regard, the study remains methodologically adequate for establishing an initial exploration of TDC dimensions from an external perspective. Therefore, the findings should be interpreted as preliminary evidence of structural coherence in an external assessment context, rather than as definitive psychometric validation, providing a necessary empirical foundation for future large-scale research.

Future research

To strengthen external validity, future studies should replicate this design across public and private business schools, at undergraduate and postgraduate levels and in different regions/countries and apply multilevel models to disentangle teacher- from institution-level variance. Longitudinal replications would also help gauge stability and change in TDC over time.

Building on the adaptation evidence, subsequent work should consolidate construct and criterion validity and test model fit for the student-adapted COMDID within the broader COMDID

structure, including measurement invariance across institution type, programme level, cohort/language, and context. A multi-source assessment architecture that triangulates teacher self-perception, student ratings, and performance/observation protocols would move beyond the prevailing reliance on self-report (Basilotta-Gómez-Pablos et al., 2022) and allow estimation of gaps between self- and third-party judgements. Conceptual models and instruments should explicitly integrate capability and actual use, together with ICT-related attitudinal determinants aligned with the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2003) and prior proposals (Tourón et al., 2018), acknowledging that perceived use surfaced spontaneously in student ratings and may be inseparable from perceived capability.

Finally, intervention studies should redesign faculty development along the axes of attitudes, knowledge, and skills (Cabero Almenara & Martínez Gimeno, 2019), include re-education components to overcome barriers and go beyond instrumental use toward didactic integration (Esteve et al., 2018), and adopt a clear impact-evaluation plan: pre/post measurement with the student-adapted COMDID-A, rubrics for task authenticity/feedback/iteration, learning analytics (participation, timeliness), and short alumni/employer pulses at 6–12 months. Where student surveys are used, testing simple bias-mitigation prompts could improve ratings quality.

Conclusion

Returning to our general objective—assessing whether business-school faculty possess sufficient TDC to train future professionals in the digital-business domain—and acknowledging the single-case nature of this study (ESIC), the overall student assessment of faculty TDC is positive. Crucially, the absence of content-related complaints should be read with caution: student judgments are anchored in what is observable in class and may not reveal content gaps that surface at internship or early-career stages. Taken together, the pattern of results underscores the need to rethink the role of ICT in teaching—moving from management/support functions to pedagogically meaningful integration—and to align faculty development, curriculum, and institutional policy with the capabilities required in digital business.

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