Macroassessment of teachers' digital competence. DigCompEdu study in Spain and Portugal

Macroevaluación de la competencia digital docente. Estudio DigCompEdu en España y Portugal

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Abstract

Teachers' digital competence is essential in contemporary education due to the growing role of technology in society, schools, and classrooms. This study examines teachers' digital competence in the context of the Iberian Peninsula, covering 170,603 in-service teachers in Spain (Andalusia) and Portugal. Its main objective is to analyze the differences in teachers' digital competence between these two countries and explore the factors that could influence this competence. The study methodology is based on a large sample of teachers who completed the validated DigCompEdu Check-In. Descriptive, contrast and inferential statistical techniques were used to analyze the data. The results indicate that, in general, Portuguese teachers showed a slightly higher level of digital competence compared to their Spanish counterparts in all competence areas assessed. The competence area "Facilitating Learner's Digital Competence" obtained lower scores in both countries, which stresses the need to improve teachers' ability to foster the digital competences of their students in digital safety, critical literacy or problem solving. Results further show that gender, age, educational level and teaching experience are significant factors in explaining teachers' digital competence. This study underscores the importance of implementing personalized training programs adapted to the individual needs and characteristics of teachers. Furthermore, the study emphasizes the significance of fostering collaboration among teachers, promoting spaces and opportunities for the exchange of knowledge, experiences, and best practices. This collaboration not only helps bridge the gap in digital competence among educators but also drives updated and relevant education in the digital age.
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Keywords: **digital competence, teacher training, DigCompEdu, compulsory education, Spain, Portugal.**

Resumen

La competencia digital docente es esencial debido al creciente papel de la tecnología en las aulas. Este estudio evalúa la competencia digital docente en el contexto de la Península Ibérica, abarcando a 170,603 docentes en activo de enseñanza obligatoria en España (Andalucía) y Portugal. Su objetivo principal es analizar las diferencias en la competencia digital docente entre estos dos países y explorar los factores que influyen en su desarrollo. La metodología del estudio se basa en una muestra de docentes que completan el cuestionario validado DigCompEdu Check-In. Se emplearon técnicas estadísticas descriptivas, de contraste e inferenciales. Los resultados indican que los docentes portugueses muestran un nivel ligeramente superior de competencia digital en comparación con sus homólogos españoles en todas las dimensiones evaluadas. La dimensión "Desarrollo de la Competencia Digital de los Estudiantes" obtuvo la puntuación más baja en ambos países, señalando la necesidad de mejorar la habilidad de los docentes para fomentar las competencias digitales del alumnado en seguridad digital, alfabetización crítica o resolución de problemas. Además, los resultados muestran que el género, la edad, el nivel educativo y la experiencia docente son factores importantes a la hora de explicar la competencia digital de los docentes. Por ello, se subraya la importancia de implementar programas de formación personalizados. Además, se enfatiza la importancia de fomentar la colaboración entre docentes, promoviendo oportunidades para el intercambio de prácticas exitosas. Esta colaboración no solo ayuda a cerrar la brecha digital, sino que también impulsa una educación actualizada y relevante en la era digital.

Palabras clave: **competencia digital, formación de docentes, DigCompEdu, educación obligatoria, España, Portugal.**

INTRODUCTION

In the context of the knowledge society, technology has become an essential component that plays a fundamental role in the educational field. In this sense, teachers' digital competence (TDC) acquires crucial importance for the adequate integration and effective use of digital technologies in the educational environment. TDC refers to the set of knowledge, skills and attitudes teachers need to use digital technologies effectively for the teaching profession, which holds a pedagogical dimension at its core (Council of the European Union, 2018; Ghomi & Redecker, 2019). One of its main objectives, according to Caena and Redecker (2019), is for teachers to develop these competences to promote the development of their students' learning and skills. Furthermore, according to Tondeur et al. (2018), there is a relationship between the pedagogical strategies used by teachers and their level of TDC.

TDC has become a significant research topic in recent years, as demonstrated by the increase in scientific production in high-impact journals, as well as monographs dedicated exclusively to this topic (Cisneros Barahona et al., 2023a; Rodríguez- García et al., 2019; Audrin & Audrin, 2022; Lucas et al., 2021; Mattar et al., 2022). This is due, in part, to the fact that TDC diagnosis usually reveals a low or intermediate level (Alarcón et al., 2020; Torres-Barzabal et al., 2022). This highlights the need to establish training policies and programs both in the pedagogical-didactic and technological-instrumental fields (Pérez, 2019; Grant et al., 2024). Furthermore, teachers' perception of their effectiveness in relation to their TDC is a factor that influences their use of technologies in teaching. All these aspects underline the importance of examining this competence, since its limited mastery has a negative impact on the educational use of digital technologies by teachers (Padilla-Hernández & Vanesa, 2020) and affects other competences necessary for teachers' professional development (Boie et al., 2023; Momdjian et al., 2024).

In relation to TDC, several frameworks have been developed, such as the UNESCO ICT Competency Framework, MENTEP or TPACK (Cabero-Almenara et al., 2020; Parra et al., 2021). One of the most consolidated is the European Framework for the Digital Competence of Educators, or DigCompEdu, which has been used at different educational levels and in various countries and continents (García-Ruiz et al., 2020; Mattar et al., 2022; Munar Garau et al., 2024). This model is organized around three macro dimensions (professional, pedagogical and learners' competences) and is broken down into six competence areas (Figure 1).

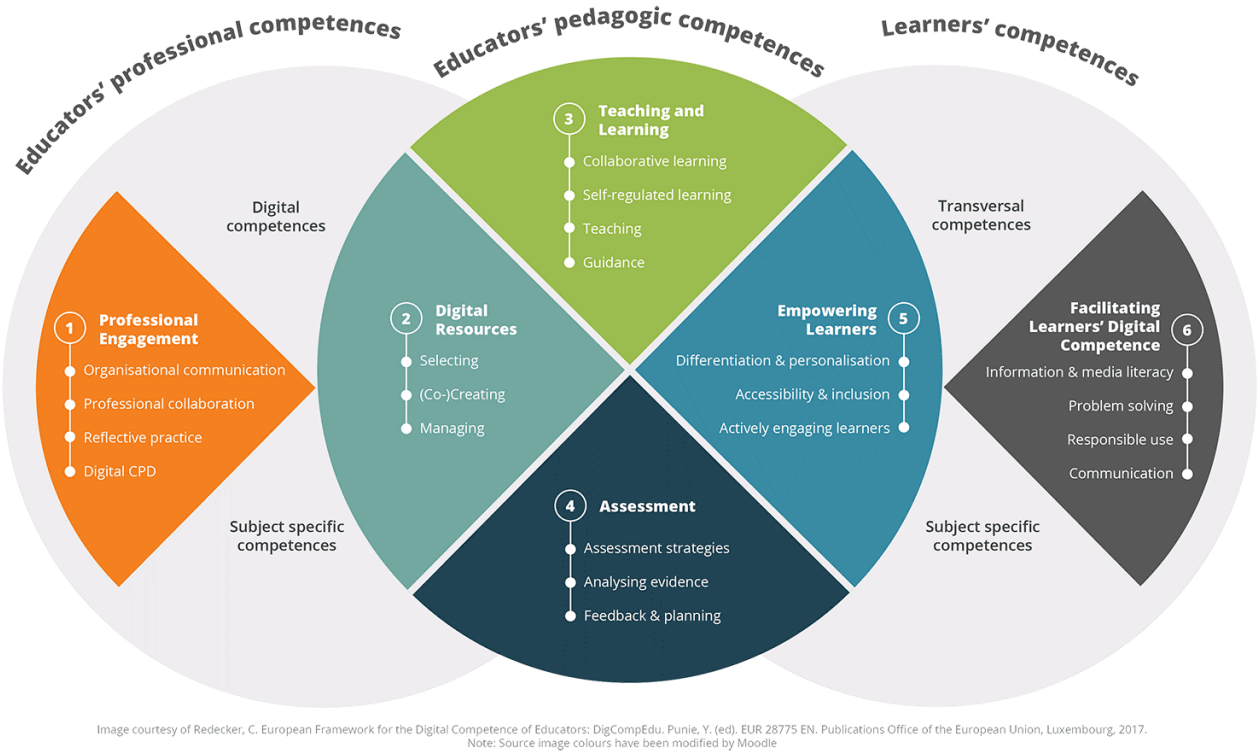

Image courtesy of Redecker, C. European Framework for the Digital Competence of Educators: DigCompEdu. Punie, Y. (ed). EUR 28775 EN. Publications Office of the European Union, Luxembourg, 2017.
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Figure 1
DigCompEdu overview
Source: JRC

These areas translate into: Professional Engagement (DIM. A), focused on communication and collaboration with other educational agents; Digital Resources (DIM. B), which covers the selection, creation, modification and management of digital content, taking into account the protection of personal data and copyright; Teaching and Learning (DIM. C), related to the planning, design, organization and integration of digital technologies into the teaching and learning processes; Assessment (DIM. D), aimed at the use of digital technologies to improve assessment processes; Empowering Learners (DIM. E), aimed at creating digital learning experiences that meet the personal and individual needs of students; and Facilitating Learner´s Digital Competence (DIM. F), focused on enhancing students' responsible and critical use of digital technologies. Each competence area further details the related competences, totalling 22 with 6 levels of development.

The DigCompEdu framework also proposes a progression model that translates different levels of digital competence development. Levels range from A1 (basic understanding and use of digital technologies) to C2 (innovative pedagogical use of digital technologies).

Although the use of digital technologies has demonstrated several benefits in the teaching-learning process (Dehghanzadeha et al., 2019; Georgiou et al., 2021; Ortega-Rodríguez et al., 2022), some studies suggest teachers barely use them in their daily practice (Gozálvez et al., 2019), and when they do, their use is limited due to their low TDC (Muñoz & Cubo, 2019; Boie et al., 2023; Carranza-Yuncor et al., 2024). The development of basic digital competence does not guarantee that a teacher has the necessary knowledge, skills and attitudes to be able to orchestrate the use of digital technologies in their learning designs. This issue raises questions about whether teachers can meet the demands of the knowledge society. Consequently, it is crucial to ask what the general and specific levels of TDC at the Early Childhood, Primary and Secondary Education levels are, and whether factors such as gender, age, educational level and teaching experience can predict them.

In relation to gender, some studies find significant differences in digital competence between males and females. For example, Manrique and García-Martín (2022) observed that female Primary Education teachers in Spain showed superior skills in the use of websites and blogs compared to their male counterparts. Other studies suggest that gender is not a determining factor in TDC (Cabero-Almenara et al., 2021; Usart et al., 2021), or that the influence of gender varies depending on the technological dimension analyzed. For example, Guillén-Gámez et al. (2023) found that there were no significant gender differences related to the use of digital resources and applications, but differences were found in relation to the use of technological devices. In Portugal, Lucas et al. (2022) found that gender was a significant predictor of digital competence, favoring male teachers. This was found for all the DigCompEdu competence areas, except for DIM. E. These findings reflect the diversity of results and the need for further research in this field.

Regarding age, an inversely proportional relationship has been observed between age and the level of TDC, since younger teachers tend to have higher levels of digital skills (Dirckinck-Holmfeld et al., 2023). This may be because younger generations are more familiar with technology from an early age or have received digital training at both personal and professional levels. The contrary is found by other studies that indicate the relationship between age and TDC is not linear and that other factors can influence this dynamic (Cabero-Almenara et al., 2021).

It is important to highlight that continuous training and professional development are essential to improve TDC (Eickelmann et al., 2021; Tang, 2021), given that technologies are constantly evolving. The digital transformation of schools/education requires ongoing training and innovation programs that promote awareness of the added value of digital technologies to transform pedagogies and improve students' learning.

The present study is based on a large sample of teachers (n = 170,603) in the context of compulsory education in the Iberian Peninsula (Spain and Portugal). The results of this study can serve as a reference for regional and national programs aimed at the digital transformation of schools, thus contributing to the creation of a European Education Area, in accordance with the objectives of the European Skills Agenda (Council of the European Union, 2018) and the Europe 2020 Strategy for New Skills for New Jobs (Kluzer et al., 2018).

In this research, the topic of Digital Competence of teachers is addressed in three educational levels (Early Childhood, Primary and Secondary Education). The study is of great relevance for several reasons. First, no research has been carried out in the Iberian Peninsula (Spain and Portugal) with such a large sample. Second, a comparative study of teachers' TDC digital competence level is presented. Third, a detailed analysis of academic and demographic variables that may explain TDC differences and inform the development of targeted programs is carried out.

METHODS

Objectives

The objectives of this study are threefold: i) to measure the digital competence level of a sample of Spanish and Portuguese teachers; ii) to examine if significant differences in TDC between Spain and Portugal exist iii) to identify the variables that may predict TDC.

Design and participants

A non-experimental design (ex post facto) was used with a sample of 170,603 in-service teachers in the Iberian Peninsula, reflecting a balanced representation between Spain (46.3%) and Portugal (53.7%). In the case of the Spanish participants, they are all teachers from the autonomous community of Andalusia. The sample is mostly composed by female teachers (72.3%), with ages ranging between 40-49 years old (38.6%),

and with considerable teaching experience, averaging 16 years. Teachers are distributed across Early Childhood Education (5.4%), Primary Education (38.3%), and Secondary Education (56.2%). For the data collection, intentional non-probabilistic sampling was used, as well as snowball sampling. Table 1 expands the sample information for each country.

Table 1
Sample distribution by country

		Spain		Portugal	
		N	%	N	%
Gender	Female	53074	43.1%	70203	56.9%
	Male	25892	54.7%	21434	45.3%
Age	Less than 25	1	1.0%	103	99.0%
	25-29	2803	84.7%	506	15.3%
	30-39	16808	76.8%	5082	23.2%
	40-49	31830	48.4%	33951	51.6%
	50-59	22524	37.6%	37453	62.4%
	60 or more	5000	25.6%	14542	74.4%
Educational level	Early Childhood	8881	96.1%	360	3.9%
	Primary	27310	41.7%	38114	58.3%
	Secondary	42775	44.6%	53163	55.4%
Teaching experience	0-5	44629	88.4%	5862	11.6%
	6-14	22517	71.5%	8959	28.5%
	15 or more	11820	13.3%	76816	86.7%

Instrument and procedure

The DigCompEdu Check-In was developed by one of the Joint Research Centers of the European Commission with the collaboration of a group of researchers and validated in the national languages of both countries participating in the study (Cabero-Almenara & Palacios-Rodríguez, 2020; Lucas et al., 2021). This instrument consists of 22 items, corresponding to the 22 competences encompassed by the six competence areas of DigCompEdu:

1. Professional Engagement (DIM. A) – 4 items
2. Digital Resources (DIM. B) – 3 items
3. Teaching and Learning (DIM. C) – 4 items
4. Assessment (DIM. D) – 3 items
5. Empowering Learners (DIM. E) – 3 items
6. Facilitating Learner's Digital Competence (DIM. F) – 5 items

Upon submission, teachers receive a detailed report in which the global proficiency level as well as the proficiency level per competence area is provided. These correspond to the proficiency levels described earlier in this work (cf. Introduction).

In addition, demographic questions were incorporated in the instrument that addressed issues such as gender, educational level, age and teaching experience.

In Portugal, data was gathered as part of a national study commissioned by the Ministry of Education. Every teacher in public schools received an invitation to complete the DigCompEdu Check-In survey between January and March 2021. A remarkable 99,760 teachers, constituting 92% of all Portuguese teachers, voluntarily participated and provided their consent to partake in this self-reflection survey. The Ministry of

Education oversaw the process to ensure GDPR and ethical procedure compliance. In Spain, data was collected under the auspices of a study requested by the Junta de Andalucía. A similar invitation was extended to all public-school teachers to participate in the DigCompEdu Check-In survey. A total of 78,966 teachers responded to the self-reflection survey on a voluntary and consensual basis, with the Junta de Andalucía responsible for ensuring adherence to GDPR and ethical procedures.

Although the instrument has been validated with university professors, with high reliability and validity rates (Cabero-Almenara et al., 2021), there is no validation in the non-university setting. Thus, a validation process was carried out. First, an exploratory factor analysis (EFA) was performed using the maximum likelihood method with oblimin rotation. A KMO test (Kaiser-Meyer-Olkin) of 0.910 was obtained, and the Bartlet test was significant ($\chi^2 = 4225.711$, $p < 0.05$). Subsequently, a confirmatory factor analysis (CFA) was carried out, which demonstrated that the data adequately fit the proposed model. The coefficients obtained remained within the thresholds established by Bentler (1989) and Schumacker and Lomax (2004), which supported the factor structure formulated in the CFA. Furthermore, the reliability of the selected items was evaluated using both Cronbach's alpha coefficient and McDonald's omega coefficient for each of the scales of the instrument, and highly satisfactory values were obtained. All these coefficients are detailed in Table 2.

Table 2

Results reliability and validity of the instrument

Model Fit Summary	χ^2	**p**	**CFI**	**TLI**	**IFI**	**NFI**	**RMR**	**RMSEA**
	3.056	0.001	0.935	0.923	0.913	0.925	0.036	0.065
Validity Analysis	Dimensions	Dim. 1	Dim. 2	Dim. 3	Dim. 4	Dim. 5	Dim. 6	
	CR	0.926	0.945	0.889	0.916	0.956	0.859	
	AVE	0.758	0.749	0.797	0.849	0.829	0.771	
	MSV	0.747	0.749	0.824	0.765	0.821	0.616	
Exploratory analysis	True variance explained (%)	67.245						
Test reliability	Cronbach's alpha	0.928	0.916	0.948	0.956	0.917	0.954	
	McDonald's Omega	0.947	0.819	0.842	0.949	0.946	0.921	

RESULTS

Spanish and Portuguese teachers' digital competence

To achieve the first objective, a descriptive analysis of the data was carried out. Table 3 presents the means and standard deviations per DigCompEdu competence areas and globally. For better interpretation of the data, the scores have been weighted on a scale of 0-5 points.

Table 3
Mean and standard deviation dimensions and total

	Spain		Portugal	
	M	SD	M	SD
DIM. A	2.50	.96	2.70	.94
DIM. B	2.43	.99	2.55	.96
DIM. C	2.26	1.11	2.44	1.10
DIM. D	2.44	.86	2.46	.91
DIM. E	2.65	1.11	2.72	1.10
DIM. F	1.95	1.06	2.23	1.00
Total	2.33	.85	2.50	.84

In Spain, the average scores of teachers vary according to the different competence areas, with Professional Engagement reaching 2.50, Digital Resources 2.43, Assessment 2.44, Empowering Learners 2.65, and a lower score in the Facilitating of Learners' Digital Competence, which obtains 1.95. The standard deviation in these scores also reflects significant variability in TDC, especially regarding Teaching and Learning with 1.11 and Empowering Learners with 1.11. The general average in Spain is 2.33, with a standard deviation of 0.85.

In Portugal, teachers obtained slightly higher scores compared to Spain in all competence areas. Professional Engagement reached 2.70, Digital Resources 2.55, Assessment 2.46, Empowering Learners 2.72, and Facilitating of Learners' Digital Competence 2.23. The competence areas of Teaching and Learning and Empowering Learners also show high variability with standard deviations of 1.10. The general average in Portugal is 2.50, with a standard deviation of 0.84. These results show that, on average, teachers in Portugal reach higher levels of TDC compared to their colleagues in Spain. Figure 2 illustrates the percentage of teachers per proficiency level on a surface plot.

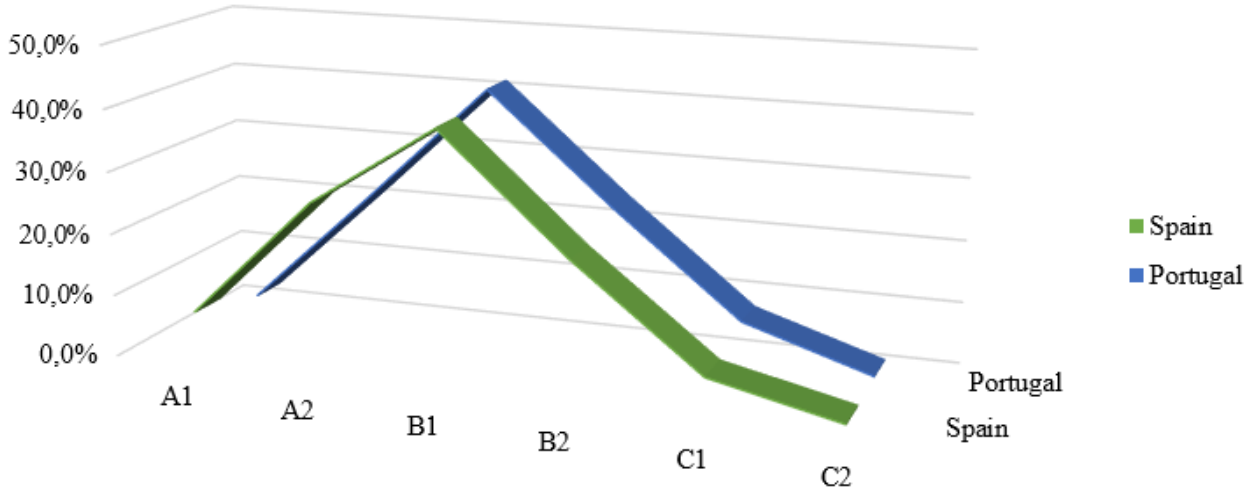

Figure 2
Percentages of self-perceived competency levels

In Spain, the majority of teachers are at levels B1 and B2, which represent an intermediate level of digital competence. The highest percentage can be found in B1 with 39.5% of teachers. Although there is a presence at levels A2 and C1, the majority of teachers are at the intermediate levels of digital competence.

Similarly, in Portugal, the majority of teachers are also at levels B1 and B2, although there is a higher percentage of teachers in B1, corresponding to 41.6%.

Significant differences in TDC between Spain and Portugal

To achieve the second objective, a contrast study is proposed using the "Country" variable. It has been shown that the sample maintains a distribution which is different from the normal one using the K-S test (sig. <0.05) and symmetry and kurtosis analysis. In this case, the non-parametric Mann-Whitney U test and average rank analysis were applied. The results can be found in Table 4.

Table 4
Mann-Whitney U test

	DIM. A	DIM. B	DIM. C	DIM. D	DIM. E	DIM. F	T
Mann-Whitney U	3162964119.500	3349230861.500	3318602240.000	3617048906.000	3512833366.000	3081340753.000	3
Wilcoxon W	6280818180.500	6467084922.500	6436456301.000	7815764609.000	6630687427.000	6199194814.000	6
Z	-45.078	-26.717	-29.626	-.105	-10.445	-53.073	-
Sig.	.000	.000	.000	.916	.000	.000	.(

Statistically significant differences were found in most dimensions: Professional Engagement (sig. = .000), Digital Resources (sig. = .000), Teaching and Learning (sig. = .000), Empowering Learners (sig. = .000), Facilitating Learner's Digital Competence (sig. = .000) and the total score (sig. = .000). These differences indicate that teachers from the two countries present notable variations in their digital competences. However, in the Assessment dimension (sig. = .916), no statistically significant differences were found between the country groups. This suggests that teachers in both countries show similar levels of digital competence regarding this aspect.

To identify which areas stood out in each country, an analysis of the average range was carried out. The results are described in Table 5. This analysis was only performed for the dimensions that proved significant in the previous test.

Table 5

Average range análisis

	Country	Average range	Sum of ranks
DIM. A	Spain	79538.26	6280818180.50
	Portugal	90268.77	8271958925.50
DIM. B	Spain	81897.08	6467084922.50
	Portugal	88236.11	8085692183.50
DIM. C	Spain	81509.21	6436456301.00
	Portugal	88570.35	8116320805.00
DIM. D	Spain	85315.36	6737012497.00
	Portugal	85290.49	7815764609.00
DIM. E	Spain	83968.89	6630687427.00
	Portugal	86450.78	7922089679.00
DIM. F	Spain	78504.61	6199194814.00
	Portugal	91159.49	8353582292.00
Total	Spain	80420.65	6350496712.00
	Portugal	89508.39	8202280394.00

In all the cases analyzed, it is observed that Portugal is at higher levels compared to Spain. This means that Portuguese teachers exhibit a higher self-perception of their digital competence, in all competence areas, in relation to their Spanish counterparts.

Variables that may predict TDC

To address the third objective, a logistic regression analysis was performed. Following the methodology proposed by Peláez (2016), logistic regression was used as a multivariate statistical technique that allows for estimating the relationship between a dependent variable, in this case the level of TDC, and a set of independent variables, which include gender, age, educational level and teaching experience. This analysis technique is considered the most appropriate to determine if a set of variables can explain the level of TDC, having been used in previous similar research (Fernández-Batanero et al., 2022).

Verification tests were carried out before performing logistic regression. The assumption of independence of observations yielded a non-significant result (sig. = 0.823), indicating that the observations are independent of each other. The Hosmer and Lemeshow test, related to the Monotonicity assumption, adequately fitted the data (sig. = .812). Next, the Omnibus test verified an accurate and significant estimate of the proposed model ($p < .05$), which implies the relationship between the independent variables (sociodemographic variables) and

the dependent variable, that is, the level of TDC. The goodness of fit of the model was assessed using the Nagelkerke (.321) and Cox and Snell (.214) regression coefficients, suggesting that the model explains approximately 29% to 39% of the total variability. Furthermore, the model was found to have a correct prediction ability in 70.2% of the cases, indicating that the model is acceptable. In addition, specificity and sensitivity tests of the model were carried out (Table 6), and the results show very satisfactory percentages.

Table 6

Multiple linear regression model

	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Desv. Error	Beta		
(Constant)	27.359	.227		120.578	.000
Gender	2.903	.076	.087	38.020	.000
Age	-2.744	.043	-.169	-63.370	.000
Educational level	8.005	.057	.320	140.471	.000
Teaching experience	1.598	.046	.093	34.934	.000

As reflected in the table, the model highlights the importance of the variables of gender, age, educational level and teaching experience as significant factors to explain the level of digital competence ($p < .001$).

DISCUSSION

In the analysis of the scores obtained by teachers in Spain and Portugal in relation to their TDC using the DigCompEdu framework, it is observed that, in general, Portuguese teachers show slightly higher scores than their Spanish counterparts in all the competence areas assessed. However, in both Spain and Portugal, a high variability stands out regarding the areas of "Teaching and Learning" and "Empowering Learners", indicating a wide range of digital competences among teachers. It is important to note that the competence area "Facilitating Learner's Digital Competence" obtained lower average scores in both countries, suggesting this is an area that may require improvement in teachers' ability to develop their students' digital competences. These results are essential to identify focus areas and guide training programs aimed at strengthening the digital competence of teachers in the educational context. Furthermore, the results indicate that TDC is a critical aspect in contemporary education, given the increasingly relevant role of technology in the classroom (Ghomi & Redecker, 2019; Momdjian et al., 2024). Teachers play a critical role in preparing students for the digital world, and improving their digital competence is essential to ensure that they can effectively use digital tools in their teaching practices, which, in turn, can enhance student learning (Alarcón et al., 2020; Torres-Barzabal et al., 2022). The variability in scores also suggests that professional development needs may vary among teachers, highlighting the importance of flexible training programs adapted to individual needs (Pinto Santos et al., 2023). These results offer valuable information for decision-making in educational policies and the design of training strategies, with the aim of strengthening teachers' digital competence and promoting effective and updated education in the digital age.

In parallel, the distribution of TDC levels suggests that there is a solid base of teachers with intermediate digital competences. However, there is a significant challenge in raising a greater number of teachers to the C1 and C2 level, which would imply a greater depth in digital competence and mastery of advanced technologies. These results once again underline the importance of implementing specific training and professional development programs to raise the level of TDC, especially in areas where there is a more limited presence at advanced levels. It is also important to recognize and take advantage of the strengths that each country may

have in terms of its distribution of teaching digital competence to drive educational policies and practices in the right direction (García-Ruiz et al., 2020; Mattar et al., 2022; Cisneros Barahona et al., 2023b).

Regarding the differences between countries, the results highlight the importance of personalized attention in the development of TDC in each country, taking into account the areas where significant differences are found. For example, in the competence areas in which statistical differences were observed, specific training programs could be designed to address the particular needs of each group of teachers. Regarding the Assessment competence area, where no statistically significant differences were found, sharing best practices among teachers from both countries could be considered, promoting collaboration and exchange of knowledge in this area. Ultimately, these findings support the idea that TDC is an essential aspect of today's education and highlights the need to invest in the training and professional development of teachers to ensure they are equipped with the necessary skills to take advantage and maximize digital tools in their teaching practices and to ultimately improve the learning experience of students (Audrin & Audrin, 2022; Munar Garau et al., 2024). Likewise, in all the cases analyzed, it is evident that Portugal surpasses Spain in terms of TDC. This means that Portuguese teachers tend to demonstrate a higher level of digital competence in all competence areas assessed compared to their Spanish colleagues. These disparities may be related to a variety of factors, such as differences in teacher training programs, educational policies, availability of technological resources, or pedagogical approaches. It is essential to highlight that this difference does not necessarily suggest that one country is "superior" to the other, but rather reflects variations in the levels of TDC according to the DigCompEdu framework. This finding provides valuable information for both countries, as it can serve as a basis for identifying areas of strength and areas where improvements can be made. Therefore, these data offer an opportunity to develop training and professional development strategies that adapt to the specific needs of teachers in each country, with the aim of promoting further progress in TDC.

Finally, the identification of the variables of gender, age, educational level and teaching experience as significant factors in explaining the level of teaching digital competence is a relevant finding that deserves an in-depth discussion.

The fact that gender is a significant variable suggests that there are disparities in the digital competence of male and female teachers. This may be due to several factors, such as gender socialization, differences in exposure to technology across the lifespan, and perceptions of gender roles related to technology (Usart et al., 2021). For example, women may tend to face cultural or trust barriers in the adoption of digital technologies (Guillén-Gámez et al., 2023). This disparity underlines the importance of addressing the gender gap in digital competence through specific training and empowerment strategies for teachers of both sexes.

Age as a significant variable indicates that TDC varies according to their age group. It is common for younger teachers, who have grown up in a digital age, to show greater familiarity and comfort with technology. On the other hand, older teachers may need additional support to develop more advanced digital skills (Guillén-Gámez et al., 2023). This highlights the need to provide technology training on a continuous basis and adapted to the specific needs of each age group.

The educational level to which teachers are dedicated (preschool, primary and secondary) is also revealed as a significant variable. This could be due to differences in the complexity of the digital competences required at different educational levels. For example, primary school teachers may need different competences than those who work in secondary or preschool education (Alonso-García et al., 2024). This differentiation underlines the importance of offering specific and relevant training for the needs of each educational level.

The teaching experience of teachers is also presented as a significant variable, suggesting that teachers with more years of experience may have a different level of digital competence compared to more novice teachers (Dirckinck-Holmfeld et al., 2023). More experienced teachers may have acquired digital competences gradually throughout their career, while newcomers may need a more intensive focus on acquiring them from the beginning. This highlights the importance of designing professional development programs that address the specific needs of teachers at different stages of their career.

Together, these results highlight the complexity of TDC and the need for a comprehensive educational strategy that considers individual differences. Training policies and programs must be flexible and adapt to variations in gender, age, educational level and teaching experience, with the aim of closing the gap and ensuring that all teachers are equipped to make the most of technologies in the classroom.

CONCLUSION

The detailed analysis of TDC in the contexts of Spain and Portugal, based on the DigCompEdu framework, provides highly relevant conclusions.

Firstly, significant differences were observed between Spain and Portugal, with Portuguese teachers showing a slightly higher level of digital competence. These differences can be explained by various factors, such as the national educational policies or the availability of technological resources in both contexts. It is important to emphasize that these differences do not imply a superiority, but rather areas of strength and opportunities for improvement in both countries.

Furthermore, a high variability was particularly identified regarding the competence areas "Teaching and Learning" and "Empowering Learners" in both countries, which reflects the diversity of digital competence among teachers, even within the same country. This highlights the need for training and professional development programs tailored to meet individual needs.

The competence area of "Facilitating Learner's Digital Competence" reveals lower scores in both countries, indicating the need to improve the capacity of teachers to promote the development of these competences with their students. This underlines the importance of specific training in this area.

The distribution of levels of TDC shows a solid base of teachers with intermediate digital competences. However, the challenge is to elevate more teachers to the C1 and C2 proficiency level, which requires advanced mastery of digital technologies and their embedding in pedagogical practices. This highlights the need for specific training programs.

The results point to the need for a continuous focus on the training and professional development of teachers in digital competence. Furthermore, the findings support the idea that TDC is a critical aspect in contemporary education, considering the increasingly relevant role of technology in schools and in the classroom. Teachers play a critical role in preparing students for the digital world, and improving their digital competence is essential to ensure that they can effectively use digital tools in their teaching practices, which, in turn, can enhance student learning.

This study has some limitations that should be considered when interpreting the results and planning future research. Although the sample is large, this study has focused exclusively on two countries in the Iberian Peninsula, Spain and Portugal, which limits the generalization of the findings at a global level. TDC can vary substantially in different regions of the world due to cultural factors, educational policies and levels of investment in technology. To obtain a more representative picture, it would be valuable to conduct similar studies in a variety of international educational contexts. Furthermore, this study does not address cultural, linguistic or regional differences within each country, even though Spain and Portugal share cultural and linguistic similarities. These differences could influence TDC, and future research should consider these variables. It should also be noted that the Spanish sample corresponds only to teachers from the autonomous community of Andalusia. Although the Junta de Andalucía guaranteed compliance with the General Data Protection Regulation and ethical procedures, the results obtained cannot be generalized to the entire Spanish territory, limiting their representativeness to this autonomous community. This geographic restriction may influence the applicability of the findings to other regions with different educational and sociodemographic contexts. For future studies, it would be beneficial to expand the sample to other autonomous communities to obtain a more generalizable vision of teaching digital competence in Spain. Another limitation is that not all relevant variables have been evaluated. Factors such as prior training in technology, the availability of

technological resources in schools and differences in pedagogical approaches have not been included in the analysis, despite their influence on TDC. Furthermore, the study does not evaluate the effectiveness of existing training programs or their impact on educational practice. Future research could address this question to determine which training approaches are most effective and what impact they have on TDC and student learning. Finally, the need for qualitative research is highlighted. Complementing quantitative with qualitative data would enable a deeper understanding of teachers' perceptions and experiences in relation to their digital competence.

In perspective, future work could consider longitudinal research, comparisons with other countries and evaluation of specific training programs. In summary, this study provides valuable information to improve teacher training and digital competence, which is crucial for effective education in the digital age.

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REFERENCES

Alarcón, R., Del Pilar Jiménez, E., & de Vicente-Yagüe, M. I. (2020). Development and validation of the DIGIGLO, a tool for assessing the digital competence of educators. *British Journal of Educational Technology, 51*(6), 2407-2421. https://doi.org/10.1111/bjet.12919

Alonso-García, S., Maldonado, J. J. V., Domingo, J. A. M., & Ortiz, B. B. (2024). Analysis of self-perceived digital competences in future educators: A study at the university of Granada. *JOTSE, 14*(1), 4-15. https://doi.org/10.3926/jotse.2521

Audrin, C., & Audrin, B. (2022). Key factors in digital literacy in learning and education: a systematic literature review using text mining. *Education and Information Technologies*, 1-25. https://doi.org/10.1007/s10639-021-10832-5

Bentler, P. M. (1989). *EQS structural equations program manual*. BMDP Statistical Software.

Boie, M. A. K., Dalsgaard, C., & Caviglia, F. (2023). Digital instinct—A keyword for making sense of students' digital practice and digital literacy. *British Journal of Educational Technology, 55*(2). https://doi.org/10.1111/bjet.13398

Cabero-Almenara, J., & Palacios-Rodríguez, A. (2020). Marco Europeo de Competencia Digital Docente «DigCompEdu». Traducción y adaptación del cuestionario «DigCompEdu Check-In». *EDMETIC*, *9*(1), 213-234. https://doi.org/10.21071/edmetic.v9i1.12462

Cabero-Almenara, J., Guillen-Gamez, F. D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2021). Classification models in the digital competence of higher education teachers based on the DigCompEdu Framework: logistic regression and segment tree. *Journal of E-Learning and Knowledge Society, (1),* 49-61. https://doi.org/10.20368/1971-8829/1135472

Cabero-Almenara, J., Romero-Tena, R., & Palacios-Rodríguez, A. (2020). Evaluation of Teacher Digital Competence Frameworks Through Expert Judgement: The Use of the Expert Competence Coefficient. *Journal of New Approaches in Educational Research, 9*(2), 275-293. https://doi.org/10.7821/naer.2020.7.578

Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu). *European Journal of Education*, *54*(3), 356-369. https://doi.org/10.1111/ejed.12345

Carranza-Yuncor, N. R., Rabanal-León, H. C., Villena Zapata, L. I., & Mora Mau, M. E. (2024). Competencia digital. Análisis comparativo pospandemia en maestros de instituciones urbanas y rurales. *Bordón. Revista de Pedagogía*, *76*(1), 31-48. https://doi.org/10.13042/Bordon.2024.99045

Cisneros Barahona, A. S., Marqués Molías, L., Samaniego Erazo, N., & Mejía Granizo, C. M. (2023a). Teaching Digital Competence. A training proposal design and validation. *Pixel-Bit. Revista de Medios y Educación*, *68*, 7-41. https://doi.org/10.12795/pixelbit.100524

Cisneros Barahona, A. S., Marqués Molías, L., Samaniego Erazo, N., & Mejía Granizo, C. M. (2023b). La Competencia Digital Docente. Diseño y validación de una propuesta formativa. *Pixel-Bit. Revista de Medios y Educación*, *68*, 7-41. https://doi.org/10.12795/pixelbit.100524

Council of the European Union. (2018). *Recomendación del Consejo, de 22 de mayo de 2018, relativa a las competencias clave para el aprendizaje permanente*. Publications Office of the European Union.

Dehghanzadeha, H., Fardanesh, H., Hatami, J., Talaee, E., & Noroozi, O. (2019). Using gamification to support learning English as a second language: a systematic review. *Computer Assisted Language Learning, 34(*7), 934-957. https://doi.org/10.1080/09588221.2019.1648298

Dirckinck-Holmfeld, L., Bygholm, A., & Tabo, G. O. (2023). Transforming education through ICT: Exploring students' study practices in a resource-constrained university setting. *British Journal of Educational Technology, 54*(6). https://doi.org/10.1111/bjet.13367

Eickelmann, B., Drossel, K., Heldt, M. (2021). ICT in teacher education and ICT-related teacher professional development in Germany. In J.C.-K. Lee & T. Ehmke (Eds.), *Quality in teacher education and professional development: Chinese and German perspectives* (1st Ed.). Routledge. https://doi.org/10.4324/9781003197973

Fernández-Batanero, J. M., Cabero-Almenara, J., Román-Graván, P., & Palacios-Rodríguez, A. (2022). Knowledge of university teachers on the use of digital resources to assist people with disabilities. The case of Spain. *Education and Information Technologies*, *27*(7), 9015-9029. https://doi.org/10.1007/s10639-022-10965-1

García-Ruiz, R., Matos, A., Arenas-Fernández, A., & Ugalde, C. (2020). Alfabetización mediática en Educación Primaria. Perspectiva internacional del nivel mediática. *Pixel-Bit. Revista de Medios y Educación, 58*, 217-236. https://doi.org/10.12795/pixelbit.74535

Georgiou, Y., Tsivitanidou, O., & Ioannou, A. (2021). Learning experience design with immersive virtual reality in physics education. *Education Technology Research and Development, 69*, 3051-3080. https://doi.org/10.1007/s11423-021-10055-y

Ghomi, M., & Redecker, C. (2019). *Digital Competence of Educators (DigCompEdu): Development and Evaluation of a Self-assessment Instrument for Teachers' Digital Competence*. CSEDU. https://doi.org/10.5220/0007679005410548

Gozálvez, V., Masanet, M. J., Hernando, Á., & Bernal-Bravo, C. (2019). Relación entre formación universitaria y competencia mediática del profesorado. *Revista Complutense de Educación, 30*(4), 1113-1126. https://doi.org/10.5209/rced.60188

Grant, S., Qi, G. Y., Lan, Y. J., & Cheng, P. Y. (2024). Fostering academic citizenship through ubiquitous technologies in an online academic conference. *Educational Technology & Society*, *27*(1), 18-34. https://doi.org/10.30191/ETS.202401_27(1).RP02

Guillén-Gámez, F. D., Ruiz-Palmero, J., Colomo-Magaña, E., & Cívico-Ariza, A. (2023). Construcción de un instrumento sobre las competencias digitales del docente para utilizar YouTube como recurso didáctico: análisis de fiabilidad y validez. *Revista de Educación a Distancia (RED), 23*(76). https://doi.org/10.6018/red.549501

Kluzer, S., Pujol Priego, L., Carretero, S., Punie, Y., Vuorikari, R., Cabrera, M., & Okeeffe, W. (2018). *DigComp into action, get inspired make it happen a user guide to the European Digital Competence framework*. JRC. https://doi.org/10.2760/112945

Lucas, M., Bem-Haja, P., Santos, S., Figueiredo, H., Ferreira, M., & Amorim, M. (2022). Digital proficiency: Sorting real gaps from myths among higher education students. *British Journal of Educational Technology, 53*(6).https://doi.org/10.1111/bjet.13220

Manrique, J. M., & García-Martín, J. (2022). La competencia digital del profesorado de Educación Primaria durante la pandemia (COVID-19). *Profesorado. Revista de Currículum y Formación del Profesorado, 26*(2), 125-140. https://doi.org/10.30827/profesorado.v26i2.21568

Mattar, J., Ramos, D. K., & Lucas, M. R. (2022). DigComp-Based Digital competence Assessment Tools: Literature Review and Instrument Analysis. *Education and Information Technologies*, 1-25. https://doi.org/10.1007/s10639-022-11034-3

Momdjian, L., Manegre, M., & Gutiérrez-Cólon, M. (2024). Digital competences of teachers in Lebanon: a comparison of teachers' competences to educational standards. *Research in Learning Technology*, *32*. https://doi.org/10.25304/rlt.v32.3203

Munar Garau, J., Oceja, J., & Salinas Ibáñez, J. (2024). Equivalencias entre los indicadores de la herramienta SELFIE y el marco DigCompEdu a partir de la técnica Delphi. *Pixel-Bit. Revista de Medios y Educación*, (69), 131-168. https://doi.org/10.12795/pixelbit.101775

Muñoz, E., & Cubo, S. (2019). Competencia digital, formación y actitud del profesorado de educación especial hacia las tecnologías de la información y la comunicación (TIC). *Profesorado. Revista de Curriculum y Formación del Profesorado, 23*(1), 209-241. https://doi.org/10.30827/profesorado.v23i1.9151

Ortega-Rodríguez, P. J., Gómez-García, M., Boumadan, M., & Soto-Varela, R. (2022). Media literacy of university students for creating digital contents. *Innoeduca. International Journal of Technology and Educational Innovation*, *8*(2), 69-82. https://doi.org/10.24310/innoeduca.2022.v8i2.14169

Padilla-Hernández, A. L., & Vanesa, M. (2020). Evolución de la competencia digital docente del profesorado universitario: incidentes críticos a partir de relatos de vida. *Educar*, *56*(1), 109-127. https://doi.org/10.5565/rev/educar.1088

Parra, L., Canales, R., Alzate, Y., & Morales, M. (2021). *Escenarios y recursos para la enseñanza con tecnología: desafíos y retos*. Octaedro

Peláez, I. M. (2016). Modelos de regresión: lineal simple y regresión logística. *Revista Seden, 14*, 195-214.

Pérez, R. (2019). Competencia Digital Docente en los Institutos Superiores de Formación de Maestros: Caso de República Dominicana. *Pixel-Bit. Revista de Medios y Educación*, *(55),* 75-97. https://doi.org/10.12795/pixelbit.2019.i55.05

Pinto Santos, A. R., Pérez-Garcias, A., & Darder Mesquida, A. (2023). Training in Teaching Digital Competence: Functional Validation of the TEP Model. *Innoeduca. International Journal of Technology and Educational Innovation*, *9*(1), 39-52. https://doi.org/10.24310/innoeduca.2023.v9i1.15191

Rodríguez-García, A. M., Trujillo Torres, J. M., & Sánchez Rodríguez, J. (2019). Impacto de la productividad científica sobre competencia digital de los futuros docentes: aproximación bibliométrica en Scopus y Web of Science. *Revista Complutense de Educación*, *30*(2), 623-646. https://doi.org/10.5209/RCED.58862

Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling*. Psychology Press. https://doi.org/10.4324/9781410610904

Tang, Y. (2021). Does information and communication technology (ICT) empower teacher innovativeness: a multilevel, multisite analysis. *Education Technology Research and Development, 69*, 3009-3028. https://doi.org/10.1007/s11423-021-10052-1

Tondeur, J., Aesaertb, K., Prestridge, S., & Consuegraa, E. (2018). A multilevel analysis of what matters in the training of pre-service teacher's ICT competencies. *Computers & Education, 122*, 32-42. https://doi.org/10.1016/j.compedu.2018.03.002

Torres-Barzabal, M. L., Martínez-Gimeno, A., Jaén-Martínez, A., & Hermosilla-Rodríguez, J. M. (2022). La percepción del profesorado de la Universidad Pablo de Olavide sobre su Competencia Digital Docente. *Pixel-Bit. Revista de Medios y Educación, 63*, 35-64. https://doi.org/10.12795/pixelbit.91943

Usart, M., Lázaro. J. L., & Gisbert, M. (2021). Validation of a tool for self-evaluating teacher digital competence. *Educación XX1, 24*(1), 353-373. https://doi.org/10.5944/educxx1.27080

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