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Assessment of the proficiency level in digital competences of higher education professors in Portugal

Avaliação do nível da proficiência nas competências digitais dos docentes do ensino superior em Portugal

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ABSTRACT
This study aims to evaluate the level of digital competence of higher education professors in Portugal. The methodology used was a survey involving an online self-assessment questionnaire based on DigCompEdu, a framework developed and validated in the European Union. The survey collected data in three dimensions: personal (gender, education level, age group and length of career), teaching (cycle level and course modality), and institutional (institutional category, institutional funding sector and administrative region). Six hundred ninety-five participants answered the questionnaire. Data analysis involved the application of statistical techniques such as Student's t-test and ANOVA. The results indicated an intermediate proficiency level in the professors' digital competences. No statistically significant effects were detected for variables such as gender, age group, length of career, institutional funding sector or administrative region. However, professors with a higher level of education and who teach at higher education levels (master's and doctorate) remotely and in polytechnic establishments showed a higher level of digital competence. The study identified needs in terms of developing frameworks that address online higher education and the development of continuios training for professors to foster improvements in their level of digital proficiency.
Keywords: Digital Competence; Higher Education; Information and Communication Technologies.

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RESUMO
Este estudo tem como objetivo avaliar o nível de competência digital dos professores do ensino superior em Portugal. A metodologia utilizada foi um inquérito envolvendo um questionário de autoavaliação online baseado no DigCompEdu, um quadro desenvolvido e validado na União Europeia. A pesquisa coletou dados em três dimensões: pessoal (gênero, escolaridade, faixa etária e tempo de carreira), docente (nível de ciclo e modalidade de curso) e institucional (categoria institucional, setor de fomento institucional e região administrativa). Seiscentos e noventa e cinco participantes responderam ao questionário. A análise de dados envolveu a aplicação de técnicas estatísticas, como t-teste de estudante e ANOVA. Os resultados indicaram um nível de proficiência intermediário nas competências digitais dos professores. Não foram detectados efeitos estatisticamente significativos para variáveis como sexo, faixa etária, tempo de carreira, setor de financiamento institucional ou região administrativa. No entanto, os docentes com nível de escolaridade superior e que leccionam em níveis de ensino superior (mestrado e doutorado) à distância e em estabelecimentos politécnicos apresentam um nível superior de competência digital. O estudo identificou necessidades em termos de desenvolvimento de estruturas que abordem o ensino superior online e o desenvolvimento de treinamentos contínuos para professores para promover melhorias em seu nível de proficiência digital.
Palavras-chave: Competência digital; Ensino superior; Tecnologias de informação e comunicação.

Introduction

Digital technologies have profoundly changed many aspects of our lives: how we communicate, work, have fun, and organize and acquire knowledge and information. They have also changed the way we think and behave, individually and collectively. Increasingly, children and young people are growing up in a world where digital technologies are ubiquitous. However, this does not mean that they are naturally equipped with the right competences to use these technologies effectively, consciously and productively.

There is evidence that institutions involved in teacher training still have difficulties in formally recognizing that digital literacy continues to grow in importance as a fundamental competence in all disciplines and professions. When present, they often tend to be used only as digital resources or specific educational software, knowledge management systems, utilities and searching the web, which amounts to a

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mere process of digitizing materials. These competences are still qualified as insufficient in number, incipient in substance, and limited in developing the required competences. Although there is broad agreement on the importance of digital competences, there are deficiencies in teacher training regarding supporting competences and techniques. (CONSELHO NACIONAL DE EDUCAÇÃO, 2015; COSTA et al., 2015; JOHNSON et al., 2014).

Contrary to expectations, it has been found that new professors, those entering the profession now or soon to enter it, do not bring with them such high levels of comfort in interacting with technologies (PEDRO, 2016).

Technical knowledge of how to use information and communication technologies (ICT) is part of professors' digital competences, related to the necessary ability and conditions for making good use of technologies in teaching activities. The analysis of the differences between the activities performed with ICT by professors leads us to infer that there is a gap in training for their digital literacy and, consequently, for the development of digital competences, in a broad sense and oriented to specific didactics (SILVA; LOUREIRO; PISCHETOLA, 2019).

The European Parliament and Council of the European Union recognize that education contributes to the preservation and renewal of the common cultural base of society, as well as to the learning of essential social and civic values such as citizenship, equality, tolerance and respect, and have recommended eight key competences for lifelong learning, among them digital competence (EUROPEAN PARLIAMENT, & COUNCIL OF THE EUROPEAN UNION, 2006), which, after being revised, is now used in the plural: digital competences (COUNCIL OF THE EUROPEAN UNION, 2018).

Still in the European context, in 2010, the European Commission launched "Europe 2020: A strategy for smart, sustainable and inclusive growth", defining the broad lines for exiting the crisis and preparing the economy for the challenges of the next decade. One of the seven initiatives was the Digital Agenda, which aims to stimulate the European economy, taking advantage of the sustainable economic and social benefits arising from a single digital market based on fast and ultra-fast internet and interoperable applications; it is also at the origin of the Digital Economy & Society

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Index – DESI (EUROPEAN COMMISSION, 2010a, 2010b, 2014, 2016).

Digital competence is considered transversal to the development of other competences and is essential for satisfactory social inclusion, active and conscious civic participation in society and the economy, and for the competitive, smart and sustainable growth of society (EUROPEAN COMMISSION, 2010a; LUCAS; MOREIRA; COSTA, 2017).

The Joint Research Centre (JRC), the Commission's science and knowledge service, has recently published DigComp 2.1 (CARRETERO; VUORIKARI; PUNIE, 2017), organized in five areas, with 21 competences and eight levels of proficiency, translated into Portuguese by Lucas and Moreira (2017), and DigCompEdu (REDECKER, 2017), also translated into Portuguese by Lucas and Moreira (2018).

This study aims to assess the level of digital competences of higher education professors in Portugal. In this sense, it adopted as theoretical reference the European Framework for the Digital Competence of Educators: DigCompEdu (REDECKER, 2017) because:

a) it presents theoretical and conceptual robustness, particularly because it was developed through extensive consultation with experts in the European context;
b) it has been evaluated, compared to seven frameworks specifically focused on educators' digital competences, by 148 experts, and stood out from the others (CABERO-ALMENARA; ROMERO-TENA; PALACIOS-RODRÍGUEZ, 2020);
c) it has a data collection instrument based on the framework that enables feedback to be sent to the participants;
d) it is available in a Portuguese language version (both the framework and the instrument).

DigCompEdu, which describes competences focusing on supporting and encouraging the use of digital tools to improve and innovate education, considers all educators from preschool to higher education (LUCAS; MOREIRA, 2018) and is organized in six areas with 22 competences, as shown in Figure 1.

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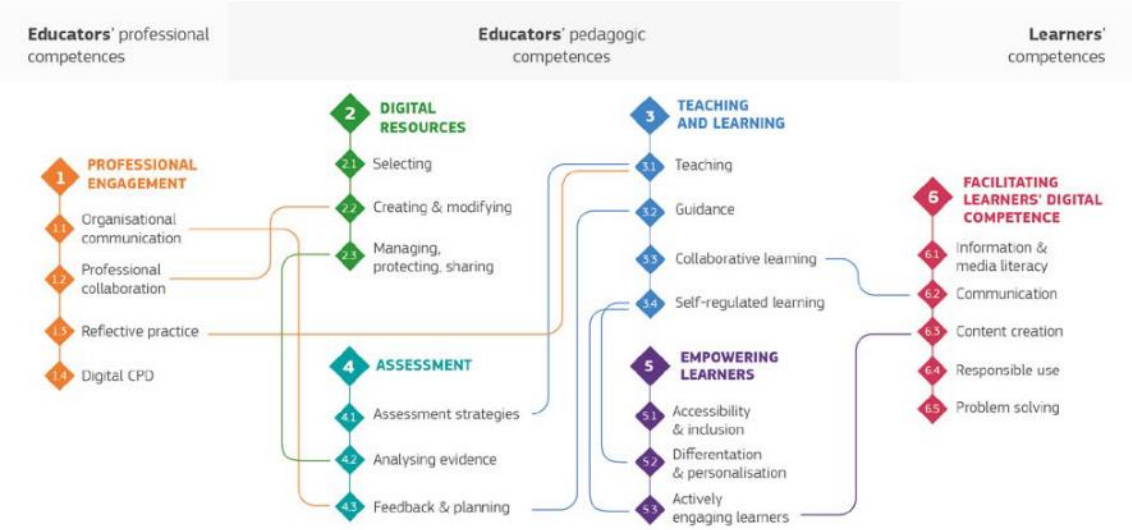
Figure 1 — Areas and competences of DigCompEdu



Source: Redecker (2017).

Although it was developed focusing on educators at all levels, DigCompEdu did not consider the universe of distance education or even *blended learning* (MATTAR et al., 2020).

DigCompEdu has a six-level proficiency progression model, from newcomer (A1) to pioneer (C2), following the levels of The Common European Framework of Reference for Languages (COUNCIL OF EUROPE, 2001), with a cumulative logic; that is, each higher level includes all descriptors of the lower level. It thus has an increasing degree of complexity, making it easier for educators to understand and value their level of digital competence. It is also important to note that it is inspired by the revised Bloom's taxonomy (LUCAS; MOREIRA, 2018), as shown in Figure 2.

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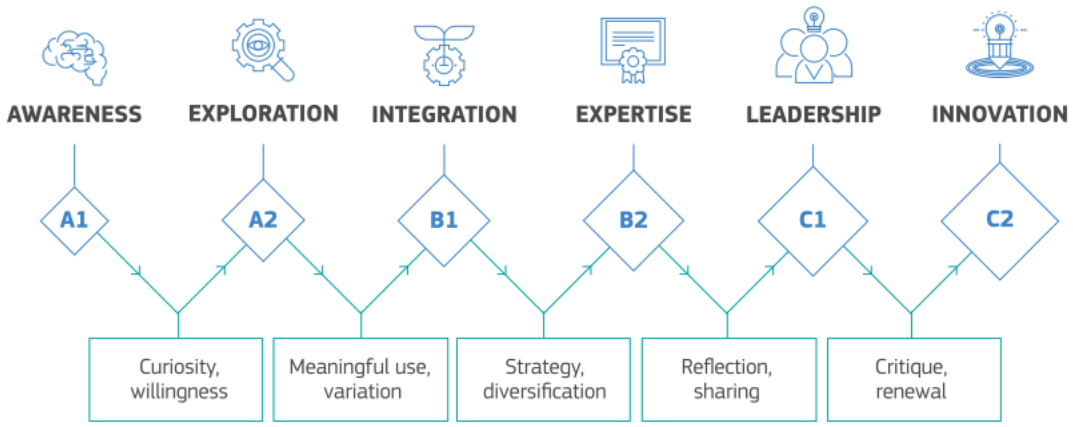
Figure 2 — Progression model of DigCompEdu



Source: Redecker (2017).

DigCompEdu's native data instrument has a version for higher education available in English, Portuguese, Russian and Slovak languages (EUROPEAN COMMISSION, 2019a; GHOMI; REDECKER, 2019; LUCAS, 2019). It was used in several studies, fully or in part, to assess the proficiency level of professors, either in basic education (BENALI; KADDOURI; AZZIMANI, 2018; DIAS-TRINDADE; MOREIRA, 2018; GHOMI; REDECKER, 2019; SILVA; LOUREIRO; PISCHETOLA, 2019) or in higher education (DIAS-TRINDADE; MOREIRA; GOMES FERREIRA, 2020).

This article is structured in four sections. The introduction contains a literature map, including the justification for choosing the subject and detailing the framework and data collection instrument used, followed by the article's aim and background about the subject in Portugal. In the methodology section, this study's methodological foundations are described and a brief description of the population is given. In the results, the sample is described, the general results and the results by area of proficiency level are detailed, then the results in the three dimensions studied (personal, teaching and institutional) are described. Discussion and conclusion follow.

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Aim

As technologies develop, it will be up to education to take advantage of them. The inclusion of these technologies has occurred at different times for students, professors, teacher trainers and higher education professors, which we can understand as patient-zero (PEDRO, 2016).

There is a dearth of studies examining the assessment of professors' digital competences. The published studies generally focus on isolated aspects, often lacking a clear theoretical field and rigorous methodology regarding the analysis of usage patterns and the level of proficiency, specifically in the integration of technologies and e-learning in higher education. These studies have been more focused on technological issues, followed by pedagogical concerns and, to a much lesser extent, organizational issues (MADERICK et al., 2016; MENGUAL-ANDRÉS; ROIG-VILA; MIRA, 2016; MONTEIRO, 2016; SILVA et al., 2014).

This study aims to assess the level of digital competences of higher education professors in Portugal, using DigCompEdu. We specifically use the DigCompEdu Check-In instrument for data collection, which has been previously validated for different levels of education (GHOMI; REDECKER, 2019; REDECKER, 2017, 2019).

With the knowledge of the level of proficiency in digital competences of higher education professors in Portugal, analysed in detail in the personal, teaching, and institutional dimensions, it will be possible to point out existing gaps. Decision-making related to professional development support can thus be subsidized, implementing and making professors more assertive in this domain, an extremely relevant fact for the scientific and technological modernization in the context of European higher education and, likewise, to achieve the current national goal of expanding e-learning in higher education (COUNCIL OF MINISTERS, 2019).

Digital competences of higher education professors

Professionals with higher levels of ICT competences have a 7.9% increase in wages. In addition, the population with low levels of ICT competences is at greater risk

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of losing their jobs because of computerization and process automation. This creates an additional responsibility for higher education institutions, which must implement digitization strategies that promote a range of competences needed for the 21st century, requiring faculty to have adequate levels of proficiency in digital competences so that they can foster digital competences in students. (BOND et al., 2018; FALCK; HEIMISCH; WIEDERHOLD, 2016; HAJKOWICZ et al., 2016).

In the evolution of education, the influence of ICT is noted, generating a change related to ways of conceiving, planning, and implementing the teaching-learning process. This leads to breaking space-time barriers, which is a fact that determines growing interest in the professors' digital competence at all levels of the educational system, including higher education (DURÁN; ESPINOSA; GUTIÉRREZ, 2019; MONTORO; LUCENA; RECHE, 2016).

Digital competences, which are not limited only to the technical component, involve a broader debate about the models that allow integrating new technologies in higher education institutions since a new electronic context is gradually involving and modifying professors' work environment. This implies that institutions must restructure themselves in methodological aspects related to the teaching and learning processs and, above all, rethink their teaching staff training (RODA; MORGADO, 2019).

Digital competence is considered an essential competence for professors to manage various aspects of the subject being taught in relation to pedagogical tools, helping them to acquire and update the competences needed in their work.

In addition to the study conducted by Dias-Trindade and Moreira (2020) in the Portuguese context, several other studies have aimed to assess the level of proficiency in digital competences of higher education professors, using varied methodologies and instruments.

Espinosa and Gutiérrez (2013) conducted a self-assessment, based on the model developed by Gutiérrez and Espinosa (2013), on Spanish higher education faculty, identifying that:

a) 70.5% have a fairly high level of knowledge regarding the installation and selection of ICT resources;

b) 70% claim to know many telematics tools;

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c) 75% take into consideration different important and necessary aspects when selecting resources;

d) 54% have a medium-low level of knowledge when it comes to implementing and evaluating educational actions with ICT;

e) 60% claim that they do not publish their content online.

The authors conclude that the score of 66% of the participating professors accumulate places them at a high level of competence, 7.5% at a medium level, and 26.5% at a low level.

Deumal and Catasús (2015), using DigComp 1.0 (FERRARI, 2013), sought to analyse the digital competences of higher education professors in design at the Bau Centro Universitario de Diseño de Barcelona. As a result, they pointed out an average level of digital competence. However, professors are uncertain in the areas of security, data protection, management of their own digital identity and management of intellectual property and authorship, and are reluctant to use social networks. They recognize the need for training in ICT and its pedagogical application, as does the institution's administration.

Evangelinos and Holley (2015) evaluate the applicability of DigComp 1.0 (FERRARI, 2013) with students, faculty and administrative staff at a UK higher education healthcare institution via an online digital competence self-assessment questionnaire developed by the authors (EVANGELINOS; HOLLEY, 2014) and semi-structured interviews. They concluded that faculty members showed concerns about the work-life balance offered by the facilities of portable devices.

Tolic and Pejakovic (2016) show that faculty from technical sciences and ICT institutions are more digitally competent in scientific research and apply contemporary technologies more than faculty from humanities and social studies institutions. Faculty at the lowest professional levels classify themselves as belonging to the digital generation (65.56%), indicating that they have taken classes or been introduced to ICT during their training. The authors also show that 76.35% own a personal computer, tablet and/or other types of innovative technology, such as e-readers, compared to 23.65% of the generation that declares itself non-digital, at higher levels. The authors

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conclude that more than 70% of professors are considered digitally competent in using computers and new technologies.

Sánches, Torre and Martín-Cuadrado (2017), as a result of using DigComp 2.0 (VUORIKARI et al., 2016) with university professors in the area of information, as a pilot project at the Universidad Nacional de Educación a Distancia (UNED) – Spain, indicated the competence of data storage and retrieval with the highest number of professors at a basic level (68%), and data navigation, search and filtering at an advanced level (11%).

Background

The Digital Economy & Society Index (DESI) demonstrates the digital performance of Europe, allowing the analysis, evolution, and comparison of the European Union Member States (28 Member States). Regarding digital competitiveness, Portugal ranks 19th, below average. Indicators related to digital competences are shown in the human capital dimension, occupying 21st position in DESI 2020 specifically in this dimension, the worst result among the five dimensions (EUROPEAN COMMISSION, 2019b, 2020), as shown in Figure 3.

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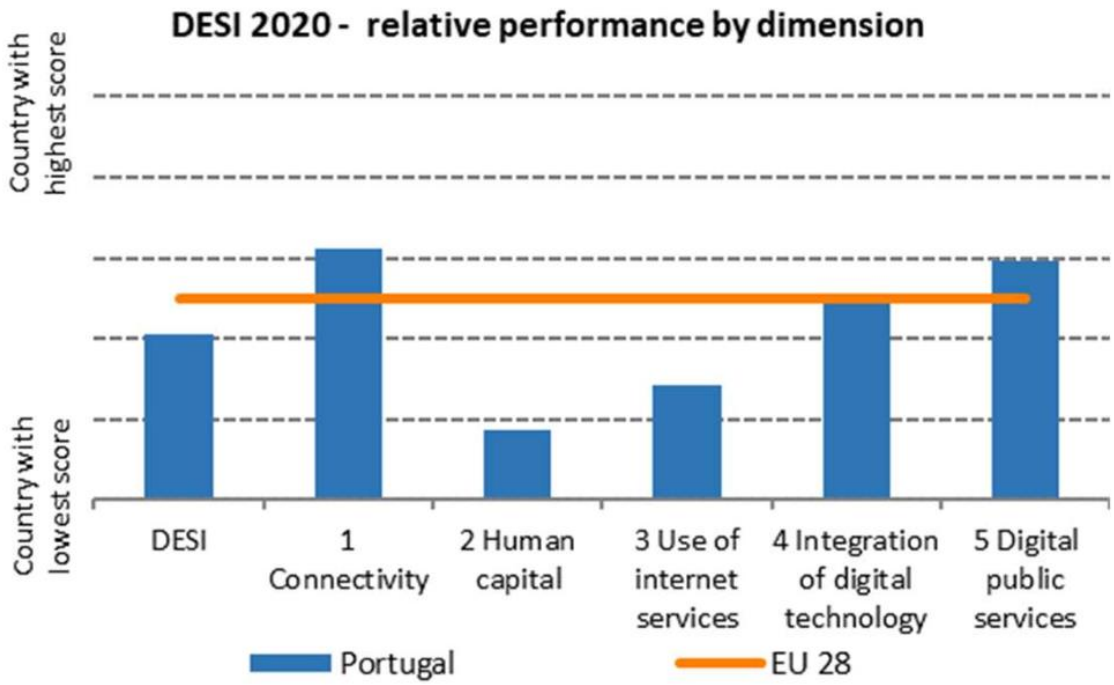
Figure 3 – Portugal's DESI by dimension in relation to the European Union average



Source: European Commission (2020).

Besides, the 2020 report showed that 52% of the Portuguese population had a minimum elementary level of digital competences, lower than the EU average (58%); 32% had advanced digital competences, slightly lower than the EU average (33%); and 26% of the population had no digital competences at all (EUROPEAN COMMISSION, 2020).

These results lead to a reflection on whether Portugal will be prepared to meet the goals set by 2030 by Decree-Law 133/2019, the legal regime for higher education provided at a distance, which aims to train 50,000 adults (COUNCIL OF MINISTERS, 2019), to ensure that 60% of 20-year-olds are in higher education and that 50% of adults between 30 and 34 have completed their higher education. This to achieve a European leadership position for Portugal concerning digital competences (COUNCIL OF MINISTERS, 2018).

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To mitigate the results obtained in the DESI and demonstrating concern with the level of citizens' digital competences, as well as the importance for their development, Portugal developed the National Digital Competences Initiative (INCoDe.2030), aiming to position itself among the main leading European countries in the area of digital competence (GOVERNMENT OF PORTUGAL, 2017). Likewise, more recently, the Action Plan for Digital Transition was presented, aiming once again to lead the way in preparation to face the challenges and changes inherent to the global digital transition, which today are transversal to all sectors of society (COUNCIL OF MINISTERS, 2020).

Through the TRACER project, which sought to portray ICT access and use in Portuguese higher education, it was found that the bulk of higher education professors have access to learning management platforms (93.5%), although many have never carried out assessment tests using ICT (49.2%). Data regarding the use of digital educational resources (DLR) in fully online teaching activities indicate that static documents (10.3%) are the most used, followed exercises and teaching and learning activities (10.8%) and portals/websites/repositories (10.8%), although in low percentages. The project also pointed out the absence of participation in training actions for the use and integration of ICT in educational practice in 70.8%. (RAMOS; MOREIRA, 2014a, 2014b).

More recently, Vicente, Lucas and Carlos (2020) showed that Portuguese higher education professors use different websites and search strategies to find and select a variety of digital resources for teaching (92.5%), giving feedback to students (digital technologies) (83.0%), creating and modifying existing digital resources (81.7%) and designing new ways to promote collaborative learning activities (77.5%). However, they also provide troubling data in some areas, in that faculty members state that they rarely or never monitor their students' activities and interactions in collaborative online environments (32.6%), allow students to reflect and self-assess their learning process (36.6%) or participate in online training (e.g., MOOCs, online seminars, virtual conferences) (39.1%).

A study conducted by Dias-Trindade, Moreira and Ferreira (2020) identified the B1 – Integrator level of proficiency in digital competences in Portuguese higher education professors, analysed in relation to age and professional area. The best

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performance was noted in the 40-49 age group in the arts and humanities area, with the small sample size (118) indicating a limitation of the study, suggesting the need to apply the instrument throughout the territory.

Methodology

This article presents the discussion of the results of an explanatory research that aims to establish relationship between variables. A quantitative approach to data collection and analysis is followed because it allows a focused, specific, and structured treatment of the data, making it possible to classify, order and measure the variables necessary to analyse the situation under study (CRESWELL, 2018; VIEIRA, 2009).

The entire process of data collection and analysis was developed with full assurance of the legal guidelines, in accordance with the Ethical Charter of the Institute of Education of the University of Lisbon, General Data Protection Regulation of Portugal, in addition to the favourable opinion of the Comissão de Ética (CdE) of the Institute of Education of the University of Lisbon.

Survey research was chosen as the data collection procedure because it allows collecting self-reported data from the participants regarding the perception of digital competences of higher education professors. This method makes it possible to obtain a quantitative description of trends, attitudes, or opinions of a population through a sample, and of the dependent and independent variables and their interrelationships, as well as allowing a generalization of the results found (CRESWELL, 2018; REA; PARKER, 2014; BABBIE, 1999).

Rea and Parker (2014) describe how to conduct survey research in a rigorous and unbiased manner. They indicate the importance of following specific and systematic procedures and propose eleven steps – step 1: identifying the focus of the study and method of research; step 2: determining the research schedule and budget; step 3: establishing an information base; step 4: determining the sampling frame; step 5: determining the sample size and sample selection procedures; step 6: designing the survey instrument; step 7: pretesting the survey instrument; step 8: selecting and training interviewers; step 9: implementing the survey; step 10: coding the completed

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questionnaires and computerizing the data; and step 11: analysing the data and preparing the final report.

The study was conducted considering the entirety of these stages and implemented in the context of Portuguese higher education, seeking to answer the following research question (stage 1): "What is the current level of digital proficiency of university and polytechnic professors in Portugal?", and the survey research method was adopted. The data collection was carried out through a closed questionnaire applied online.

In the academic year 2019/2020 (stage 2), the 1st semester was dedicated to developing and validating the webtool of self-assessment of digital competences www.digcomptest.eu, while the 2nd semester was dedicated to invitating professors to answer the questionnaire, data collection and processing, preparation of the final report and publication of the results.

Through a literature search, a survey of available *frameworks* dedicated to professors' digital competences was conducted, as described in the introduction section (step 3), as well as the results of other investigations.

The sampling frame (step 4) was determined as the e-mail address of the Direção-Geral de Ensino Superior (DIREÇÃO-GERAL DO ENSINO SUPERIOR, 2020), where all Portuguese higher education institutions are listed, considering Portuguese higher education professors as the study population.

The latest consolidated data for 2018 indicated a total of 35,283 faculty members, with 77.3% (n = 27,279) from public institutions and 22.7% (n = 8,004) from private institutions. As for gender, 54.9% (n = 19,368) were male and 45.1% were female (n = 15,915). Regarding the institutional category, 61.2% (n = 21,595) of the faculty members teach in university education and 38.5% (n = 13,688) in polytechnic education. As for age, this group is composed of 3.9% (n = 1,365) of professors under 30 years old, 18.3% (n = 6,462) between 30 and 39 years old, 32.5% (n = 11,459) between 40 and 49 years old, 30.2% (n = 10,672) between 50 and 59 years old and 15.1% (n = 5,325) over 60 years old (FUNDAÇÃO FRANCISCO MANUEL DOS SANTOS, 2020).

Since higher education professors are the unit of analysis, the minimum sample

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size was determined (step 5), considering the numbers found in the population and using the multinominal proportions technique (THOMPSON, 1987), for a confidence level of 95% with a minimum precision of 5%, arriving at the number of 510 professors.

The process of data collection in the study was carried out using a questionnaire, specifically the DigCompEdu Check-In, developed and validated by Redecker (2019) (steps 6, 7 and 8), which focuses on the self-assessment of the professors' perception of their digital competences to assess their level of proficiency.

This follows the trend of most research on digital competence that focuses on the use of measurement instruments based on self-assessment of professors' perceptions, which analyse, describe and/or measure the level of proficiency in digital competences based on respondents' statements and opinions (DURÁN; ESPINOSA; GUTIÉRREZ, 2019).

In addition to the data collected through the instrument selected for this study, profile data were also collected in three dimensions:

a) personnel: gender, level of education, age group and career length;

b) teaching: cycle level and course modality;

c) institutional: institutional category, institutional funding sector and administrative region.

The dissemination and the invitation to participate in this research (step 9) were carried out by e-mail in March and April of 2020. E-mails were sent to the executives of 34 universities and 44 polytechnic education institutions, and/or directly to the faculty member when the e-mail address was publicly available on the internet.

The questionnaire was made available online for easier access to the population in question, embedded at www.digcomptest.eu (step 10). This process allowed researchers immediate access to the data, while enabling respondents to self-diagnose. After the professor filled it out, the platform automatically sent him or her a detailed report by e-mail, indicating the level of proficiency in digital competences overall and by area.

The data extraction and analysis process (step 11 and final) were based on the application of several statistical analysis techniques, such as t-test and ANOVA, performed using IBM® SPSS® Statistics version 26.0.0.0 to analyse the effect of

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exogenous variables on the dependent variable of a quantitative nature (COHEN; COHEN, 2008; LARSON; BETSY, 2016; PESTANA, 2014), in this case the mean obtained after filling out the instrument.

Results

Based on the results obtained after the respondents filled out the questionnaire, the overall score and the score by area were calculated, as described in Table 1. These results were analysed considering other variables of personal, teaching and institutional dimensions.

Characterization of the respondents' group

After extracting the information from the database, two criteria were used for inclusion in this research: respondents must be professors of higher education and working in the Portuguese context. This was necessary because the instrument was open for online completion.

The data were collected between March and April of 2020, with 695 individuals, 56.1% (n = 390) male and 43.9% (n = 305) female. As for the level of education, 73.5% (n = 511) were PhDs, 17.4% (n = 121) had a master's degree and 9.1% (n = 63) were graduates. Most of the professors are Portuguese: 97.4% (n = 677).

In relation to the institutional category, 59.4% (n = 413) come from institutions integrated in the university system and 40.6% (n = 282) from polytechnic education.

Professionally, 91.7% (n = 637) belong to a public establishment and 8.3% (n = 58) to a private one. As for the level at which they teach, 51.1% (n = 355) teach at the undergraduate level, 34.2% (n = 238) at the master's level, and 14.7% (n = 102) at the doctoral level. Regarding the modality in which they teach, 60.7% (n = 422) declared that 100% of their workload is face-to-face, 29.9% (n = 208) that their workload is 70% face-to-face and 30% at a distance, 4.7% (n = 33) with 30% face-to-face and 70% at a distance, and 4.6% (n = 32) with 100% at a distance– these were the options presented in the questionnaire.

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Overall evaluation

The result of the level of proficiency in digital competences is scaled by points, which vary according to the area by the number of competences. The overall results show an overall mean of 48.28 points, with a standard deviation of 16.02 and variance of 256.67. This result allows us to assign proficiency level B1 – Integrator, as shown in Table 1.

Table 1 – Scores by overall proficiency level and by area

PROFICIENCY LEVEL	A1	A2	B1	B2	C1	C2
General	< 20	20-33	34-49	50-65	66-80	> 80
Area						
Professional Engagement Teaching and Learning	4	5-7	8-10	11-13	14-15	16
Digital Resources Evaluation Empowering Learners	3	4-5	6-7	8-9	10-11	12
Facilitating Learner's Digital Competence	5-6	7-8	9-12	13-16	17-19	20

Source: Redecker (2019).

When analysed in a stratified manner, 2.7% of the sample presented a proficiency level A1 – Newcomer, 16.1% A2 – Explorer, 35.5% B1 – Integrator, 29.8% B2 – Expert, 13.5% C1 – Leader, and finally 2.3% C2 – Pioneer, as shown in Figure 4.

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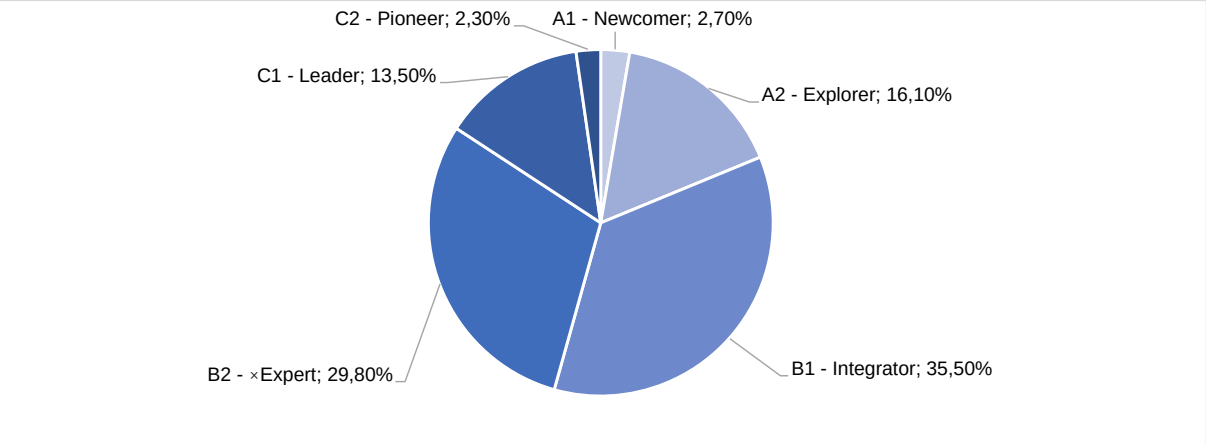
Figure 4 - Level of proficiency Overall Evaluation



Source: the authors.

Assessment by area

Analysis by area showed that professors have a lower level of proficiency in the area of assessment (A2 – Explorer) compared to the other areas (B1 – Integrator), in addition to a borderline level in the area of empowering learners, as can be seen in Table 2, based on the scale described earlier in Table 1.

Table 2 – Results by area

AREAS	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Professional engagement	B1 – Integrator	9.81	3.071
Digital resources	B1 – Integrator	7.22	2.423
Teaching and learning	B1 – Integrator	9.10	3.649
Assessment	A2 – Explorer	5.60	2.581
Empowering learners	B1 – Integrator	6.08	3.040
Facilitating learners' digital competence	B1 – Integrator	10.51	4.237

Source: the authors.

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Personal Dimension

Gender

Both genders are at B1 – Integrator, and thus no different levels of proficiency in the competences are identified, as shown in Table 3.

Table 3 – Proficiency level by gender

GENDER	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Male (n = 390)	B1 – Integrator	49.11	16.255
Female (n = 305)	B1 – Integrator	47.27	15.680

Source: the authors.

The t-test showed no statistically significant difference between the means of the genders ($t = 1.532$; $p > 0.05$).

Level of education

Analysis showed a difference in the level of proficiency in digital competences according to the level of education. Professors with only an undergraduate degree and those with a doctorate were placed in B1 – Integrator – although the latter show an overall average higher than the former – while those with a master's degree were placed in B2 – Expert, as shown in Table 4.

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Table 4 – Level of proficiency by level of education.

LEVEL OF EDUCATION	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Graduate (n = 63)	B1 – Integrator	43.75	16.453
Master (n = 121)	B2 – Expert	50.30	15.883
Doctorate (n = 511)	B1 – Integrator	48.37	15.922

Source: the authors.

ANOVA (or analysis of variance) demonstrated the existence of a statistically significant effect of faculty training level on the mean ($F(2.692) = 3.515$; $p < 0.05$). Tukey's post-hoc test signalled significant differences between the training level of graduates and those with a master's degree.

Age group

The professors ranked B1 – Integrator in all five age groups, the same level of proficiency in digital competences, as shown in Table 5.

Table 5 – Level of proficiency by age group.

AGE GROUP	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
25 – 34 (n = 30)	B1 – Integrator	45.20	19.949
35 – 44 (n = 171)	B1 – Integrator	48.41	15.312
45 – 54 (n = 262)	B1 – Integrator	47.97	16.477
55 – 64 (n = 207)	B1 – Integrator	49.27	15.374
65 – 75 (n = 25)	B1 – Integrator	46.24	16.544

Source: the authors.

ANOVA showed that there is no statistically significant effect of age group on the mean ($F(4.690) = 0.602$; $p > 0.05$).

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Length of career

The professors were at the same proficiency level, B1 – Integrator, in all six career time bands, although the highest overall average values were obtained for professors with 21-30 years in the career, as shown in Table 6.

Table 6 – Proficiency level by career time

CAREER TIME	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
< 5 (n = 80)	B1 – Integrator	45.19	15.511
6 – 10 (n = 81)	B1 – Integrator	48.00	16.857
11 – 20 (n = 192)	B1 – Integrator	48.08	15.092
21 – 30 (n = 208)	B1 – Integrator	49.87	16.319
31 – 40 (n = 115)	B1 – Integrator	48.39	16.381
41 – 50 (n = 19)	B1 – Integrator	46.58	17.970

Source: the authors.

ANOVA showed that there is no statistically significant effect of career length on the overall mean ($F(5.689) = 1.061$; $p > 0.05$).

Teaching Dimension

Cycle level

Regarding the degree level at which they work, it can be seen that professors who work only at the undergraduate or master's level are ranked B1 – Integrator, while those who work at the doctoral level are ranked B2 – Expert, as shown in Table 7.

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Table 7 – Proficiency level by cycle level

CYCLE LEVEL	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Bachelor's (n = 355)	B1 – Integrator	46.28	15.917
Master's (n = 238)	B1 – Integrator	49.14	15.327
Doctorate (n = 102)	B2 – Expert	53.28	16.833

Source: the authors.

ANOVA showed that there is a statistically significant effect of the cycle in which the faculty member teaches on the means ($F(2.692) = 8.264$; $p < 0.05$). Tukey's post-hoc test indicated a difference between faculty teaching at the doctoral and undergraduate levels.

Course modality

Regarding the modality they teach, the professors who dedicate themselves 100% to the face-to-face modality were at level B1 – Integrator, while those who work in the distance learning modality, regardless of the proportion, were at level B2 – Expert, as shown in Table 8.

Table 8 – Proficiency level by education modality.

COURSE MODALITY	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
100% On-c (n = 422)	B1 – Integrator	43.46	15.361
70% On-c 30% e-L (n = 208)	B2 – Expert	55.44	13.789
30% On-c 70% e-L (n = 33)	B2 – Expert	58.33	16.937
100% e-L (n = 32)	B2 – Expert	54.31	13.350

Note: On-c = On-campus courses; e-L = e-learning
Source: the authors.

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ANOVA showed that there is a statistically significant effect of the course modality on the averages obtained ($F(3.691) = 37.134$; $p < 0.05$). Tukey's post-hoc test indicates the difference between the professors who teach 100% in the face-to-face modality and those who teach in the distance learning modality in any proportion.

Institutional dimension

Institutional category

Professors who teach in institutions integrated into the university system are at level B1 – Integrator, while those who teach in polytechnics are at level B2 – Expert, as shown in Table 9.

Table 9 – Proficiency level by institutional category

INSTITUTIONAL CATEGORY	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Universities (n = 413)	B1 – Integrator	47.03	16.187
Polytecnic (n = 282)	B2 – Expert	50.12	15.623

Source: the authors.

The t-test showed a statistically significant difference between the overall means of the institutions ($t = -2.501$; $p < 0.05$), with polytechnics showing the highest overall means.

Institutional funding sector

Professors working in public and private institutions are at the same level, B1 – Integrator, as shown in Table 10.

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Table 10 – Proficiency level by institutional funding sector

INSTITUTIONAL FUNDING SECTOR	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Public (n = 637)	B1 – Integrator	48.17	16.157
Private (n = 58)	B1 – Integrator	49.53	14.516
Military and Police Public (n = 0)	-	-	-

Source: the authors.

The t-test showed no statistically significant difference between the means of the different institutional funding sectors (t = -.620; p > 0.05).

Administrative Region

Professors from Porto and North regions were at level B2 – Expert, while professors from the other regions were at B1 – Integrator, as shown in Table 11.

Table 11 – Proficiency level by administrative region.

REGION	PROFICIENCY LEVEL	MEAN	STANDARD DEVIATION
Alentejo (n = 37)	B1 – Integrator	49.08	17.108
Algarve (n=26)	B1 – Integrator	46.77	13.854
Centre (n = 132)	B1 – Integrator	48.05	15.563
Lisbon (n = 308)	B1 – Integrator	47.04	16.103
Porto and North (n = 145)	B2 – Expert	51.52	16.389
Autonomous Regions (n=25)	B1 – Integrator	47.64	14.468

Note: There was no response regarding the administrative region for 22 respondents.
Source: the authors.

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ANOVA showed that there is no statistically significant effect of administrative region on mean scores ($F(5.667) = 1.640$; $p > 0.05$).

Discussion

In the overall assessment of the level of proficiency in digital competences of Portuguese higher education professors, it was found that almost two-thirds of the professors (65.30%) are between two intermediate levels: B1 – Integrator (35.50%) and B2 – Expert (29.80%). The B1 proficiency level has already been identified in other investigations in the Portuguese context, both in higher education (DIAS-TRINDADE; MOREIRA; GOMES FERREIRA, 2020) and in basic education (DIAS-TRINDADE; MOREIRA, 2018), using the same framework and instrument in these cases.

The B1 proficiency level – Integrator is, in principle, a favourable result, although it indicates that there is a need to improve the understanding of which tools work best in different situations and how to adapt them to pedagogical methods and strategies.

With the advancement of the use of ICT in education, specifically in higher education, a high level of proficiency in digital competence is required from professors because of the new digital tools used, whether for pedagogical or administrative use, becoming even more critical when they start teaching activities online.

The introduction of ICT in education has promoted a new organization of work and, consequently, a rethinking in teacher training processes. Educational institutions encourage the adoption of technologies in pedagogical processes, but this movement is not always technologically aligned with the available infrastructure, since professors do not always choose this effective adoption. This gap between institutional adoption and pedagogical use by professors may be related to the low level of proficiency in digital competences (SILVA, 2019).

Analysing the results of the six areas of the framework, it was possible to identify a greater deficiency in the area of assessment, with a competence level of A1 – Newcomer (5.60), while in the other areas, the digital competence level of B1 – Integrator was identified. However, the area of empowerment of learners was in a borderline position, close to A2 (6.08, with a threshold of 6). The area of assessment

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involves competences of assessment strategies, evidence analysis, feedback, and planning. Other evidence along these lines had already been identified in studies of higher education in the Portuguese context, which identified that 49.20% of professors said they had never carried out assessment tests with the use of ICTs (RAMOS; MOREIRA, 2014b), and 44.90% said they do not use digital technologies to monitor the progress of their students (VICENTE; LUCAS; CARLOS, 2020). Assessment can be a facilitator or a barrier to innovation in education, in that it requires a wide range of available data about each learner's individual learning behaviour and can help to monitor their progress directly, facilitate feedback and allow educators to evaluate and adapt their teaching strategies (LUCAS; MOREIRA, 2018). Learner empowerment, in turn, is also related to many of these factors.

Analysis of the professors' level of digital proficiency in the personal dimension identified no difference in the variables of age group and career length, all in B1 – Integrator, and no statistically significant effect was identified.

The DESI 2020 report, in addition to identifying the absence of digital competences in 26% of the population, pointed out a low rate (0.7%) of women ICT specialists in Portugal, compared to the European Union (1.4%) (EUROPEAN COMMISSION, 2020). However, in this study, no statistically significant differences were identified in the variable gender.

It was also identified in the personal dimension that the level of proficiency differs according to the level of the professors' education . Those who have a master's are at B2 – Expert (50.30), while graduates (43.75) and those with a PhD (48.37) are at B1 – Integrator, although the PhDs are in a borderline position, close to B2. Statistically, the effect was demonstrated by identifying the difference between the group of graduate and master's professors. It is important to note that in Europe since the Bologna Process, unlike in Brazil, the master's degree has been characterized as a professional complement to undergraduate teacher training. Therefore, professors who are only graduates have a training limitation that only allows them to teach at the undergraduate level. In this sense, the better performance of those with a master's or a doctorate may be related to greater activity in the teaching area, which requires greater investment in the use of different tools to support their teaching activities.

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Recent research has shown a higher level of digital proficiency when practical activities are incorporated (CALATAYUD; MARIMAR; ESPINOSA, 2018; LLORENTE; IGLESIAS, 2018).

In the teaching dimension, it was found that professors who teach at the doctoral level have a proficiency level of B2 – Expert (53.28), higher than those who work only at the undergraduate (46.28) and master's (49.14) levels, who have level B1 – Integrator, with this difference being statistically significant for professors who work at the doctoral and undergraduate levels. PhD professors, in addition to teaching activities, are naturally involved in research projects. According to Guillen-Gamez and Mayorga-Fernández (2019), for example, there is a positive correlation between participation in research/innovation projects and digital competence.

The level of proficiency also differs according to the course modality. Professors who work at e-learning course, in any proportion, have a higher proficiency level (B2 – Expert) compared to those who work exclusively in on-campus courses (B1 – Integrator), and this difference is statistically confirmed. This higher proficiency level can be justified because professors who work at e-learning use various digital tools in their daily lives, such as virtual environment configuration, production and availability of content, communication and monitoring of students, and assessment, which promote the acquisition of digital competences.

It was also found that professors in a polytechnic institution, which has a practical nature, have a higher proficiency level (B2 – Expert) than those teaching in university institutions (B1 – Integrator). Other evidence had already been identified that professors in a polytechnic institution were more digitally innovative (80.9%) than those in university institution (73.80%), when asked about using digital technologies to occasionally experiment with new collaborative learning formats (VICENTE; LUCAS; CARLOS, 2020).

Finally, there was no statistically significant effect of institutional funding sector (public or private) nor administrative region on the level of professors' competences.

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Conclusion

The overall result of this research pointed to an intermediate proficiency level (B1 – Integrator) in the digital competences of Portuguese higher education professors. This result, and the others of this study, summarized in the following paragraphs, were similar to the results of other research studies.

In the personal dimension, it was identified that gender, age group and career length are factors that have no significant effect on the level of professors' proficiency . However, the level of education revealed a statistically significant difference, with those with a master's positioned at a higher level (B2 – Expert) than graduates (B1 – Integrator).

In the teaching dimension, professors who teach at the doctoral level are at a higher level of competence (B2 – Expert) than the others (B1 – Integrator). A higher level of proficiency was also detected for those faculty members who work online in any proportion, compared to those dedicated exclusively to on-campus courses.

In the institutional dimension, professors who teach in polytechnic institution showed a higher level of proficiency (B2 – Expert) than those who teach in university institution (B1 – Integrator). The institutional funding sector (public or private) and administrative region did not have a statistically significant effect on professors' level of proficiency.

In this sense, the main contribution of this study was the evaluation the digital competences of Portuguese higher education professors in several dimensions, analysing how different aspects of these dimensions influence the level of proficiency in these competences and comparing these results with other research in the area.

Among the limitations of this research can be mentioned the sampling strategy. As the questionnaires were sent to the leaders of the institutions or directly to the professors over the internet, this may have generated a bias in the sample due, for example, to higher or lower motivation to answer the questions. In addition, it is possible to conceive a statistical deepening in the analysis, for example, with a study of interactions through a factorial ANOVA between the variables that make up the three

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dimensions of this study, in addition to the analysis of results by area through a multivariate analysis of variance - MANOVA.

As mentioned, the rationale in developing DigCompEdu did not consider online education. However, this article's results show a clear difference in the level of proficiency in digital competences of professors who teach online, in any proportion, compared to those who teach only on-campus, thus demonstrating that teaching online is an important factor in the proficiency level . Even though the 22 competences described in DigCompEdu are essential for online teaching, the framework lacks a specific perspective at online education. Considering now the emergency remote learning scenario of the COVID-19 pandemic, affecting the lives of nearly 1.6 billion young children and their families worldwide with the closure of educational institutions (GOUËDARD; PONT; VIENNET, 2020; HODGES et al., 2020; SCHLEICHER, 2020), the development of a digital competence framework that incorporates theories and practices of online education is even more pressing.

Digital competence assessments in other countries, such as Brazil, can benefit from the methodology used in this study. Furthermore, this research has reinforced the importance of strategies and training that seek to raise the digital competence of higher education professors by changing their intermediate proficiency level.

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