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Digital Competence in the Master's Degree in Training for Teachers: The Influence of Academic and Emotional Factors on Its Development

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Abstract

Digital Competence (DC) is relevant among approaches aimed at educational innovation in the digital society. This work analyses the DC level of students of the Master's Degree in Training for Teachers in a University of the Basque Country, and identifies the socio-academic and emotional factors that determine their development. A total of 137 students (56.93% women) completed an online questionnaire that collected the following information: sociodemographic characteristics, DC, motivation, creative self-efficacy and life satisfaction. The results revealed that the students present a basic-intermediate level of DC. They have appropriate knowledge about available digital platforms and systems and their general use, although notable lacks dealing with tasks that include the creation of content to energise exercises or solve problems. Gender was not a determining factor for DC, in contrast with the branch of knowledge: those specialised in natural sciences or technology show greater digital skills. Furthermore, creative self-efficacy and motivation were shown to be predictive factors of their DC level. In conclusion, training plans must be redefined to offer future teachers personalised and progressive training in DC. To achieve this, any educational intervention must consider the needs of students in each degree programme, as well as the various academic and emotional factors that influence learning.

Keywords: digital competence; teacher training; higher education; master

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1. Introduction

Information and Communication Technologies (ICTs) have become an essential element for citizens of the 21st century in a historical era marked by the impact of digitalization. ICTs have permeated all areas of the Knowledge Society (Jaramillo & Escudero, 2024), allowing information to flow in a volatile and instantaneous way, without any sort of borders. In fact, for García-Delgado et al. (2024) technology has directly influenced the multiple transformations that have occurred in recent years at the social, economic, productive and educational levels. This situation has also caused great advances and, in parallel, numerous challenges in multiple fields and disciplines (Lena-Acebo & García-Ruiz, 2021), which has accelerated the need to train the population in the use of technologies to achieve a citizenship that is competent in the face of the demands of a digitalized world (Benavente-Vera et al., 2021; European Commission, 2020; OECD, 2016).

In the educational field, ICTs have boosted the debate on Digital Competence (DC) training. There is general agreement on the need to develop skills and knowledge that allow educational objectives to be exceeded through the safe, critical, efficient and responsible use of technological resources (Engen, 2019; Li et al., 2023). Above all, because DC is a basic competence that any person who directly or indirectly intervenes in the teaching-learning processes (Vásquez-Pajuelo et al., 2024) must integrate to progress academically and professionally throughout of life (Ralda-Baiges et al., 2024).

In this sense, educational institutions and government agencies have been preparing for some time to offer quality education that responds to the demands of a dynamic, interconnected and digitalised society, as stated in the Spanish Organic Law (Ley Orgánica 4/, 2007, de 12 de abril, 2007, known as LOMLOU). At the Spanish level, the Organic Law for the Improvement of Educational Quality (Ley Orgánica 8/, 2013, de 9 de diciembre, 2013, known as LOMCE) proposed that DC was an elementary competence that should be acquired transversally when going through the educational system and, years later, the Organic Law that modified the LOE (Ley Orgánica 2/2006, de 3 de mayo, de Educación) urged educational administrations to include a specific subject for its development (Ley Orgánica 3/, 2020, de 29 de diciembre, 2020, known as LOMLOE). At the same time, Spanish universities, with the creation of the European Higher Education Area (EHEA) and the Bologna Plan (Navas, 2020), included the DC among the competencies of the study plans so that students, as an active subject, acquired it to guarantee meaningful and permanent learning (European Commission, 2006).

Given this scenario, and in order to promote initial and continuous training in DC, multiple conceptualizations and theoretical models have emerged that demonstrate the general agreement around the fact that DC is composed of different dimensions (McGarr, 2024). In the United States, the International Society for Technology in Education [ISTE] (2008, 2023) establishes six basic factors: digital literacy, research and information processing, critical thinking, communication and collaboration, digital citizenship and creativity and innovation. In Europe, DigComp stands out (Ferrari, 2013) as a comprehensive framework that includes five priority areas for teachers: information, communication, content creation, security and problem resolution. Based on one of the adaptations of this last standard, in the context of Higher Education, from the DigCompEdu emerge six elementary dimensions that teaching staff must develop to promote ICTs-based training: professional commitment, digital content, teaching and learning, evaluation and feedback, student empowerment and development of students' digital competence (Castañeda et al., 2023).

The definition of these parameters has also motivated the creation of numerous evaluation instruments and, with it, a growing empirical interest in evaluating the DC of students (Barbudo et al., 2021) and teachers (Vásquez-Pajuelo et al., 2024), as a key figure in the challenge of promoting education in accordance with the technological nature of society (Casal-Otero et al., 2022). Society is coping with new generations of teachers arising in a new model, so it urges us to design strategies that reduce the gap between the training received and the demands of the labour market (Cedefop, 2016; McGarr, 2024; OECD, 2016) that requires professionals trained in digital matters (Alejandre-Marco, 2021; Kiryakova & Kozhuharova, 2024). In this regard, the literature also highlights the need to personalise the training offered to cover both individual needs and each area of the digital competence framework (Faiella et al., 2019).

Regarding the study of digital competence among future teachers, several studies state that future teachers have a low-intermediate level of DC (Barbudo et al., 2021; García-Delgado et al., 2024). University students successfully carry out a wide range of simple or instrumental activities associated with systems and devices that they regularly use (Gaona-Portal et al., 2024). For instance, they are capable of searching, managing, evaluating and presenting information in multiple formats (Mamani et al., 2024), even interacting and working collaboratively in social networks or Learning Management Systems (LMSs) (Gamito et al., 2018; Silva & Morales, 2022). However, they do not take full advantage of technology's potential, neglecting the tasks that require technical skills such as creating digital content and solving problems to offer more innovative and personalised educational practices (García-Delgado et al., 2024; Moreno et al., 2018; Røkenes & Krumsvik, 2014).

Some approaches analyse the impact of gender on the acquisition of DC, although the results are contradictory and do not allow for confirming the existence of a gender gap (Fernández-Sánchez & Silva, 2022). According to Jiménez-Hernández et al. (2020), men perceive themselves as more competent in the use of ICTs, especially in practices related to information management, interaction or leisure. In fact, they use computers more to browse the internet, download information, and stream content (Grande-de-Prado et al., 2020). Women, on the other hand, say they are more familiar with searching for academic information (Pérez-Navío et al., 2021), as well as graphic design or image or text processing to disseminate content, especially on social media (Grande-de-Prado et al., 2020).

In a similar vein, a recent study considers the positive role of variables associated with academic development, or personality and psychological determinants in explaining DC (Van Laar et al., 2020). For Pinto-Santuber et al. (2023), autonomous learning and motivation, understood as a set of cognitive and meta-cognitive strategies that students tend to develop in their behaviour to improve or acquire certain knowledge or skills, are key to successfully face the handicaps of a changing and digitalised learning environment. Cepa-Rodríguez et al. (2025) and Gómez-Trigueros et al. (2024) added that such autonomous learning and motivation are predictive factors of the digital skills perceived by future teachers. Domínguez-González et al. (2025) and Köstler and Wolff (2025) point out that ICTs training is associated with better DC rates which, in turn, are linked to greater confidence in the personal ability to overcome digital challenges. Gómez-Gómez et al. (2022) highlighted the impact of the emotional state: they found that high levels of DC are related to better satisfaction rates, pointing out that this link can be valuable when defining alternative strategies to improve the digital-pedagogical training of future teachers.

However, most of these works focus on Early Childhood Education and Primary Education students (Casal-Otero et al., 2022), with no extensive scientific production related to students preparing as master's teachers (Mamani et al., 2024). Pérez-Navío et al. (2021) also confirmed the differences depending on the branch of knowledge in an approach to the reality of 220 students of the Master's Degree in Training for Teachers, in addition to revealing that the DC level was low-medium and confirming the lack of acquiescence in the literature in relation to the influence of gender. That is, those who come from social sciences or arts have lower DC scores than those who come from Architecture and Engineering (Cabero-Almenara et al., 2021). On the other hand, the literature recognises that people with studies in education obtain results that are in the middle between both groups (Cepa-Rodríguez & Lancha-Villamayor, 2025), giving clues to the importance that students of such branch give to the DC (Gaona-Portal et al., 2024).

According to this background and to expand knowledge on the topic, this study has pursued the following three main objectives: to analyse and describe the level, dimensions and indicators of the DC of students of the Master's Degree in Training for Teachers, to study possible differences in the level of DC dimensions and indicators depending on gender and specialty, and to identify academic and emotional predictors that significantly influence the development of DC in each specialty of the Master's.

2. Materials and Methods

This study followed a non-experimental and cross-sectional quantitative methodological approach, with a descriptive, correlational, comparative and predictive scope.

2.1. Design and Participants

The sample consisted of 137 students (78 women) enrolled in the Master's Degree in Training for Teachers of the University of the Basque Country (EHU/UPV), located in Donostia (Basque Country), with an average age of 25.98 (SD = 4.22). A non-probabilistic sampling strategy was used, and students from four specialties participated: Social Sciences, Natural Sciences, Technology, and Educational Orientation (Table 1). Data collection took place during the 2023–2024 academic year.

Table 1. Student participation by specialty.

	Educational Orientation	Social Sciences	Technology	Natural Sciences
Sample	22	39	36	40
Enrolments	28	47	44	49
Total		298		

Note: "Enrolments" refers to the group of students enrolled in those specialties in the 2023–2024 academic year, whereas "Total" refers to the total number of people enrolled considering the eight specialties offered in the programme.

The accessible population for the study comprised 168 students enrolled in these four specialties. The sample size corresponds to the total number of students who voluntarily agreed to participate during the data collection period, as no formal sample size calculation was conducted. Although the use of non-probabilistic sampling facilitated access to the target group, it may limit the generalizability of the findings.

Inclusion criteria required participants to be enrolled in one of the four specialties and to complete the full questionnaire. Data cleaning procedures involved removing incomplete or inconsistent responses prior to analysis.

2.2. Instrument

After sociodemographic questions (gender, speciality of the studies, and so forth), questions from four existing questionnaires were combined to create a self-administered online survey that includes the following scales to measure variables as derived from the literature:

Digital competence (DC): The Spanish questionnaire for the study of the DC of Higher Education students known as "Cuestionario para el estudio de la Competencia Digital del Alumnado de Educación Superior" (CDAES) (Gutiérrez-Castillo et al., 2017) was used to evaluate six areas of DC using 44 items: (1) technological literacy; (2) search and processing of information; (3) critical thinking; (4) communication and collaboration; (5) digital citizenship; and (6) creativity and innovation. Each participant indicated how they perceived themselves regarding the indicators on a 10-point scale (1 = completely unable, and 10 = completely capable). Cronbach's alpha of each dimension confirmed that the scale had adequate internal consistency that varied from $\alpha = 0.773$ to $\alpha = 0.896$.

Motivation: Academic motivation was measured using an adaptation of the Motivated Scale Learning Questionnaire (MSLQ) proposed and validated by Villarreal-Fernández and Arroyave-Giraldo (2022): "Cuestionario de Motivación del Aprendizaje" (CMA). It uses a 5-point degree of agreement Likert scale (1 = totally disagree, and 5 = totally agree), with 19 items divided into five areas: (1) assessment of the task; (2) orientation to extrinsic goals; (3) intrinsic goal orientation; (4) self-efficacy; and (5) test anxiety. The scale obtained acceptable internal consistency, given that the reliability indices ranged between $\alpha = 0.715$ and $\alpha = 0.767$.

Creative self-efficacy: This construct was measured with the Creative Self-efficacy Scale (CSE) in its Spanish version "Escala de Autoeficacia Creativa" (EAC) (Aranguren et al., 2011). This tool proposes five summative items to be evaluated with a Likert scale (1–5): 1 was "totally in disagree" and 5 "totally agree". The reliability analysis revealed an acceptable internal consistency ($\alpha = 0.737$).

Life satisfaction: The evaluation was conducted with the Spanish version of the Satisfaction with Life Scale (SWLS) or "Escala de Satisfacción con la Vida" (Atienza et al., 2000). This questionnaire also proposes five statements, and the degree of agreement had to be indicated using the same 5-point Likert scale. The reliability of the scale was confirmed using Cronbach's alpha obtaining $\alpha = 0.872$.

2.3. Procedure

Before collecting data, the proposal was presented to the Ethics Committee for Research Related to Human Beings of the EHU/UPV (CEISH in Spanish) and obtained its approval (ref.: M10_2023_178). Afterwards, the complete information about the study was sent to the Academic Committee of the Master's programme and, once their approval was obtained, they were provided with the link of the questionnaire so that they could distribute it among the students, which significantly speeded up the process of data collection.

The participants were informed in writing of the details of the research and their rights (among them, their free and voluntary participation). In addition, they had to read and accept the informed consent before completing the questionnaire, which guaranteed the confidentiality of their responses.

2.4. Data Analysis

With the data collected, the Microsoft Forms template was downloaded, and initial debugging was carried out to prepare the file for processing in version 28 of SPSS.

Initially, it was confirmed with the Kolmogorov–Smirnov (KS) test that the data fit a normal distribution ($p \geq 0.05$) and then, to meet the objectives, the following analyses were carried out: reliability (Cronbach's alpha), univariate descriptive analysis, comparative analysis (Student's t-test and analysis of variance—ANOVA—depending on the number of groups) as well as their effect size, and multiple linear regression analysis.

3. Results

3.1. Level in the Dimensions and Indicators of the Digital Competence

A descriptive analysis was carried out to know the level of DC in each area and indicator. The dimensions in which mastery was the highest, with a medium level, were "technological literacy" (M = 7.42; SD = 1.31) and "information search and processing" (M = 7.17; SD = 1.25). On the other hand, those that posed challenges to the Master' students, with medium-low scores, were "critical thinking" (M = 6.64; SD = 1.67) and "innovation and creativity" (M = 6.58; SD = 1.76).

An exhaustive analysis of the results by indicators also revealed that within each area there were differences in the level of knowledge and performance on the tasks they cover. For example, in the dimensions with notable performance, Master's students showed great ability to use different devices, systems or browsers (M = 8.09; SD = 1.39) to transfer their knowledge (M = 8.15; SD = 1.55) and locate reliable information on the Internet (M = 8.44; SD = 1.18). However, there appear to be serious gaps when trying to solve problems that required advanced knowledge about configuration (M = 6.41; SD = 2.50), where the variability between the data was high, or when processing and organising information in different formats (M = 6.12; SD = 1.78). In the dimensions with a lower domain, students performed better in tasks related to the selection of ICTs resources and the creation of the means to complete and present work (DIM3.2: M = 7.79; SD = 1.65, and DIM6.2: M = 7.45; SD = 2.10), although they faltered when the task required knowing how to configure specific software or hardware (M = 5.31; SD = 2.55) or relying on emerging technologies to respond to challenges (M = 5.86; SD = 2.18). One of the tasks in which they showed the best skills, however, was participating in multidisciplinary teams and working collaboratively facing challenges (M = 7.92; SD = 1.77), although they did not stand out in "communication and collaboration".

3.2. Digital Competence in Areas and Indicators According to Gender and Specialty

Two comparative analyses were carried out to study the association of DC (its areas and dimensions) with gender (Figure 1) and speciality (Figure 2).

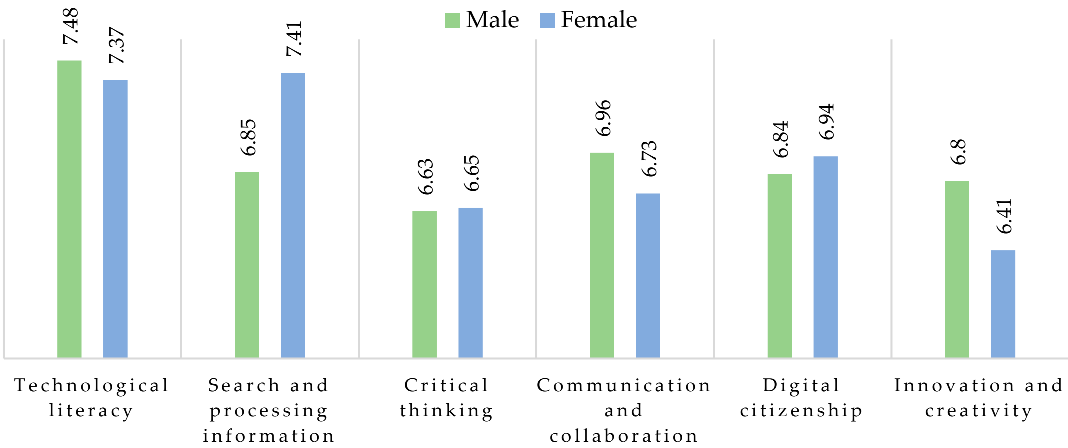

Figure 1. Comparison of means in dimensions by gender.

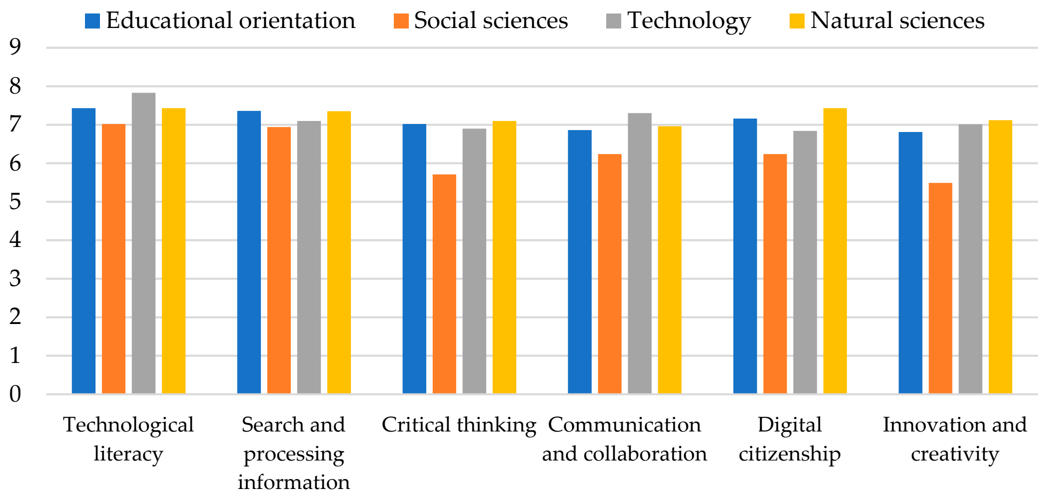

Figure 2. Comparison of means in dimensions by specialty.

Based on gender, no major differences were found either in the dimensions or in their indicators. Despite this, as seen in Figure 1, men obtained slightly higher scores in "technological literacy" and "communication and collaboration" whereas women stood out in "digital citizenship". The greatest differences between the two, however, occurred in "innovation and creativity" ($p = 0.193$), where the male gender stood out, and in "search and processing of information", in which the female gender showed notably greater capacity ($p \leq 0.01$; d = 0.46). Above all, when processing and organising information to present it through different ICTs resources and formats ($p \leq 0.01$), with the effect size of their differences (d = 0.54).

Depending on the speciality, the differences were more evident, as shown in Table 2.

Table 2. Analysis of variance (ANOVA) of DC by area and indicator.

Variable	ORI M(*SD*)	SOC M(SD)	TEC M(SD)	NAT M(SD)	*p*	η^2
DIM1. Technological literacy	7.43 (1.11) [1]	7.02 (1.30) [1]	7.83 (1.55) [1]	7.43 (1.11) [1]		
1.1.-Manage ICT systems.	8.09 (1.21) [1]	7.93 (1.30) [1]	8.19 (1.67) [1]	8.15 (1.31) [1]		
1.2.-Choose and effectively use applications.	7.08 (1.23) [1]	6.60 (1.48) [1]	7.52 (1.62) [1]	7.09 (1.35) [1]		
1.3.-Investigate and solve problems with ICT.	6.72 (1.98) [1,2]	5.38 (2.70) [1]	7.72 (2.26) [2]	6.05 (2.29) [1,2]	***	0.129
1.4.-Transfer knowledge with ICT.	7.98 (1.51) [1]	7.92 (1.49) [1]	8.43 (1.75) [1]	8.22 (1.45) [1]		
DIM2. Search and processing information	7.36 (1.36) [1]	6.94 (1.16) [1]	7.10 (1.45) [1]	7.35 (1.07) [1]		
2.1.-Plan information searches.	8.13 (1.46) [1]	8.51 (1.17) [1]	8.58 (1.23) [1]	8.42 (0.96) [1]		
2.2.-Organise, analyse, evaluate and ethically use information.	6.54 (1.96) [1]	5.44 (2.50) [1]	6.17 (2.47) [1]	6.55 (2.10) [1]		
2.3.-Evaluation and selection of tools.	7.97 (1.67) [1]	8.12 (1.12) [1]	7.85 (1.40) [1]	8.37 (0.99) [1]		
2.4.-Process and communicate results.	6.77 (1.49) [1]	5.72 (1.82) [1]	6.07 (2.07) [1]	6.20 (1.54) [1]		
DIM3. Critical thinking	7.02 (1.40) [2]	5.71 (1.70) [1]	6.90 (1.70) [2]	7.10 (1.42) [2]	***	0.128
3.1.-Identify and define problems.	7.45 (1.18) [2]	5.46 (2.38) [1]	6.78 (2.57) [2]	7.15 (1.87) [2]	***	0.125
3.2.-Plan activities in projects.	7.86 (1.46) [1]	7.38 (1.71) [1]	7.72 (1.54) [1]	8.20 (1.74) [1]		
3.3.-Analyse data to make decisions.	6.91 (2.02) [2]	5.95 (2.48) [1]	6.83 (2.08) [2]	7.65 (1.70) [2]	**	0.089
3.4.-Use multiple processes and provide solutions.	5.86 (2.38) [2]	4.03 (2.64) [1]	6.28 (2.42) [2]	5.40 (2.22) [2]	***	0.119
DIM4. Communication and collaboration	6.86 (1.32) [2]	6.24 (1.72) [1]	7.30 (1.75) [2]	6.96 (1.48) [2]	*	0.061
4.1.-Collaborate in multiple environments.	6.67 (1.38) [2]	5.70 (1.90) [1]	7.20 (1.79) [2]	6.72 (1.65) [2]	**	0.101
4.2.-Communicate ideas in multiple formats.	6.86 (*1.77*) [1]	6.64 (2.05) [1]	7.18 (2.06) [1]	6.95 (2.00) [1]		
4.3.-Develop global awareness.	6.91 (1.77) [1]	7.15 (1.94) [1]	7.03 (2.08) [1]	6.83 (1.93) [1]		
4.4.-Participate in teams and solve challenges.	7.73 (1.12) [1]	7.23 (1.80) [1]	8.31 (2.23) [1]	8.35 (1.35) [1]	*	0.075
DIM5. Digital citizenship	7.16 (1.16) [2]	6.24 (1.75) [1]	6.84 (1.84) [2]	7.43 (1.31) [2]	**	0.083
5.1.-Safe, legal and responsible use of ICT.	7.55 (1.40) [1]	6.56 (2.13) [1]	6.56 (2.27) [1]	7.64 (1.42) [1]	**	0.073
5.2.-Positive attitude towards ICT.	7.50 (1.44) [2]	6.12 (2.17) [1]	7.67 (1.97) [2]	7.85 (1.66) [2]	***	0.133
5.3.-Leadership for digital citizenship.	6.41 (1.52) [1]	5.82 (2.10) [1]	6.85 (1.85) [1]	6.91 (1.62) [1]	*	0.063
DIM6. Innovation and creativity	6.81 (1.63) [2]	5.49 (1.95) [1]	7.01 (1.48) [2]	7.12 (1.42) [2]	***	0.155
6.1.-Generate ideas, products or processes.	7.08 (1.67) [2]	5.73 (2.23) [1]	7.09 (1.52) [2]	7.31 (1.45) [2]	***	0.127
6.2.-Create and present original works.	7.09 (1.74) [1,2]	6.72 (2.38) [1]	8.31 (1.94) [2]	7.58 (1.87) [1,2]	**	0.085
6.3.-Identify trends and possibilities.	6.27 (2.16) [2]	4.53 (2.15) [1]	6.23 (1.93) [2]	6.60 (1.92) [2]	***	0.154

Note 1: Educational Orientation (ORI) n = 22, Social Sciences (SOC) n = 39, Technology (TEC) n = 36, and Natural Sciences (NAT) n = 40. Significant correlation at level: 0.05 (bilateral) with *, 0.01 (bilateral) with **, and 0.001 (bilateral) with ***. Note 2: The numbers allow us to differentiate the groupings that have emerged in the Scheffe post hoc contrast.

With a high effect size, the differences between groups were significant ($p < 0.001$) in "critical thinking" ($\eta^2 = 0.128$), "digital citizenship" ($\eta^2 = 0.083$) and "innovation and creativity" ($\eta^2 = 0.155$). In these dimensions, students in the speciality of social sciences obtained notably lower scores, while students in the speciality of natural sciences were those who presented a higher level of performance. However, the latter were not the ones who excelled in all areas. For instance, students specialised in technology had a higher DC in the tasks related to "communication and collaboration" ($p = 0.05$; $\eta^2 = 0.061$), although the effect size of their differences was medium. It was also found that those in the educational orientation branch stood out slightly in "searching and processing information" ($p = 0.413$). What appears unquestionable is that the students of social sciences were the ones that showed the lowest DC (Figure 2).

The comparison by indicators revealed a similar trend. Firstly, the social sciences group only stood out above the rest in the item related to the ability to develop cultural and global awareness (DIM4.3.; $p = 0.893$). Secondly, the educational orientation group, which stood out in DIM2, had a slightly higher level of performance than the rest in processing data and communicating results (DIM2.4.; $p = 0.167$) as well as in identifying and defining research problems (DIM3.1.; $p < 0.001$; $\eta^2 = 0.125$), followed by the students of technology and natural sciences. Thirdly, especially compared to the scores of the social sciences students, the results highlighted that the group of technology showed a higher level to investigate and solve problems using ICTs (DIM1.3.; $p < 0.001$; $\eta^2 = 0.129$), to rely on multiple processes and perspectives to offer alternative solutions (DIM3.4.; $p < 0.001$; $\eta^2 = 0.119$), to interact and collaborate in multiple digital environments (DIM4.1.; $p = 0.01$; $\eta^2 = 0.101$) and to create numerous resources and present different works in an original way (DIM6.2.; $p = 0.01$; $\eta^2 = 0.085$). Fourthly, the natural sciences group stood out (especially in comparison with social sciences), on the one hand, because it had better skills to analyse data and make informed decisions (DIM3.3.; $p = 0.01$; $\eta^2 = 0.089$) and participate in multidisciplinary team projects, producing original work or responding to challenges (DIM4.4.; $p < 0.001$; $\eta^2 = 0.075$). Moreover, it stood out due to their high levels of performance in activities related to "digital citizenship" and "innovation and creativity", and especially due to their positive attitude towards ICT (DIM5.2.; $p < 0.001$; $\eta^2 = 0.133$) and their ability to generate new ideas, products and processes (DIM6.1.; $p < 0.001$; $\eta^2 = 0.127$) and identify trends or possibilities in digitalized media (DIM6.3.; $p < 0.001$; $\eta^2 = 0.154$). All highlighted indices were also reiterated in Scheffe's post hoc contrast (see Table 2).

3.3. Motivation, Creative Self-Efficacy and General Satisfaction: Predictors of the DC of the Master's Students

A multiple linear regression analysis (MLR) was carried out to determine, among the academic-emotional variables, which ones contributed to predict DC in each field or speciality. To do this, the "stepwise" method was used, as it allowed the most significant variables to be included in stages for this purpose ($p > 0.05$).

Table 3 shows the R^2 values that estimate the percentage of variance explained in each area along with the predictor factors that were significant in the study, divided by speciality. As seen, one of the most repeated variables when explaining the results in the DC dimensions of each group and, consequently, the most determining in most cases is the Creative Self-Efficacy (CRE). Furthermore, on its own it explains 57.9% of the changes in "search and processing of information" among the educational orientation students and even 46.2% of the variance in "communication and collaboration" among the technology students.

There are differences between branches or specialities. In educational orientation, along with CRE, two subcomponents of motivation were fundamental: on the one hand, the extrinsic goal orientation (EGO), since both significantly explained 66.5% of the variances in "technological literacy" and, on the other hand, the anxiety in front of exams (ANX), which together with the first one clarified 79.3% and 61.6% of the variance of two dimensions (i.e., critical thinking and innovation and creativity, respectively). In social sciences it is notable that, to explain the changes in "communication and collaboration" ($R^2 = 0.682$), the model included four variables: self-efficacy (SEL), CRE, life satisfaction (SAT) and orientation towards intrinsic goals (IGO). In fact, the latter—IGO—together with the CRE, were important factors to justify the variance in "innovation and creativity", not only in the social sciences group ($R^2 = 0.634$), but also in the technology group ($R^2 = 0.606$) and, to a lesser extent, in natural sciences ($R^2 = 0.325$). In the technology group, for its part, another component that stands out is the assessment of the task (TA), whose contribution was decisive in explaining the changes in "digital citizenship" ($R^2 = 0.577$), while in natural sciences the contribution of the EGO could be highlighted, especially in the model of "communication and collaboration" ($R^2 = 0.542$) and "digital citizenship" ($R^2 = 0.446$).

Table 3. A summary of the multiple linear regression model for DC by speciality.

Model	Educational Orientation			Social Sciences			Technology			Natural Sciences		
	F	β	p	F	β	p	F	β	p	F	β	p
DIM1	CRE, EGO R^2 = 0.665			IGO R^2 = 0.084			CRE R^2 = 0.312			CRE, EGO R^2 = 0.409		
VI1	31.584	0.78	***	4.407	0.33	*	16.901	0.58	***	18.921	0.58	***
VI2	21.816	−0.34	*							14.520	0.36	**
DIM2	CRE R^2 = 0.579			CRE R^2 = 0.164			CRE, EGO R^2 = 0.305			CRE, TA R^2 = 0.344		
VI1	29.905	0.77	***	8.278	0.43	**	11.333	0.50	**	15.472	0.54	***
VI2							8.689	0.31	*	11.237	0.30	*
DIM3	CRE, ANX R^2 = 0.793			CRE R^2 = 0.278			CRE R^2 = 0.417			CRE, IGO R^2 = 0.440		
VI1	58.125	0.86	***	15.236	0.55	***	26.083	0.66	***	21.669	0.60	***
VI2	41.343	0.33	*							16.332	0.34	**
DIM4	CRE R^2 = 0.550			SEL, CRE, SAT, IGO R^2 = 0.682			CRE R^2 = 0.462			CRE, EGO R^2 = 0.542		
VI1	26.688	0.76	***	30.859	0.68	***	31.039	0.69	***	16.094	0.55	***
VI2				29.962	0.45	***				10.863	0.30	*
VI3				24.031	−0.22	*						
VI4				20.855	0.23	*						
DIM5	CRE R^2 = 0.278			CRE, EGO R^2 = 0.409			CRE, TA R^2 = 0.577			EGO, CRE R^2 = 0.446		
VI1	9.079	0.60	**	21.367	0.61	***	40.440	0.74	***	25.425	0.63	***
VI2				13.812	0.28	*	24.912	0.26	*	16.701	0.30	*
DIM6	ANX, CRE R^2 = 0.616			CRE, IGO R^2 = 0.634			CRE, IGO R^2 = 0.606			CRE, IGO R^2 = 0.325		
VI1	23.470	0.74	***	53.242	0.77	***	43.845	0.75	***	12.851	0.50	***
VI2	17.823	0.42	*	33.004	0.27	*	27.942	0.31	*	10.383	0.34	*

Note * Indicates that the result is significant at the level: 0.05, ** at the 0.01 level, and *** at the <0.01 level. TA refers to "Task Assessment", EGO to "Extrinsic Goal Orientation", IGO to "Intrinsic Goal Orientation", SEL to "Self-Efficacy", ANX to "Exam Anxiety", CRE to "Creative Self-Efficacy" and SAT for "Life Satisfaction".

4. Discussion

Education seeks to promote inclusion, participation, lifelong learning and the comprehensive development of all people. To achieve a more democratic, fair and equitable society, the development of Digital Competence (DC), along with critical thinking, flexibility and collaboration (Kiryakova & Kozhuharova, 2024; McGarr, 2024; Ralda-Baiges et al., 2024), is a primary objective in a context marked by the volatility with which methods and resources to access, process, share and evaluate the information evolution (European Commission, 2020). For that reason, studies have placed great interest in the digital skills of education professionals (Benavente-Vera et al., 2021; García-Ruiz et al., 2023), especially of future teachers (Colomo et al., 2023; Köstler & Wolff, 2025) as active agents of change and progress (Engen, 2019).

The presented work sought to respond to several objectives associated with this topic. Regarding the first objective, the results reveal that the Master's students obtain basic-intermediate scores in all the areas and indicators that make up the DC and confirm the lack of training in digital skills among those who, in the short term, are going to work as teachers. Master's students therefore ratify the findings of Cabero-Almenara et al. (2021) and García-Delgado et al. (2024), who indicate that future teachers show a medium-low mastery of DC, which makes it difficult to achieve the objectives of the Horizon Report on the use and integration of ICTs (Alexander et al., 2019). In this regard, students know and master different systems or devices and adequately plan the search, management, communication, evaluation and ethical use strategies of information (Mamani et al., 2024; Silva & Morales, 2022). However, they express serious difficulties in working collaboratively and developing creative projects or solving problems online, or promoting the safe, legal and responsible use of information, the Internet and ICTs (Cepa-Rodríguez et al., 2025;

Røkenes & Krumsvik, 2014). Likewise, it is confirmed that their performance is inferior in designing and creating effective spaces and resources in the face of the challenges of digital teaching (García-Delgado et al., 2024; Moreno et al., 2018). Furthermore, with the study of the descriptors, it is confirmed that Master's students perform better in instrumental or basic tasks that they perform frequently (Gaona-Portal et al., 2024), but those that require specialised knowledge represent a handicap (García-Delgado et al., 2024).

Focusing on the second objective, no differences have been found in DC between women and men. The findings are like those of Grande-de-Prado et al. (2020), who rule out the existence of a gender gap. However, it is corroborated that women have greater sensitivity and patience when carrying out exhaustive data searches and are more careful with the presentation of work (Fernández-Sánchez & Silva, 2022). For their part, men show greater attitudes toward using a variety of devices and systems, sharing content, exploring alternative solutions and collaborating on projects (Grande-de-Prado et al., 2020). The comparison based on the branch of knowledge, however, has highlighted notable differences. Unlike Jiménez-Hernández et al. (2020), it is confirmed that the speciality with a lower DC level is social sciences, while future teachers who come from careers framed in natural or technological sciences have a higher mastery of digital resources. Along these lines, the scores of the group specialised in educational orientation, in contrast to Pérez-Navío et al. (2021), show that they move notably away from those of arts and humanities and are closer to those of pure sciences. This finding is probably due to the fact that they come from degrees associated with Education Sciences in which knowledge about aspects linked to the Internet and ICTs deserves a greater value every day (Cepa-Rodríguez & Lancha-Villamayor, 2025).

Reviewing the third objective, it has been found that certain components of motivation (for example, intrinsic or extrinsic goal orientation) and, above all, creative self-efficacy are predictive factors of DC. The results, in this sense, confirm the postulate of Anistyasari et al. (2024) and Gómez-Trigueros et al. (2024), who argue that students who have extrinsic and especially intrinsic motivation show a greater willingness and curiosity to acquire and improve their digital skills. This, in turn, increases their ease or confidence in facing different challenges with ICTs and adapting to new socio-academic demands in a creative way (Gaona-Portal et al., 2024). Coupled with this, Pinto-Santuber et al. (2023) maintain that positive attitudes towards learning and high beliefs about self-efficacy in the use and management of technological devices (Anistyasari et al., 2024; Köstler & Wolff, 2025) lead teachers and students to show greater creativity in their work, which reinforces the need for emerging methodologies to include clear approaches for the development of creativity (Ramón-Verdú et al., 2021); even more so because they constitute essential factors for digital learning and academic performance (Cañete et al., 2022; Gómez-Trigueros et al., 2024; Van Laar et al., 2020). However, in contrast to Gómez-Gómez et al. (2022), from the results of our research, life satisfaction is not decisive for the improvement of DC.

The results obtained are consistent with recent studies on digital competence in the initial teacher education and point to the need for concrete training proposals. Alastor et al. (2024) identify insufficient levels of competence in problem solving, creativity and the pedagogical use of ICTs, highlighting the importance of implementing differentiated and targeted training actions to respond to the specific needs of each student group. Similarly, Marimon-Martí et al. (2023) stress the relevance of assessing students' initial competence to design programmes that move beyond instrumental skills and strengthen methodological areas such as pedagogical design, assessment and the educational use of digital technologies. Together, these findings reinforce the relevance of developing structured training models aimed at enhancing advanced, pedagogically-oriented digital skills.

5. Conclusions

Given this reality, it is essential to involve and raise awareness among teachers, both through continuous and initial training, to achieve the strategic objectives of digitalization. The integration of ICTs depends primarily on the predisposition and aptitudes towards them. However, there are still steps to be taken to achieve this goal. The findings reveal that there is a certain homogeneity in the digital educational offer of university degrees within the framework of the Bologna Plan, which increases the gap between the knowledge of teachers and the demands of a digitalised educational system (García-Delgado et al., 2024; Navas, 2020). On the other hand, it is necessary to reinforce the knowledge of students in all areas, including the integration of technical notions applicable in essential dimensions for teaching, such as critical thinking and content creation. The need to make progress on the subject is ratified in order to design strategies that guarantee that the curricula prepare, in a personalised and equal way, future teachers to practice their profession in a scenario marked by the preponderance of ICTs (Kiryakova & Kozhuharova, 2024; Köstler & Wolff, 2025; Vásquez-Pajuelo et al., 2024), which, in turn, address academic-emotional aspects. In this sense, our results point to the relevance of incorporating structured training modules, micro-credentials or supplementary workshops focused on pedagogical design, digital assessment, creative production of digital resources and collaborative problem-solving with ICTs. Likewise, implementing diagnostic assessments at the beginning of teacher education programmes would allow institutions to adapt the intensity and orientation of these activities to students' initial profiles, ensuring a more effective and personalised progression in advanced digital competence development.

This research has been influenced by some limitations that should be kept in mind both to interpret the results clearly and prudently and to define aspects for improvement for the future. First, the sample was not selected randomly to capture the totality of the perceptions of the Master's students. In future occasions, it would be advisable to opt for a probabilistic, larger and more representative sample, which achieves a more comprehensive and representative knowledge. Second, a self-perceptive instrument was used that, historically, has been linked to the collection of subjective opinions. In this sense, it would be necessary to complement with objective data about the real DC and compare it with such perceptions, and even combine with qualitative methods to understand the topic more contextualised. Despite these limitations, the results offer clear directions for future work, such as examining how digital competence develops throughout teacher education programmes, identifying which teaching practices most effectively strengthen advanced digital skills, and analysing institutional factors that shape students' digital learning experiences. These lines of inquiry may help universities design evidence-based training models better aligned with the emotional and academic needs of future teachers.

Future research should also delve into the educational practices that are carried out at each academic level in order to understand how ICTs are used to support learning and how digital skills are effectively developed. Additionally, to deepen their relationship with the learning objectives and results included in the teaching plans, to propose personalised updated guidelines adapted to the versatility with which resources evolve and transform to search, process, organise, evaluate and transfer knowledge and information (Gaona-Portal et al., 2024; McGarr, 2024; Ralda-Baiges et al., 2024). Also, it would be wise to know the digital skills of university lecturers, given their role in the training of future generations and the promotion of DC among them. Finally, they could propose regression or path analysis models that verify the way in which different academic and emotional factors (such as motivation, satisfaction, academic performance, etc.) contribute to the development of DC. Furthermore, this path constitutes the added value of this empirical proposal, pioneering in the field, which brings great progress in understanding the reality of the students of the Master's Degree in Training for Teachers.

Taken together, the findings of this study offer evidence that can inform the design of training programmes that respond to the emotional and academic needs of future teachers. The identification of specific gaps in advanced digital skills, together with the relevance of motivational and self-efficacy factors, provides a clear basis for developing targeted interventions that integrate pedagogical, methodological and emotional dimensions. These insights may guide universities and policymakers in refining curricula, designing specialised modules and implementing institutional strategies that foster a more coherent and effective development of digital competence within initial teacher education.

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Abbreviations

The following abbreviations are used in this manuscript:

ICT	Information and Communication Technologies
DC	Digital Competence

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