Research Article

Teachers' digital competences in higher education in Portugal and Spain

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ARTICLE INFO	ABSTRACT
	The potential of DTIC has brought new and emerging challenges to teachers, making it essential to acquire digital competences, especially in virtual learning environments and online technologies. In this sense, based on the *DigCompEdu CheckIn* self-assessment questionnaire, validated for the Portuguese population by earlier studies, this research aims to identify the most fragile and robust areas of digital competences of Portuguese and Spanish university teachers. The quantitative methodological approach emphasizes teachers' perception of their digital competences in three dimensions: teachers' professional competences, teachers' pedagogical competences and students' competences and involved 347 teachers from Portugal and Spain. The results show that teachers of the two institutions have an overall moderate level of digital proficiency–level B1 and B2–and that the differences encountered between Portuguese and Spanish teachers (for example, Portuguese teachers have level A2 in area 4–assessment–, while Spanish teachers are already at level B2) highlight the need to invest in specific training that may address specific frailties, and therefore allow for the promotion of their digital competences. Results relating to teaching experience and age show that there is no direct relation between either factor or being digitally competent. Regarding gender, results reveal that men had slightly better results than women. Overall, what the results show is the need for teachers to increase the level of digital competence through specific training, prepared according to the specificities of each institution, and the importance of developing public policies that prepare teachers for a more digital education. **Keywords:** digital technologies, digital competence, higher education, teacher training, DigCompEdu

INTRODUCTION

In times of marked changes, in a complex world, where analogue and digital, real and virtual, human and machine, offline and online cohabit, all of us aware that we live in an era marked by the COVID-19 pandemic and the dizzying evolution of digital technologies, we are faced with the need to rethink models, educational communication processes and, above all, to rethink teacher training to act in new scenarios and educational ecosystems.

At a time when action plans are being presented in different parts of the world, such as the European Commission's action plan for digital education (2021-2027) (European Commission, 2021), it becomes necessary to consider a paradigm that allows, on the one hand, the creation and development of a quality digital education ecosystem, with infrastructures, connectivity and digital equipment and high quality learning content, and on the other, a strengthening of the competences - and specifically the digital competences–for a digital transformation of all educational stakeholders.

We are at a juncture in which it is necessary to consider what spaces and timeframes we wish to have in this new digital education ecosystem. This ecosystem should be characterized by a more intense presence of digital technologies and of communication networks and by its hybridism at the level of both different presences (physical and digital), times (synchronous and asynchronous), technologies (analogue and digital), cultures (pre-digital and digital) and, above all, the different spaces and learning environments (analogue and digital). In this sense, the creation of this new reality requires a high level of competence and innovation from teachers and school leaders, and which necessitates all educational agents to be trained in digital competences.

In a society, where we increasingly live in digital spaces, the development of these digital competences becomes forever more important. In the educational field, different documents have underlined this relevance. An example is UNESCO report (UNESCO, 2022), which recognizes that "to state the obvious, digital literacy and access are a basic right in the twenty-first century; without them it is increasingly difficult to participate civically and economically" and that "the first order of business is to close this divide and to consider digital literacy, for students and teachers, one of the essential literacies of the twenty-first century" (p. 34).

In a similar vein, the European Union stresses that, to keep up with the changes that society has experienced over the most recent years, "teaching professionals in all sectors of education, from early years to adult learning, are at the forefront of this change, and need to be equipped with the confidence and competence to use technology effectively" (European Commission, 2021, p. 33).

Thus, it is understood that the development of higher education teachers' digital competences is essential, as these may have a positive impact on the digital competences of the students themselves. Therefore, it is necessary to understand how this digital competence manifests itself and which factors may influence it. Several studies have already been conducted with higher education teachers (Barragán Sánchez et al., 2022; Bilbao-Aiastui et al., 2021; Cabero-Almenara et al., 2021; Dias-Trindade & Santo, 2021; Dias-Trindade et al., 2020; Inamorato dos Santos et al., 2023; Ota & Dias-Trindade, 2020; Santos et al., 2021), and the work presented here seeks to relate the results of the application of the *DigCompEdu CheckIn* questionnaire validated by Dias-Trindade et al. (2019) to two higher education institutions in the Iberian Peninsula and propose actions in light of the results obtained.

Through the answers obtained, our objective is to understand what the level of digital competence of the teachers of the higher education institutions is and what use they make of digital technologies, above all, to improve their teaching practices and promote the digital competences of their students. Furthermore, we intend to understand which variables, such as age, length of service or scientific area, may affect the teacher's digital competence. By gaining insights from this analysis, we can design training programs that are tailored to the specific profiles and needs of individual teachers.

TEACHERS' DIGITAL COMPETENCES

Pedro and Matos (2019), explaining the idea of "21st century competences" for teachers, point out that "digital, information management and organization, metacognition, communication and collaboration competences, and ethical and social aspects should be considered as fundamental, thus encompassing the different practical, technical, pedagogical, scientific and ethical dimensions" (p. 349), in essence very similar to TPACK model defined by Mishra and Koehler (2006), which argues that teachers should be able to articulate pedagogy, content and technology.

In the field of education, teachers' digital competences should encompass not only the teachers' own working capacity, but also their ability to use these competences to facilitate and develop their students' learning, thus contributing to fostering the development of those same digital competences in students (Dias-Trindade & Ferreira, 2020).

In this context, it is essential that teachers know how to take advantage of these technologies and make use of them to create new learning environments, where analog and digital, real and virtual, human and machine, offline and online, cohabit. The primary concern is no longer whether or not to use technology in the educational context: the challenge today is to know how to pedagogically use technology "to transform learning into a normal act of everyday life, even making it not even recognized as learning" (Dias-Trindade & Moreira, 2017, p. 54).

To this end, it is necessary for the teacher to have a critical mindset, especially when it comes to discerning the uses that the different digital technologies and the resources accessible make possible (European Parliament and the Council, 2006; Ilomäki et al., 2016; INTEF, 2017). Moreover, teachers should possess the necessary creativity and confidence to use the different digital resources in order to achieve the desired goals related to employment, education, leisure time, social inclusion and participation in society (INTEF, 2017).

This ability to adapt takes on particular importance when the need to keep pace with change is acknowledged. Being aware of one's digital competences and knowing how to make effective use of digital tools with a view to social participation, joint work that involves communication, critical thinking, and problem-solving skills (Cartelli, 2010; Martin & Grudziecki, 2006), is an initial stage in the evolutionary process of evolution becoming digitally competent.

This stage of digital literacy, of knowing what to do with what resources to achieve the desired objectives, can evolve towards the achievement of digital fluency, i.e., mastering a whole set of other skills, such as the ability to go beyond critical thinking to create new knowledge, face new challenges (Dias-Trindade & Ferreira, 2020; Miller & Bartlett, 2012; Sparrow, 2018) and, in addition to knowing "what to do" and "how to do it", also knowing how to articulate the "when" and the "why" (Briggs & Makice, 2012).

Understanding, where the teacher stands with regard to the pedagogical use of digital technology at different stages of the educational process is vital. Similarly, recognizing that there are different areas of competence in the use of digital technologies and that these can be used at different stages of the educational process–either as tools to enhance the teaching process, or as a way to assist and contribute to the quality of learning–is particularly important for teachers to navigate both normal and extraordinary moments of development of quality educational processes.

In higher education, considering that this is, where future professionals are prepared for the needs of society, it becomes even more relevant that teachers possess digital competences, as these are the professionals tasked to help students integrate those same competences into the scientific knowledge of the professions for which they are being prepared. This is an objective at the heart of the European agenda, present in all the projects developed around the *DigComp* benchmark. As mentioned by Oberosler et al. (2021), "the great potential of digital technologies is in fact identified in their ability to shift the educational focus onto the learners, creating opportunities for educational personalization and facilitating forms of collaborative and self-regulated learning" (p. 19).

Several studies have already been conducted with teachers in higher education (Bilbao-Aiastui et al., 2021; Cabero-Almenara et al., 2021; Dias-Trindade & Santo, 2021; Dias-Trindade et al., 2021; Ota & Dias-Trindade, 2020; Santos et al., 2021). It is generally understood that the development of higher education teachers' digital competences is essential, as these may in turn have a positive impact on the digital competences of the

Table 1. Faculties of the participants

Faculty	n	%
Spain		
Faculty of Health Sciences	3	3.1
Faculty of Law, Business and Employment	11	11.2
Faculty of Medicine	1	1.0
Faculty of Education and Psychology	22	22.5
Higher Polytechnic School	1	1.0
Faculty of Experimental Sciences	4	4.1
Faculty of Communication	56	57.1
Total	98	100
Portugal		
Faculty of Pharmacy	12	4.8
Faculty of Law	14	5.6
Faculty of Medicine	34	13.7
Faculty of Psychology and Educational Sciences	19	7.6
Arts College	1	0.4
Faculty of Sport Sciences and Physical Education	7	2.8
Faculty of Sciences and Technology	104	41.8
Faculty of Economics	22	8.8
Faculty of Arts and Humanities	33	13.3
Institute for Interdisciplinary Research		1.2
Total	249	100

students themselves, as future professionals (Inamorato dos Santos et al, 2023). Furthermore, it is necessary to understand how this digital competence manifests itself and which factors may influence it.

METHODOLOGY

The empirical component of the research proposed follows a quantitatively oriented procedure by placing emphasis on the teachers' perception of issues related to their digital teaching competences. To carry out this assessment, between September 2021 and June 2022, an online questionnaire was created and validated by Dias-Trindade et al. (2019) based on the European framework *DigCompEdu* and the respective *DigCompEdu CheckIn* questionnaire, a self-reflection tool for measuring educators' digital competence (Caena & Redecker, 2019), was distributed in two higher education institutions–one Portuguese and one Spanish. This questionnaire is considered one of the most "valuable and sufficient in assessing teachers' digital competences" by different authors (Cabero-Almenara et al., 2020; Cebi & Reisoglu, 2022; Ghomi & Redecker, 2019).

The questionnaire was answered by 249 Portuguese teachers (representing 12.2% of the total number of teachers in that institution) and 98 Spanish teachers (making up 10.8% of the corresponding Spanish university) from all the faculties existing in the two institutions (**Table 1**). Central tendency measures (mean, maximum, and minimum values) were used to analyze the data.

The Portuguese university lecturers have an average age of 51.1 years and the Spanish 45.3 years. In terms of gender distribution, 52.6% were male and 47.4% female among the Portuguese and 57.1% were male and 42.9% female among the Spanish.

RESULTS

Considering the levels of digital competence defined in the *DigCompEdu* reference tool, the results obtained by the teachers in each of the institutions are at different levels: the Portuguese university teachers are at level B1 (integrator level), with 38 points, while the Spanish teachers have a higher average, having reached level B2 (expert), with 51 points. These results reveal that Portuguese teachers use digital technology in their pedagogical practices, albeit in a very instrumental and technicist way, thus needing to invest in training to understand how to integrate technology critically and creatively in new digital learning ecosystems.

The analysis of the results for each of the six areas that make up the framework (**Table 2**) shows that both institutions are at level B1 in area 1 and area 2. In the remaining areas, Spanish teachers find themselves at

Table 2. Mean results by area

		Portugal		Spain	
		Mean	Level	Mean	Level
Educators' professional competences	Area 1–Professional engagement	9	B1	10	B1+
Educators' pedagogical competences	Area 2–Digital resources	4	B1-	4	B1-
	Area 3–Teaching and learning	9	B1-	13	B2-
	Area 4–Assessment	5	A2+	8	B2-
	Area 5–Empowering learners	3	A2	5	B1+
Learners' competences	Area 6–Facilitating learners' digital competence	7	A2-	11	B1+
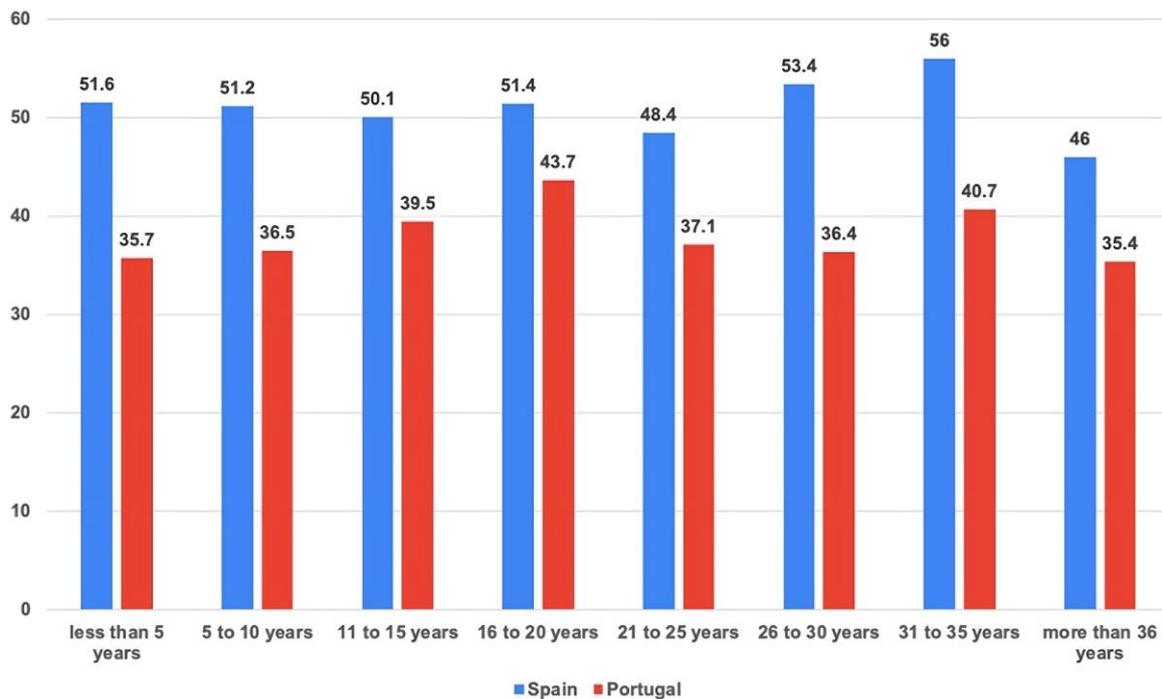
Figure 1. Results by years of teaching experience (Source: Authors)

level B2 in area 3 and area 4 and B1 in area 5 and area 6, while Portuguese teachers are at level B1 in area 3 and level A2 in area 4 to area 6.

These results suggest that in area 1 and area 2, Iberian teachers are at a stage of expansion both in their professional practice and their ability to insert digital resources into the learning context. In area 3, Portuguese teachers use digital technologies in the teaching and learning process, while Spanish teachers appear to be able to use digital technology more critically and creatively. Moreover, regarding area 4, the responses of Spanish teachers indicate that they are able to innovatively integrate digital technology to assess their students, while Portuguese teachers are still in an exploratory phase. In area 5, Spanish teachers affirm that they are already able to empower their students through digital technologies, while Portuguese teachers, once again, are at an exploratory stage. With regard to area 6, Portuguese teachers are able to encourage their students to use digital technologies while Spanish teachers in addition possess the knowhow to develop activities that help promote their students' digital competence (Punie & Redecker, 2017).

Following this presentation of the global results in each of the six areas of the questionnaire, a description will now be presented of the global results of the participants, by years of teaching experience, age and gender. The values correspond to the average overall results (from a maximum of 84 points) for each of the three issues.

A comparative analysis was then carried out on the relationship between digital competence and professional experience (**Figure 1**).

In both cases, levels of digital competence according to teaching experience were similar. The lowest levels were found in both Portuguese and Spanish teachers with more than 36 years of experience, while those with higher average levels are in the group with 31 to 35 years of experience (in the Spanish case) and between 16 and 20 years of experience (among Portuguese teachers).
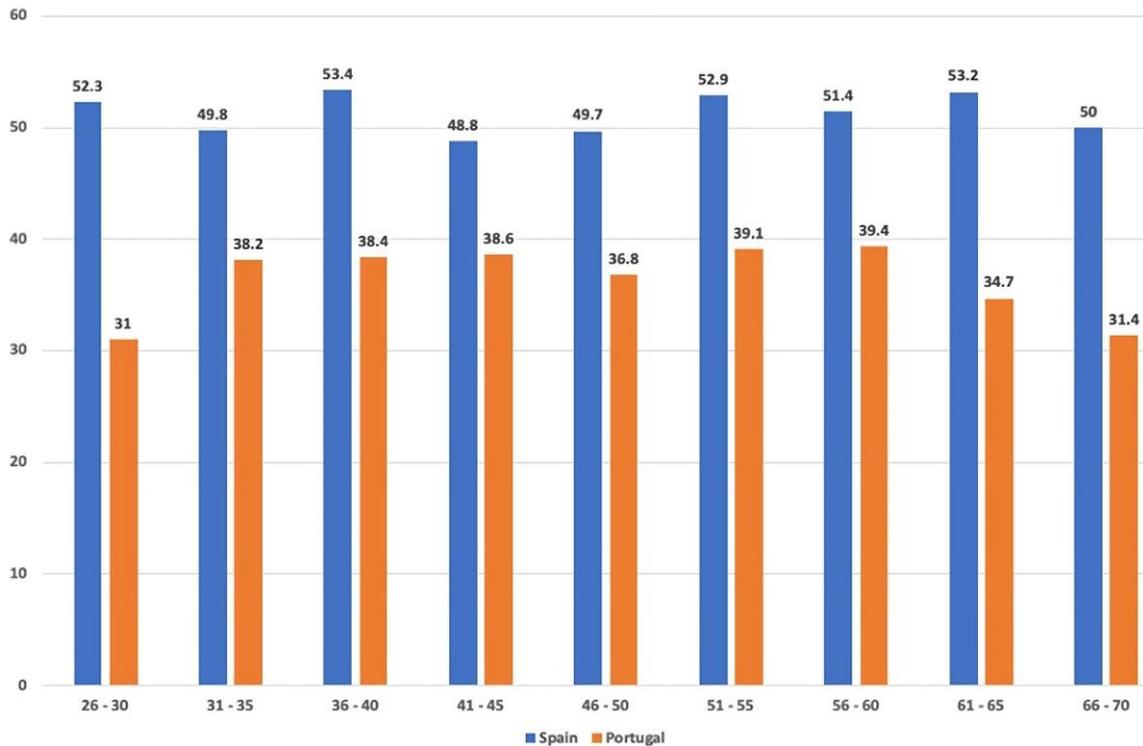
Figure 2. Results by age (Source: Authors)
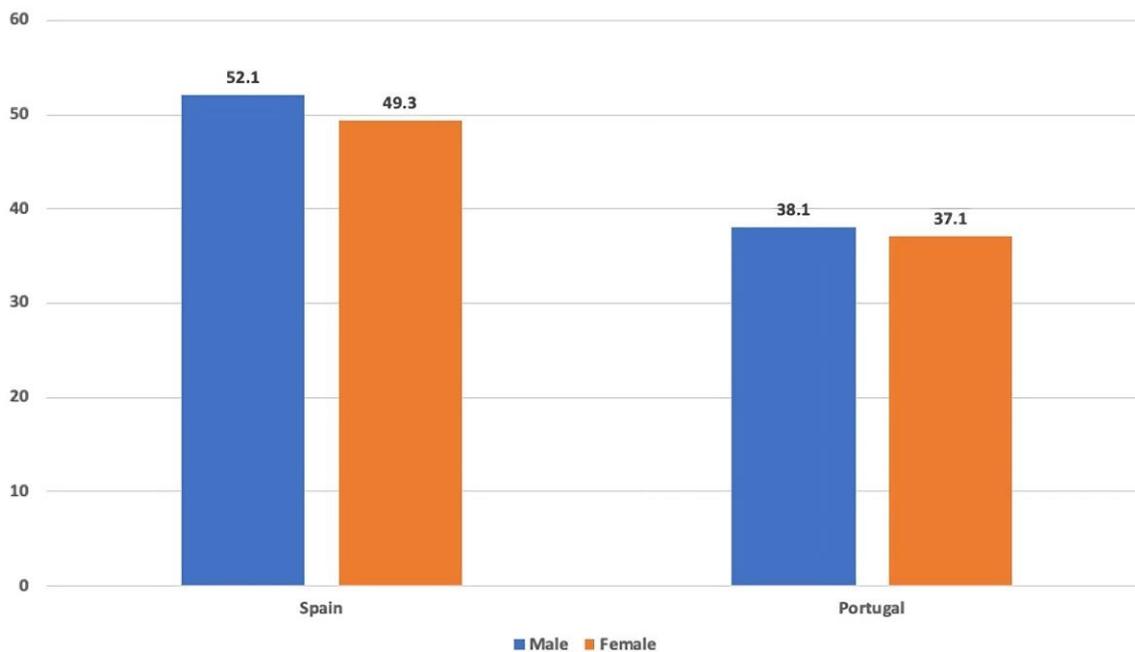
Figure 3. Results by gender (Source: Authors)

The relationship between teacher age and digital competence was also analyzed (**Figure 2**).

Having examined the relationship between the age of teachers and their digital competence, it was found that among the Spanish, the age group between 36 and 40 years old enjoyed the highest digital competence, while the group aged between 41 and 45 years old possessed the lowest digital competence. With regard to the Portuguese teachers, it is the youngest who show the greatest weaknesses (teachers between 26 and 30 years old), while teachers between 56 and 60 years demonstrated the highest level of digital competence.

Finally, **Figure 3** reflects results by gender and reveals that male teachers have slightly higher levels than female teachers.

DISCUSSION

Having observed that the difficulties of Portuguese teachers are found more in area 4, area 5, and area 6, it is mainly in the last area, that of students' digital competences, where the weaknesses are greater. Hence, it is advisable to invest in training not only for digital assessment, but, especially in area 6–learners' competences, developing training actions that permit the fostering of students' digital competences. As explained in the reference material, these teachers need time and practice as well as encouragement and inspiration. Facilitating the exchange of experience between teachers would be a good example of how to accomplish this. Area 5 and area 6 are fundamental, as "they are crucial for the successful integration of university students into the demands of the world of work, for example: active participation, inclusion of digital competences, responsible use of digital competences, problem solving, etc." (Bilbao-Aiastui et al., 2021, p. 845).

Challenges have also been found in these areas in other studies (Casal Otero et al., 2021; Inamorato dos Santos et al., 2023; Urbina et al., 2022). Inamorato dos Santos et al. (2023) affirm that these areas need investment as the results obtained suggest that "if current students represent the technology driven 'digital natives' of 'generation Z' (aged between 18 and 23), the current generation of academics do not seem equipped to exploit those students' potential" (p. 19). In addition, it is crucial for these young students to receive support from their teachers in order to comprehend how to effectively harness the potential of digital technologies to enhance their learning experiences. Teachers play a fundamental role in facilitating the transition from a social use of technology to a pedagogical use. Their guidance and actions are essential in this process. This viewpoint is in line with Bakhmat et al (2022) and Urbina et al (2022), who present similar reflection.

The adaptation of universities to these contexts, or as Villarroel Henríquez and Stuardo Troncoso (2022) choose to word it, the adaptation from "Universities 1.0 to students 3.0" implies considering not only technological changes, but also critical thinking, creation and innovation (p. 243). In the Portuguese and Spanish contexts, universities have some autonomy to define their education and research programs. This reinforces the need for these programs to be prepared considering the technological and digital advances of society, taking into account the specificities of their teaching staff and the reality of their own institution, so as to be better prepared to meet the needs of the present time.

In the case of Spanish teachers, and despite some teachers already showing a confident, creative and critical use of technologies and digital resources to enhance their practices (particularly in the areas of teaching and learning process and assessment), some investment is advisable. Apart from these two areas, the area regarding digital resources is also in need of support. This is essential to promote experimentation and reflection, as this competence contributes directly to the promotion of more efficient teaching and learning processes (Castañeda & Adell, 2013).

When the relationship between teaching experience and the level of digital competence is observed, and despite the differences between the two universities, there is a phenomenon that can be seen in both: as already pointed out by Wang et al. (2013), there is no direct relation between teaching experience and digital competence. Teaching experience can most certainly bring advantages, which, when combined with other characteristics, can contribute to better digital competence. This study reveals that more experienced teachers tend to have better average values for digital competence, while teachers with less time in service return weaker average results.

Having also analyzed the results on the relationship between teachers' age and their levels of digital competence, once again we find parallels with those reported by Inamorato dos Santos et al. (2023), Torres Barzabal et al. (2022), and Wang et al. (2013). In their studies, these authors concluded that different social, psychological, organizational, and even demographic factors influence the existence of higher or lower digital competence among teachers. Age is one of these factors but does not play a sole determining role.

When gender was considered, a high similarity of results was found. This is in line with other studies (Cabero-Almenara et al., 2021; Fernández-Morante, 2023; Inamorato dos Santos et al., 2023; Mora-Cantallops et al., 2022; Tomás-Rojas et al., 2021), which reported that no significant differences were found in this

dimension and that therefore there existed no relevant differences in digital competence levels between men and women.

However, Inamorato dos Santos et al. (2023) present the results of several studies carried out on university teachers in Ibero-America and North Africa and the authors' conclusions show similarities and differences among them. While there is an absence of a direct relation between factors such as age, professional experience, and gender, the influence of age and professional experience emerges as significant. The findings reveal that older teachers will tend to have fewer digital skills and that teachers with less experience obtain better results. These conclusions differ from the results of the present study also those of Cabero-Almenara et al. (2021) or Casal Otero et al. (2021).

These differences and similarities thus reinforce the perception of the importance of implementing specific training plans for higher education teachers. This notion is also conveyed by several of the aforementioned authors.

CONCLUSIONS

The findings of this study highlight the importance of providing training appropriate to the specific needs of the teachers of each of the university institutions presented here, as of any other. As Barroso et al. (2019) points out, "if more teacher training were offered, beyond the technical aspects, we would make it easier for students to build their knowledge from the beginning of the activity, taking into account diversity." (p. 196). In this sense, and perceiving the specificities that each institution may have, this study corroborates the need for public policies that promote the adaptability of the training to the real needs of the trainees. We therefore agree with Inamorato dos Santos et al. (2023), who state that by identifying the strongest and weakest areas it is possible for higher education institutions to "understand, where the digital gaps in higher education seem to be, both in terms of teaching and learning. In deciding which competences to develop further, institutions should also consider their pedagogical model" (p. 19).

The training programs themselves should be designed in such a way that the training involves changes in structured practices. This would help teachers to think critically about their use and to generate new knowledge, in a logic of "learning by doing" (Villarroel Henríquez & Stuardo Troncoso, 2022).

Beyond these training proposals, the results obtained by the teachers of the two institutions (and as conveyed in the official documents relating to *DigCompEdu*) reveal that there is always room for more training and for progression, within a culture of innovation that, as highlighted by Martínez et al. (2019), is "oriented towards boosting adaptation to constant change, to dialogue with a renewing future that ensures a permanent improvement in educational quality" (p. 185). This, through the integration of digital technologies, gains new momentum and new possibilities to promote the development of students' digital competences in alignment with the demands of the 21st century.

This study presents a small sample size, which may be a limitation. Nevertheless, it is understood that the comparing and contrasting of results of these two Iberian institutions may constitute a case study that allows us, when comparing these findings with those of other studies carried out in the same geographical space and similar contexts, to affirm the relevance of individual work within each higher education institution.

It is in this sense that we propose that higher education institutions promote activities that allow them, firstly, to understand their teachers' perception of the existing conditions for the use of technologies and digital resources in teaching and non-teaching practices. This would be made possible by the completion of the teachers' self-perception questionnaire on their own digital skills. This initial stage of work will allow for the relation between working conditions with the perception of digital training of the teaching staff, thus creating a space for analysis on what trainings need to be prepared, for whom and ways in which the institution can help ensure these training initiatives are meaningful and effective.

In a second stage, the training activities would be organized by areas of competence and levels - initial for teachers with results between A1 and A2, intermediate for teachers with results between B1 and B2, and advanced for all those who fit into levels C1 and C2–, in line with what has already been proposed by Dias-Trindade and Ferreira (2020b). It is argued, however, that these training programs can be organized to take place over an extended period (for example a semester), to provide teachers with moments throughout their

teaching activities to put into practice the learning in progress, in the aforementioned logic of 'learning by doing' and thereby, as Fernández-Morante et al. (2023) assure, shifting the focus away from technology per se to consolidated pedagogical practice.

Finally, a crucial third stage involves teachers having the opportunity to express their perceptions. However, unlike some studies that have already had the opportunity to collect these perceptions before and after the training activities (although the study was conducted with secondary school teachers), the framework and the training proposal are similar to the study conducted by Lucas et al. It is recommended that teachers and their own institutions have time to reflect on the learning, on the needs and changes to be made. Subsequently, the questionnaire is answered once again by the teachers. This process may provide valuable insights both to the teachers themselves and to their institution of what has already changed, and, for a new academic year, what further training may be needed in this new phase.

Furthermore, it is proposed that students form a part of these processes, as they also need to enrich their digital skills in an educational context. Considering the existence of a self-perception questionnaire of digital skills based on *DigComp* framework (Clifford et al., 2020), we suggest that, in future studies, students' needs be considered in digital empowerment activities, so that appropriate training initiatives may be designed and implemented.

As a suggestion for future work, there exists the possibility of carrying out a case study in a higher education institution, following the steps presented in this study, subsequently analyzing the results achieved.

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